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Abstract

This paper characterises rules-based fiscal policy setting. Basically, we translate a standard monetary policy rule into a simple fiscal policy rule. We then infer on fiscal policymakers' reaction coefficients by testing the rule with GMM. Interaction is also tested directly by the inclusion of monetary policy setting. Our results qualify existing evidence on systematic fiscal policy in two respects. First, fiscal policy usually stabilises public debt. And there is indeed substantial interaction between fiscal and monetary policy via the debt channel. Second, sustainability is achieved with a "stop-go" cycle of consolidation. Consolidation does not come at the cost of less cyclical stabilisation unless debt ratios are high.

JEL Code: E61, E63.

Keywords: monetary policy, fiscal policy, policy interaction and policy rules, debt sustainability.

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1. INTRODUCTION

The sustainability of public finances has once again come to the forefront of the policy agenda in the United States, Japan and the European Union. A brief look at the figures reveals that in recent years, debt ratios have been on the rise again (see Fig. 1). This comes somewhat as a surprise after rules-bound policies came into vogue in the nineties, on the tide of neo-classical thinking on long term stability policies. Even if the Gramm-Rudman-Hollings Act never officially applied, the Clinton administration nevertheless governed a substantial reduction of public debt. The EU governments enshrined public debt and deficit targets in the Treaty of Maastricht, and strengthened these provisions in the Stability and Growth Pact (henceforth SGP). The rules of the Pact comprise the use of automatic stabilisers around structural fiscal positions that are close to balance or in surplus in the medium term. Fiscal rules have thus become a way to think about systematic fiscal policy, both in academic and policy debates.

Newspaper articles rarely discuss budget decisions without reference to the complete policy stance. Even few economists would disregard the policy mix in a colloquial analysis. For the USA, the fiscal expansion of the Bush administration is rarely mentioned without accompanying loose Federal Reserve policy. The impotence of Japanese monetary policy over the last decade has repeatedly given rise to calls for fiscal expansion. And the gradual dismantling of the SGP reveals some tension on the right policy balance in a heterogeneous monetary union. At the same time, central bankers seem to take special interest in taming fiscal profligacy.[3] This may be part of the policy game, in which the fiscal or monetary authority tries to manoeuvre policy settings in its favour. But central bankers may also be aware of the constraints that unsustainability of public finances imposes on monetary policy in the longer term.

Despite recent theoretical advances, an empirical analysis of joint systematic policy behaviour is currently missing. Monetary Taylor rules that express the setting of the interest rate as a reaction function of inflation and output have enjoyed enormous empirical interest. But the different nature of fiscal policy has impeded a straightforward

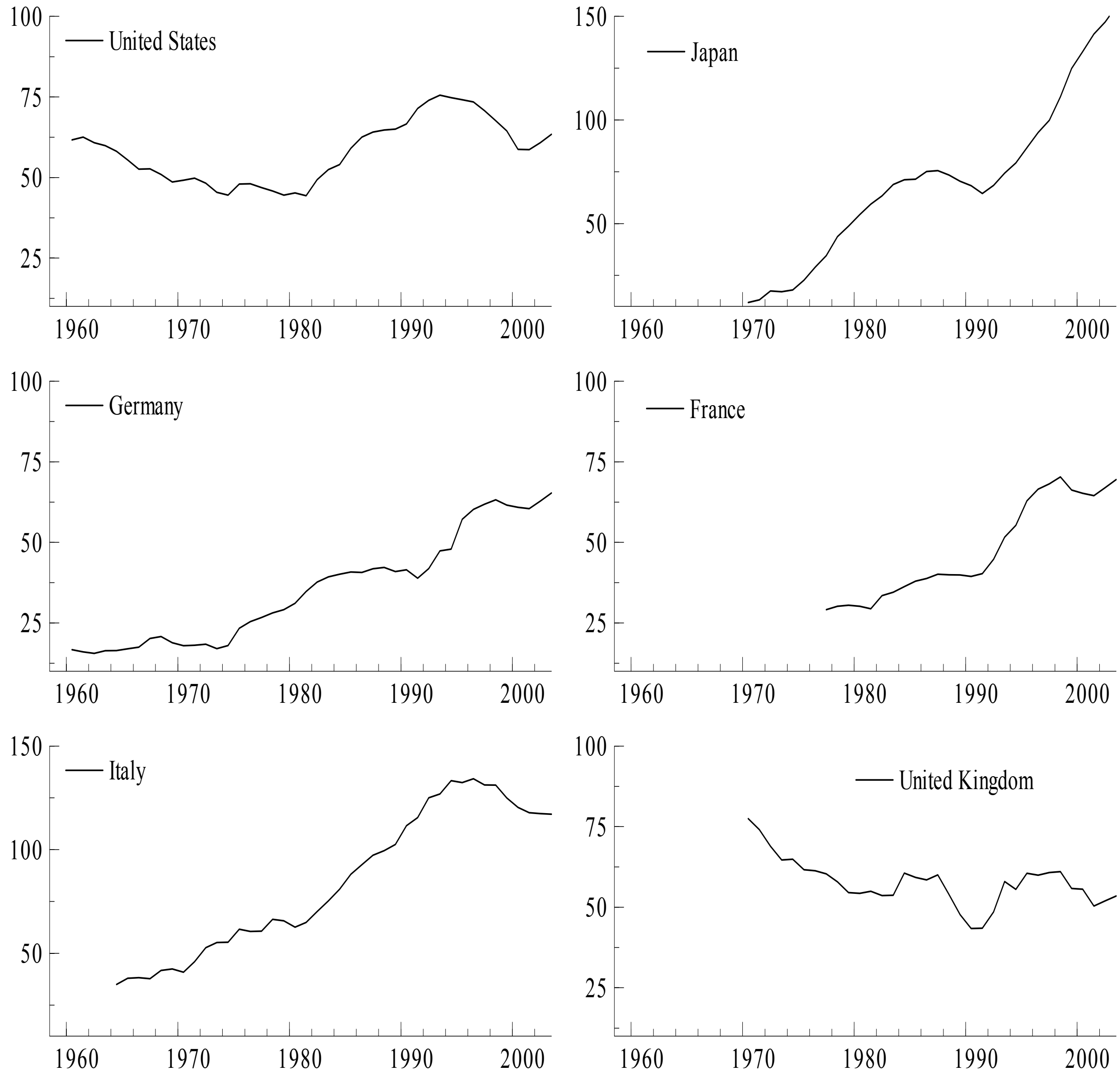
[3] "*Greenspan Urges Reinstating Budget Rules*" AP 12/02/04; "*Trichet wirbt für den Stabilitätspakt*", FAZ 21/11/03.

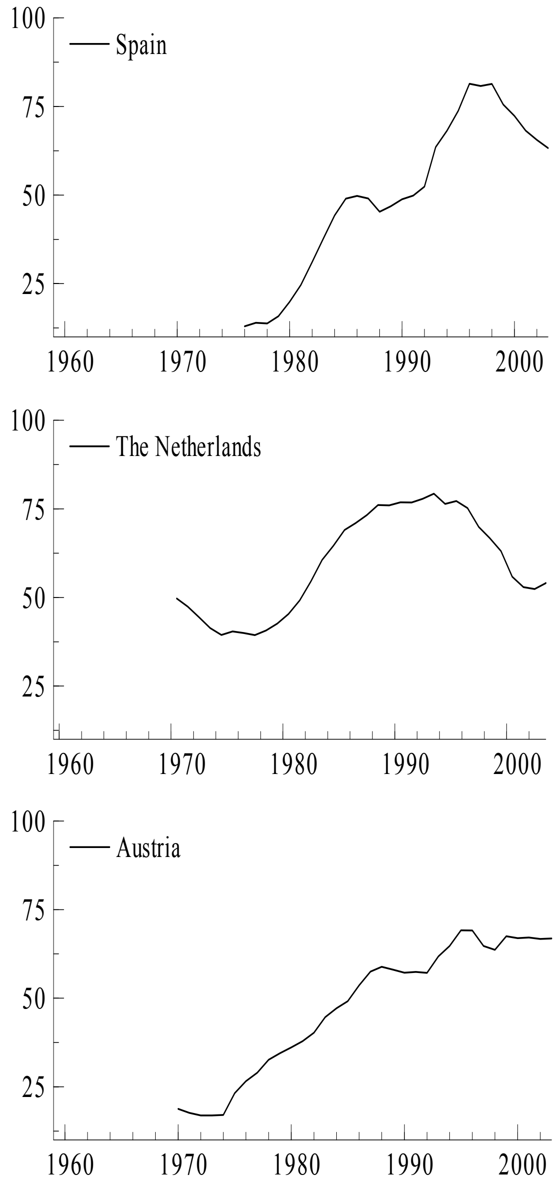
extension,[4] even though estimates of fiscal policy rules are implicit in diverse strands of the empirical literature. Many of these papers are confined to an analysis of the government budget's cyclical properties, and ignore the composition of the budget or the trade-off with debt stabilisation. The effects of monetary policy are assumed to be non-existent. Usually, the important feedback effects of fiscal policy on output are not taken into account.

The principal objective of this paper is to analyse fiscal instrument rules empirically. In Section 2, we discuss recent developments in the theoretical literature on systematic fiscal policy. This concise overview points at similarities and differences with rules-based monetary policy, and provides the basic arguments for the derivation of empirical fiscal policy rules. Specification and methodology are likewise adjusted in Section 3, and contains the two major contributions of this paper. First, we closely follow Clarida et al. (1998) in presenting a fiscal rule in which the policy instrument is gradually adjusted to its target level. However, policy interaction makes the specification differ somewhat from the existing literature. This concerns in the first place the reaction to public debt. Not only does this provide a test for solvency à la Bohn (1998). Debt sustainability may have important spillovers on monetary policy as well. Conversely, we allow monetary policy setting to influence fiscal policy directly and this may be considered a test for policy interaction. For the same reason, we estimate fiscal rules under different regimes. I.e., we contrast evidence for G-3 countries (Germany, Japan and United States) with a sample of former EMS countries. The argument is that the differences in monetary policy regime may have induced different fiscal reactions. We also explicitly model policy shifts as we search for a structural break in the reaction coefficients. Second, our methodology consists in estimating the non-linear policy rule with GMM. As such, we correct for policy endogeneity in determining output and inflation. Moreover, the intertemporal character of fiscal policy is thereby respected. The results - discussed in Section 4 - reveal that there are diverse channels through which fiscal and monetary policies interact. We show fiscal policy is concerned about debt sustainability, but that this objective does not necessarily enter the fiscal authorities' rule in a stable way. Consolidation comes at the cost of

[4]First, fiscal policy is - unlike monetary policy - subject to an intertemporal budget constraint. Second, fiscal instruments are inherently heterogeneous, both in its setting (composition of revenues versus expenditures) and in its effects on agents. The latter also adds a distinct political flavour. Third, potential channels of interaction between monetary and fiscal policy need to be taken into account, whereby the intertemporal government budget constraint again plays a crucial role.

Figure 1. General government debt ratio to GDP (%).





reduced cyclical stabilisation only if debt had clearly derailed before. An extensive robustness analysis, both in methodology and specification confirm these insights. Conclusions follow in Section 5.

2. POLICY RULES: A FISCAL POLICY PERSPECTIVE

2.1. Monetary versus fiscal policy rules

Since Taylor's (1993) proposal for a simple rule for setting interest rates, the theoretical and empirical analysis of monetary policy rules has become a true industry of research. The leitmotiv of this analysis is the validity of the Taylor principle, by which central banks should not accommodate changes in the price level. We only highlight here the omission of any interaction with fiscal policy: the derivation of results usually proceeds under the Ricardian assumption that fiscal policy setting is irrelevant.

The discussion of fiscal policy rules has mostly been normative, and limited to simple rules with practical policy implications. Proposals of balanced budget rules, a golden rule, deficit or debt target values, … have been discussed extensively in the literature criticising the SGP, for example. However, there is no comprehensive framework to analyse fiscal policy rules. And not much more research has been devoted to its empirical examination. As a consequence, some of the terminology by which fiscal policy will be characterised needs to be clarified. By definition, we can decompose[5] the overall indicator s_t of fiscal stance[6] into a structural - or cyclically adjusted $s_{s,t}$ - and a cyclical part αy_t as in (1):

$$s_t \equiv s_{s,t} - \alpha y_t , \qquad (1)$$

with α the elasticity of the fiscal indicator with respect to output. Using either of these two indicators, we can attribute fiscal policy to discretionary policy or automatic stabilisers respectively. With an econometric approach, in contrast, we express the indicator s_t as some function f(•) of cyclical (y_t) and exogenous variables (X_t,) as in (2):

$$s_t = f(y_t, X_t; \xi) + \varepsilon_t , \qquad (2)$$

We associate systematic fiscal policy with both automatic stabilisers and the cyclical reactions of discretionary policy, conditional upon the reaction to the exogenous variables X_t, and subject to a possible policy shift ξ. The non-systematic part then is the true "policy shock" (ε_t) and reflects a kind of filtered measure of discretionary policy.

[5]A variety of heuristic detrending methodologies are used to calculate the structural deficit. The OECD estimates the elasticities α for different budget categories and relates these to the output gap. Others apply a filter to the actual indicator s_t directly.
[6]It is irrelevant for the specification whether this indicator is a deficit or a surplus, but the notation in terms of surpluses is more common in the literature.

Few papers test fiscal policy rules as such. Much of the analysis is limited to the cyclical sensitivity of some fiscal policy indicator. Taylor (2000) himself suggests and estimates simple rules for the USA by regressing the structural and the cyclical surplus on the output gap. His results indicate a procyclical elasticity of 0.45 in the total surplus, mainly provided by the automatic stabilisers. However, Auerbach (2002) finds a somewhat stronger systematic response of discretionary policy to the cycle, including reactions to fiscal imbalances over the last decade. Favero and Monacelli (2003) estimate a Markov-switching model of an inertial rule and include debt stabilisation as well. Fiscal policy is found to be countercyclical and debt stabilising over the whole sample. Other studies assess cyclical properties of fiscal policy in a European or OECD sample, either on a country-by-country or panel basis. Fatas and Mihov (2001) relate growth ratios of different fiscal variables to output growth. Panel estimates show that the primary deficit ratio is slightly countercyclical. Fatas and Mihov (2003) also examine non-systematic policy setting in the EU, after controlling the overall surplus for an even larger set of cyclical variables - also including monetary variables. The endogenous component of policy seems to become more important in explaining fiscal policy variability.[7]

There is a strong argument for shifts in fiscal policy regimes. A whole range of ad hoc breakdates has been suggested in the literature. The narrative SVAR studies on the effects of fiscal policy suggest major defence spending increases as the Korean and Vietnam War to identify fiscal shocks. Taylor (2000) includes a 1984-dummy for the Reagan administration in his rule. A common turning point for European fiscal policymakers is the Treaty of Maastricht (Wyplosz, 2002; Galí and Perotti, 2003). Only Favero and Monacelli (2003) model different policy regimes explicitly and argue that USA fiscal policy was undisciplined before 1987.

The results of these papers do not have any structural interpretation, however, and

[7] The empirical analysis of fiscal policy implicitly contains a rule of the type in (2). Arreaza et al. (1999) examine the various channels of income smoothing on the basis of the different categories of national income. In a panel of OECD and EU countries, countercyclical government consumption and transfers can account for up to one third of income smoothing. These effects are largely symmetric over the cycle, with transfers being much more significant in recessions. No trade-off with debt is apparent. The assessment of fiscal policy is also related to the literature on income smoothing and inter/intranational risk sharing. Another strand relates government size to output volatility. These papers obtain estimates of budget elasticities by examining changes in government size. According to Hercowitz and Strawczynski (1999), the combined effect of acyclical deficits during booms and deficitary reactions in recessions is responsible for the rise in the government spending ratio in OECD countries.

cannot characterise systematic policy behaviour. Not only do cyclical fluctuations explain an important part of the variation in the fiscal variable because of the workings of the automatic stabilisers. Except under the hypothesis of Ricardian equivalence, these fluctuations may be determined by the fiscal variable too. This suggests instrumental estimation to correct for the endogeneity of output. The following studies correctly label their reaction function estimates as fiscal rules then. Lane (2003) examines cyclical properties of different components of the government budget. The regression of these categories on output growth shows that cyclicality varies substantially across categories and countries. Ballabriga and Martinez-Mongay (2003) estimate non-linear fiscal policy rules for EU countries. Fiscal policy is countercyclical and debt stabilising. Galí and Perotti (2003) estimate systematic discretionary policy in EMU countries before and after the introduction of the Maastricht rules, but do not find evidence of reduced countercyclical reactions.

2.2. Debt sustainability: the nexus of policy interaction

The debate spurred by the dispute on the fiscal theory of the price level (henceforth FTPL) has led to a reconsideration of the channels of interaction between fiscal and monetary policy.[8] It has once more placed the focus on fiscal sustainability and on the policy mix in determining macroeconomic outcomes. Basically, the argument of the FTPL hinges on the interpretation of the intertemporal government budget constraint (henceforth IGBC) as a value equation rather than as a constraint. Ultimately, the responsibility for the price level is in the hands of the fiscal authority then. If fiscal policy is sufficiently reactive to debt, then the IGBC will be satisfied for all price paths. Monetary policy retains the ability to control prices in this Ricardian environment. However, if an exogenous process determines fiscal policy, it will select the price path for the economy.

This has two major implications for policy rules. First, the main finding is that optimal monetary policy rules need not conform to the standard properties anymore. In particular, under non-Ricardian regimes the properties of policy rules need to be reversed to ensure determinacy. Second, if the IGBC is not a constraint, then models of fiscal policy need to be closed in very much the same way as models of monetary policy are closed. I.e., with

[8] The FTPL is still highly controversial between proponents (Cochrane, 1998; Woodford, 2001) and contenders (Buiter, 1999).

a fiscal rule that expresses the surplus as a function of debt D_t, as in (3),

$$s_t = \theta D_t + \chi_t , \qquad (3)$$

and where θ = 0 would imply a non-Ricardian policy.

The empirical examination of the relevance of policy interaction is still at an infant stage. The main reason is that the main contention of the FTPL literature is not directly testable. There are no identifying restrictions that allow distinguishing the IGBC as a value equation or as a constraint, for this equilibrium relation necessarily holds.[9] This casts doubt on the validity of direct tests for solvency on this relation. This analysis is typically limited to univariate tests on the properties of debt, or a cointegration analysis of government revenue and expenditure.

There are nevertheless direct testable restrictions on the policy rules. In first instance, this relates to the sign and magnitude of the reaction coefficients in monetary and fiscal rules. Of more importance for the fiscal rule is the reaction of the fiscal surplus to public debt. Bohn (1998) - although driven by other motivations than testing the FTPL - proofs that a positive reaction of the primary surplus to the (initial) debt to GDP ratio (θ>0), is a robust sufficient condition for fiscal solvency.[10] In the empirical counterpart to (3), Bohn (1998) relates the primary surplus to debt, and models χ_t by conditioning on permanent and cyclical components of fiscal policy. In the FTPL context, the test on the significance of the debt reaction may give us an idea of the independence of monetary policy. However, these short term reactions may not be distinguishable as FTPL reactions in the longer term (Canzoneri et al., 2002).

Clearly, it is somewhat inappropriate to infer on fiscal or monetary policy rules in isolation.[11] One strategy is to simultaneously estimate a system of fiscal and monetary

[9] For some attempts to test the FTPL, see Cochrane (1998), Canzoneri et al. (2001), Woodford (2001) and Sala (2004).

[10] Under the additional assumptions that the process is stationary and ergodic, and that χ_t is bounded as a share of GDP.

[11] Other strategies are still based on univariate analyses of fiscal policy. Favero and Monacelli (2003) add a fiscal rule to a VAR-augmented Taylor rule. This results in an improved fit for inflation in periods of fiscal indiscipline. Conversely, Galí and Perotti (2003) insert a monetary

reaction functions. Both policies are set in function of cyclical conditions and policy interaction is introduced by mutual inclusion of the other policy instrument. Mélitz (2000) estimates such a system and concludes for a pool of 19 OECD countries that automatic stabilisation is much weaker than what previous studies find (elasticity of only 0.1). Debt dynamics are kept under control. There is also evidence of policy substitutability: fiscal and monetary policies tend to offset each other. Wyplosz (1999) includes some additional explanatory variables but results for the panel of EMU countries are very much alike. Nevertheless, while the European central banks react in the standard Taylor rule way to inflation and the output gap, no reaction to fiscal policy is detected as such. Conversely, fiscal policy is a strategic substitute to monetary policy, albeit the effect is small. Von Hagen et al. (2001) look into the pre-EMU fiscal consolidations, and estimate a small model consisting of fiscal rules and output growth. Fiscal policy again tends to relax when monetary policy tightens, while monetary policy is set as a complement. Favero (2002) constructs a small structural model. A system of equations for inflation, the output gap, the policy reaction functions and debt interest payments is set up. Identifying restrictions are imposed in order to separate systematic from non-systematic policies. The SUR-estimation of this system for the 4 large EMU-countries confirms prior evidence on fiscal policy behaviour: (a) systematic stabilisation effects are small as a combination of countercyclical revenues and procyclical expenditures, (b) fiscal policy always reacts in a stabilising way to debt rises, be it through lower expenditures or increased revenues; and (c) the interest rate channel on interest payment burden is important. Besides, deviations by fiscal authorities from systematic behaviour do not change the behaviour of monetary policy.

3. METHODOLOGY

This paper is a bit diverse and more limited in scope than the latter studies. We closely follow Clarida et al. (1998) in presenting the empirical specification of a fiscal policy rule. This “rule” approach provides a sufficient solvency test on public debt, while being completely consistent with theoretical models of fiscal policy. I.e., the empirical model

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policy shock into their fiscal rule and find that fiscal policy is a significant yet unimportant substitute to monetary policy. Another - more informal - way to assess policy interaction is based on a descriptive correlation analysis of both fiscal and monetary policy shocks, either within or between countries. See Bruneau and DeBandt (2003) for evidence in the SVAR context, or Ballabriga and Martinez-Mongay (2003) in the policy rule literature.

conditions upon cyclical responses and policy interaction. This specification then gives a testable condition that allows using a Generalised Method of Moments (GMM) procedure to identify the reaction coefficients.

3.1. The fiscal policy rule

A direct translation of the simple definition equation would be the following reaction function:

$$s_t^* = \bar{s} + \gamma(y_{t+n}^{e,t} - \hat{y}). \qquad (4)$$

The fiscal policy maker sets the target instrument s_t^* at time t in response to expected output deviations from target. Here, the constant $\bar{s}$ represents a long term equilibrium level (e.g. at golden rule level), $y_{t,t+n}^{e}$ is the expectation at time t of the future output level some n periods ahead, and $\hat{y}$ is the target output level of the fiscal authority.

A more general fiscal policy reaction function may be modelled along the arguments of Benigno and Woodford (2003), as follows:

$$s_t^* = \bar{s} + \gamma(y_{t+n}^{e,t} - \hat{y}) + \beta(\pi_{t+k}^{e,t} - \hat{\pi}). \qquad (5)$$

The inclusion of a response to inflation deviations from target may seem rather peculiar. [12,13] Such an instrument rule may be optimal once allowing for interaction with monetary policy. Benigno and Woodford (2003) characterise time-invariant optimal monetary and fiscal policy targeting rules, the commitment to which implements the welfare-maximising equilibrium. Both policymakers intend to minimise the distortions by stabilising inflation (around zero) and the output gap that results from both distortionary taxes and sticky

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[12] With this formulation, $\pi_{t,t+k}^{e}$ is the expectation at time t of the future inflation rate k periods ahead, and $\hat{\pi}$ is the target inflation rate of the fiscal authority.

[13] The coefficients γ and β are functions of the reaction coefficients to demand and supply shocks from an optimal instrument rule. Such a linear reaction function arises as a reduced form of an optimal policy rule derived from - and robust to several specifications of - a central bank's (quadratic) loss function over inflation and output, subject to a (linear) Phillips curve economy.

prices. With two policy instruments and two targets, many joint policy settings are possible. Under the dual assumption that the central bank takes the evolution of public debt as given, whereas fiscal policy leaves output determination to the central bank, a target rule for inflation and debt can be derived. As instrument or target rules are equivalent representations of optimal policy, we choose to specify a fiscal rule in terms of the underlying policy variables, output gap and inflation. Another argument for inflation stabilisation has its roots in the OCA literature and is highly relevant to monetary union. With asymmetric shocks or diverging inflation preferences, national fiscal policy makers may assume the role of monetary policy in stabilising inflation.[14]

Applying the definition equation (1) and the assumption that the government sets its fiscal instrument consistent with its output level target, we then obtain the structural instrument target of the fiscal authorities, which comprises a structural long term part $\bar{s}_s$ and a cyclical part such that

$$s^*_{s,t} = \bar{s}_s + (\gamma - \alpha)(y^{e,t}_{t+n} - \hat{y}) + \beta(\pi^{e,t}_{t+k} - \hat{\pi}). \qquad (6)$$

The baseline specification (6) need be augmented with two more factors of policy interaction. In first instance, we want to account for monetary policy setting. The monetary instrument i is directly plugged into the rule in an ad hoc way. This goes beyond the inclusion of a term responding to variations in the interest saved on the monetary base, as the literature on dynamically optimal fiscal policy would suggest.[15] Indirectly, as both policymakers pursue the same targets, there must be important reactions of systematic monetary policy on fiscal policy setting. As the rule already conditions on cyclical and inflation variability, and the estimation procedure controls for systematic policy, [16] we consider it to be a direct test of policy interaction.

[14] Further reasons for fiscal reactions to inflation are the non-indexation of tax brackets and the Olivera-Tanzi effect. These effects are not expected to determine real tax revenues in industrialised economies featuring low to moderate inflation however.

[15] Seigniorage is unlikely to matter for the validity of the conclusions anyhow (Woodford, 2001).

[16] It is an incomplete way of controlling for systematic policy though. We would need a complete model of systematic policy being appended to this model. An extension to system estimation of a fiscal and monetary rule may be considered. The economic arguments for a system approach have strong theoretical foundations. As shocks in both policies are likely to be contemporaneously correlated (Favero, 2002), joint estimation would allow a more precise estimation of systematic policy reaction coefficients. Data limitations urge us to estimate the fiscal rule only.

In addition, interaction concerns fiscal solvency. Fiscal rules that include a reaction to the public debt ratio are a means of closing models of fiscal policy and provide a test of fiscal sustainability. This approach complements the approach of Bohn (1998) as we model explicitly the χ_t term, and identify it as a "fiscal rule".[17] Some measure of government debt D_t is therefore included.

It has been argued in the monetary policy rule literature that interest rate smoothing is a realistic description of central bank behaviour. Persistence in a fiscal reaction function seems more natural as the budgetary process involves lengthy parliamentary processes and sunk decisions. The fiscal instrument thus adjusts only gradually to its target level:

$$s_t = \rho s_{t-1} + (1-\rho)s_t^* + \mu_t , \qquad (7)$$

with $0 \leq \rho \leq 1$ the degree of persistence. Introducing smoothing and augmenting the target indicator gives us the following empirical specification:

$$s_t = \rho s_{t-1} + (1-\rho)\left[\delta + \gamma x_{t+n} + \beta \pi_{t+k} + \omega i_t + \theta D_t\right] + \varepsilon_t . \qquad (8)$$

In this rule, δ equals $\bar{s}_s - \gamma(\hat{y} - y^*) - \beta\hat{\pi}$ and represents the long term fiscal indicator adjusted for inflation and the deviation between the government's output target and potential output y^*. The output gap is given by $x_{t+n} = y_t - y^*$. The error term in (8) is composed of an exogenous i.i.d. disturbance representing shocks to fiscal policy and the forecast error on output and inflation.[18]

Let us now assume that the fiscal instrument is the actual surplus ratio. Key interest usually focuses on γ, which reflects the systematic cyclical properties of fiscal policy. If systematic fiscal policy just "lets the automatic stabilisers work", then γ=α and the structural deficit s_s is constant at its long term level $\bar{s}_s$, ceteris paribus. A positive

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[17] Ignoring the modelling of these components risks creating omitted variable problems, at least if not both s and D are non-stationary, in which case estimates would be super-consistent.

[18] That is, $\varepsilon_t \equiv \mu_t - (1-\rho)\gamma(x_{t+n} - x_{t+n}^{e,t}) - (1-\rho)\beta(\pi_{t+k} - \pi_{t+k}^{e,t})$.

coefficient $\gamma - \alpha > 0$ indicates additional discretionary intervention, while $\gamma - \alpha < 0$ procyclically magnifies the gap. The important caveat in the further analysis is that only systematic policy behaviour can be detected. New to the analysis is that we can test the significance of inflation as an independent policy target for fiscal policy.[19]

Debt sustainability has commonly been inferred from a positive coefficient θ, without specifying the magnitude. It is also a sufficient condition for fiscal policy to be considered Ricardian. We have also isolated the direct interaction between policy authorities.[20] In FTPL-terminology, a significant systematic response implies policy is non-autonomous: we label monetary policy either as a strategic substitute $(\omega < 0)$ or complement $(\omega > 0)$.

3.2. Methodology

Under rational expectations, shocks to systematic policy behaviour should be unrelated to external information at time t. Let z_t be a vector of variables that contain this external information, then equation (8) defines a set of orthogonality conditions

$$\left[\{s_t - \rho s_{t-1} - (1-\rho)(\delta + \gamma x_{t+n} + \beta \pi_{t+k} + \omega i_t + \theta D_t)\} z_t\right] = 0, \qquad (9)$$

that imposes a testable condition such that the policy rule can be estimated with GMM. As such, we correct for the endogeneity problem referred to above. If systematic policy has indeed real effects, then the output gap and inflation will be correlated with the error terms in the policy rule. Applying OLS leads to biased and inconsistent estimates and the degree of stabilisation would thus be overestimated consequently. In addition, the instruments capture to some extent the systematic part of monetary policy. GMM estimation suffers from different flaws, however (Fuhrer and Rudebusch, 2002). First, instrumental variables may be potentially weak. We test the validity of the overidentifying restrictions through the J-test. The interpretation of the J-test also provides a neat way to assess the importance of the additional policy targets we include in the rule. In particular, when the overidentifying restrictions are valid, policy makers react systematically to all relevant and available information. But rejection of this null means explanatory variables

[19] Even if the sign of the fiscal policy response is unclear a priori.

[20] The problem of identifying equilibrium responses of reaction functions is solved by the GMM methodology.

have been omitted, leading to a violation of the orthogonality conditions. We therefore compute the J-test with the explanatory variables[21] included among the instrumental variables instead of in the systematic reaction function. As the J-test does not consider a specific alternative, it is likely to have low power. We therefore compute in addition an F-test on the first stage regression. A second problem of GMM relates to the non-linearity of the policy rule. We control in particular for residual autocorrelation.[22] A more serious problem is the sensitivity of GMM to the normalisation imposed upon the orthogonality conditions. Estimations are therefore run on alternative rephrasings of specification (9).[23] In Section 4.2, we discuss some other robustness checks too.[24]

The rules approach is somehow subject to criticism on the ad hoc identifying restrictions. Even if the basic specification of the fiscal rule may be derived from a consistent theoretical framework, the timing of policy reactions need be based on the practical ability to adjust policy. The budget is usually set on an annual basis, even if within-the-year adjustments are not uncommon. However, as the fiscal impact of output runs mainly through automatic stabilisers, we include the contemporaneous output gap (n=0). Our choice of contemporaneous inflation is motivated by its tax effect on fiscal receipts and debt deflation (k=0). Also, we choose to lag the measure of debt by one period, even if this may be too rapid if unsustainability is not immediately apparent. Even more challenging is the timing of the interaction term. Theoretical models provide little guidance as strategic interaction between policymakers mostly evolves as a stage game, where either fiscal or monetary policy is assumed to have a first-mover advantage. We proceed under a practical assumption on the nature of the policy game: fiscal policy is infrequently set whereas monetary policy is a swing variable that may anticipate fiscal actions instantaneously. Under such regime, reactions to the central bank rate are backward-looking.

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[21] These include in particular inflation and the interaction term.

[22] The disturbances have an MA-representation. GMM-estimates are corrected for heteroskedasticity and MA(4) autocorrelation.

[23] As the results are nearly identical, this is not further discussed.

[24] There are two other problems with moments estimators that we can discard. First, the policy rule may not provide a fully correct moment condition. Second, binding constraints on the optimisation problem underlying the derivation of the fiscal rule, may blur estimation results. The deficit ceilings may indeed have constrained policy makers.

The estimation procedure is conducted as follows.[25] In first instance, the non-linear policy rule is estimated with OLS. These initial coefficient estimates are then used as starting values for 2SLS estimation of the reaction function, with a sufficient number of instrumental variables. An optimal weighting matrix is constructed to start off the iteration procedure for GMM. Perturbation of the initial estimates - and especially those of the persistence parameters - performs robustness checks on the coefficient estimates.

3.3. Data

Henceforth, we consider the primary surplus ratio to potential output as the fiscal instrument. This choice is a logical consequence of our specification of the fiscal policy rule. First, the distinction between discretionary and cyclical fiscal policy is of minor importance at this point, as we want to characterise aggregate fiscal policy setting. As neither structural deficit nor automatic stabilisers are directly observable, we also avoid contentious choices on the method of cyclical adjustment. Second, a spurious relationship between the overall deficit and monetary policy may arise if a monetary tightening - resulting in higher interest payments - induces compensations in other components of the budget. The primary category corrects for this effect. Third, actual output is endogenous with respect to the policy instrument. Potential GDP filters out this effect. As the interaction variable, we use the monetary policy instrument which by standard choice in the literature, is a nominal short-term interest rate directly influenced by the central bank.[26] The policy target variables are taken to be CPI inflation and a simple mechanical output gap measure. On the basis of the IGBC, one would argue for a reaction to the debt ratio. However, from the literature on non-Keynesian effects of fiscal consolidations, we know that reactions of fiscal policy makers may be highly non-linear. Consequently, we examine different indicators of debt. In order to implement GMM, we need a set of instrumental variables. In order to avoid potential estimation bias in small samples, only a small number of overidentifying restrictions is imposed. The basic set

[25] We proceed under the assumption that all variables in the policy rules are stationary. Appropriate data transformations are applied to that end, but the unit root hypothesis cannot always be rejected. By construction, the output gap satisfies this assumption, yet for some of the main variables (the fiscal indicator and the debt ratio in particular), the ADF test does not always reject a unit root and the KPSS confirms this. These results may suffer from the relatively short sample length during which only a few large swings in fiscal policy are evident.
[26] This instrument of the Bundesbank is also the relevant foreign interest rate in countries that fixed the exchange rate.

includes a single lag of the policy instrument and the target variables. In addition, domestic and international monetary conditions[27] are used, as are supply side factors.[28]

Data availability on government accounts dictates the data frequency and the sample of countries included. All data come from the OECD Economic Outlook and are on an annual basis (see Table 1). Monetary policy decisions are taken at a much higher frequency. But given a high degree of interest rate smoothing, this measure is probably not too coarse. Fiscal policy is set at an annual frequency, even if discretionary in-year revisions are not unusual. The countries in the sample can be divided in two main groups: (a) the G-3 countries: United States, Japan and Germany; and (b) the EMS countries: France, Italy, Great Britain, Spain, The Netherlands and Austria.

A first look at the policy instruments and the objectives of both authorities in these countries (see Figs. 2), shows two major facts for fiscal policy. First, prolonged periods of primary deficits and surpluses occurred with no obvious cyclical reversals in the European countries and Japan. In contrast, a nearly perfectly synchronised relationship exists in the USA. Second, the nineties have been characterised by much more persistent behaviour. With the exception of Germany, it seems that the Maastricht conditions led to reductions in the primary deficit in the European countries, and especially so after 1995 (Fatas and Mihov, 2003). A similar fall is apparent in the United States, but seems to be strongly related to the extraordinary growth over the same period. Exactly the opposite evolution occurred in Japan. With regard to monetary policy, we get the "Volcker-Greenspan" observation. Pre-1980 central bank policy was accommodative in all countries in the sample. Since, anti-inflationary monetary policy has set short-term interest rates constantly above inflation, implying positive ex post real interest rates. Such comovement is less apparent for France in the hard ERM period (1988-1992) and in the Netherlands, which continuously maintained a hard peg to the DEM in the EMS. Another eye-ball observation is that after the initial disinflationary period, interest rates seem to have become more responsive to the output gap.

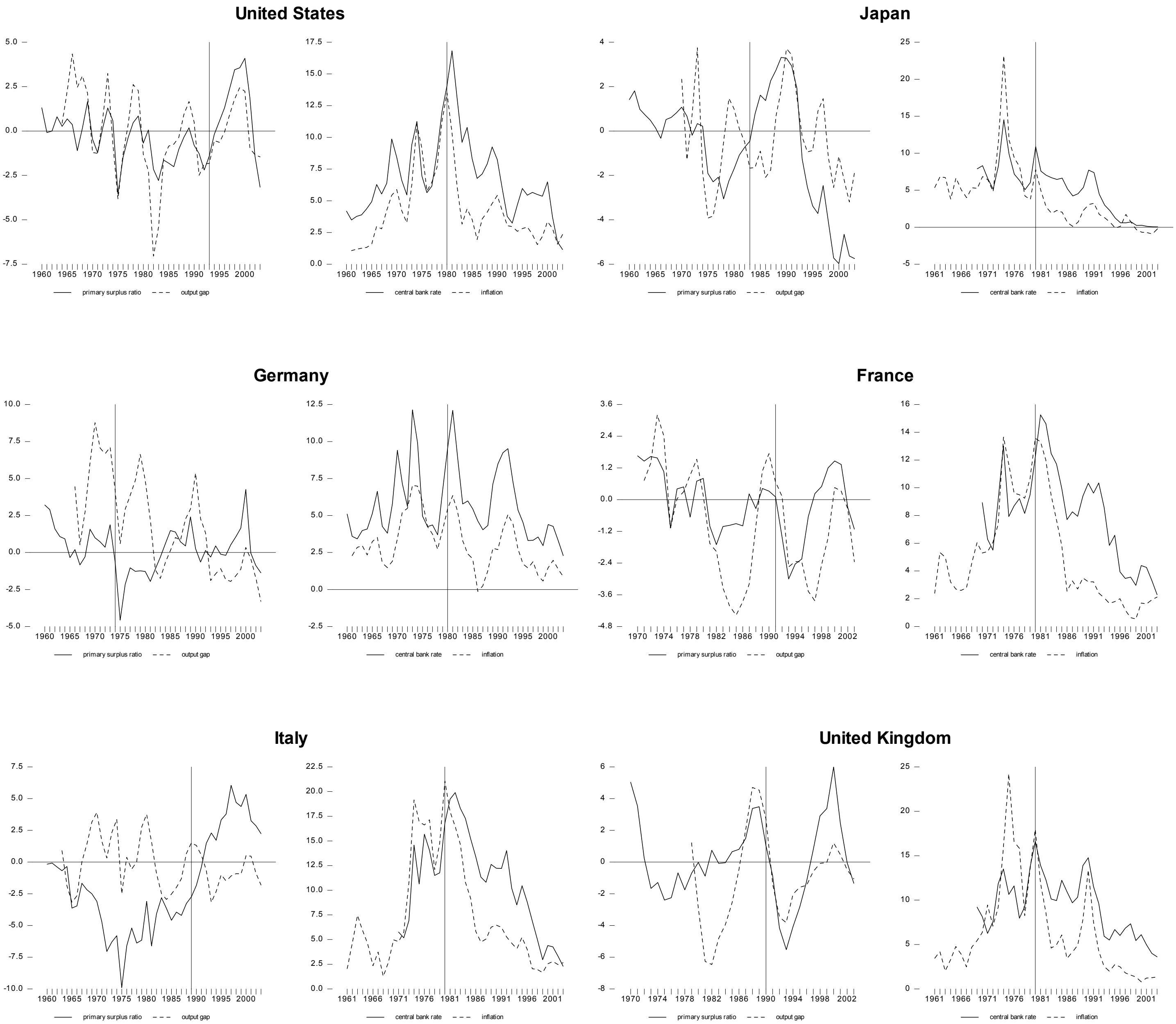
[27] These include a single lag of a broad money aggregate, a commodity price index, the yield, a foreign interest rate and the exchange rate to the DEM or the USD.
[28] Either lagged NAIRU or unit labour cost.

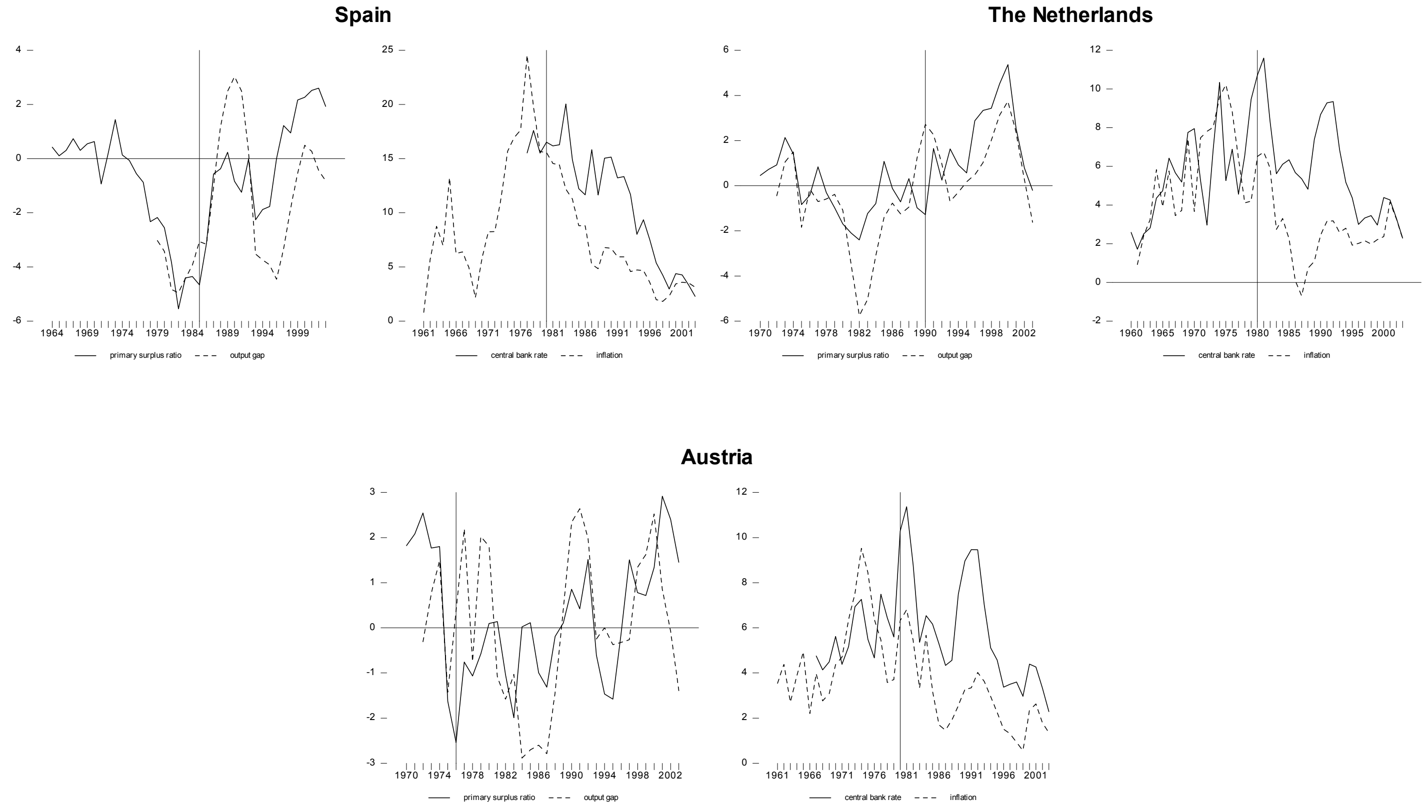
Table 1. Data sources

Series	***Source***
primary surplus ratio (% of potential output) = revenues - expenditure + (capital transfers received by government + other capital transfers - income property paid by government + income property received by government + consumption of government fixed capital)	OECD EO no. 74
revenue (real) = = social security transfers received by government + direct taxes + indirect taxes + transfers received by government	
expenditure (real) [(a)] = government consumption (non- wage) + government consumption (wage) + government gross investment + transfers	
transfers (real) = subsidies + social security transfers + other transfers paid by government	
structural primary deficit ratio (% of potential output)	
general government debt (% of potential output)	
CPI	
public consumption deflator	
GDP deflator	
short term interest rate (central bank rate)	
output gap (%)	
interest payments	
GDP and potential output	
unit labour cost	
NAWRU	
exchange rate (to USD or DEM)	IMF / IFS
commodity price index	CRB
money stock	IMF / IFS

Note: (a) real expenditure is derived by deflating public consumption with the corresponding deflator other components are deflated with the GDP deflator.

Figure 2. Data: primary surplus ratio versus output gap, and interest rates versus inflation: breakdate for fiscal policy indicated (see Table 4).





4. EMPIRICAL RESULTS

The following paragraphs give a structural interpretation to the fiscal policy rule, compare these results with existing evidence, and check for their robustness. We focus in particular on fiscal sustainability and the effects of policy interaction. Results are displayed in Table 2.

4.1. Baseline results

4.1.1. Fiscal sustainability and systematic policy responses: a good model?

There is no unequivocal debt stabilisation response of fiscal policy. The effect is significant in the United States, Italy, the United Kingdom, the Netherlands and Austria. In these countries, fiscal policies are sustainable and can be called Ricardian. The magnitude of the response is on the lower side of what Bohn (1998) finds for the United States. The reaction coefficient is much higher in Italy and the United Kingdom; however.

The absence of debt stabilisation for Japan, Germany, France and Spain is puzzling and not in line with existing evidence (Favero, 2002). The rejection of solvency does not imply fiscal policies are necessarily unsustainable, however. For that reason, we check whether the specification of a fiscal rule as the χ_t term in (3) provides a good model to test sustainability.

This relates in the first place to the cyclical stabilisation properties of fiscal policy.[29] The reaction coefficients show policy to be °leaning against the wind° in the United States, Japan and the smallest EMS members only. For most European countries, policy is indeed acyclical.[30] This is in line with eye-ball evidence and suggests that discretionary fiscal interventions affect importantly the automatic stabilisation response.

4.1.2. Fiscal sustainability and policy interaction

Taming inflation seems not to have been an important separate concern for fiscal authorities. And there is also no significant evidence of policy being non-autonomous. However, both policy targets are important in both long-standing EMS members, Austria and the Netherlands. Fiscal policy is set as a substitute to monetary policy. An interest rate hike of 1% would loosen fiscal policy by about 30 pp. Similarly, deviations of inflation from target induce a fiscal tightening in both countries. The budget process shifts to target inflation and cyclical stabilisation in order to offset the constraint of monetary policy dependence under EMS. This does not seem to affect debt nor output stabilisation reactions.

This does not imply inflation or interest rates are less important in the other countries' fiscal policy setting. With the exception of Japan, Germany and France, neither of the variables is rejected to matter as elements of the rule. But imposing the restriction that fiscal policy reacts to the real interest rate is not valid. It is not rejected for Italy, Austria

[29] The policy persistence parameter displays some interesting patterns too. We would expect fiscal persistence to be high, and we find an adjustment to target of between one and two thirds on a yearly basis. This is not much stronger than monetary smoothing. Even at this data frequency, the budget process is not too slow.

[30] The reaction coefficient is very diverse and not consistent with the usual elasticity of automatic stabilisation, even if a Wald-test for this coefficient equalling 0.50 is hardly rejected.

and the Netherlands though. As a further check on the importance of the monetary variables, we reestimate the rules with the cyclical and debt variable only. This clearly is an incomplete model. Debt reactions are always positive, but significant in Italy only. The cyclical reaction is hardly significant either. Modelling policy interaction is thus an important element in recovering significant debt feedback. The joint significance of monetary variables and debt is only rejected in Germany and France. Our argument is that by conditioning for monetary policy behaviour, we have modelled an important component of fiscal policy setting that complements fiscal feed-back effects. I.e., it alleviates to a large extent the pressure of debt on current fiscal policy setting. Price level variations deflate the real payoffs on nominally-denominated government debt. Even if the Olivera-Tanzi and tax bracket effects of inflation are small, the effect of high public debt ratios and low inflation may still have considerable effect. Interest rate moves can be exploited to reduce the debt ratio.

But how does interaction matter? We reformulated the model with the cyclical and debt variable only, and added inflation and interest rates to the instrumental variables. If these variables are explanatory variables, the J-test for overidentifying restrictions on this specification should reject the null. This “information set” hypothesis is never rejected though. This leaves us with inconclusive evidence on the role of monetary variables.

Another question is whether our labelling of policy interaction is correct. Buti et al. (2001) argue that policy substitutability does not necessarily mean that both policies have constantly been on conflict course. Both policies can still be relatively tight (or loose). A different measure of policy interaction may therefore be needed. A suggestion is to use the deviation from the normalised policy instrument. This renders fiscal policy autonomous, but does not alter the debt feedback.

4.1.3. Policy regime shifts

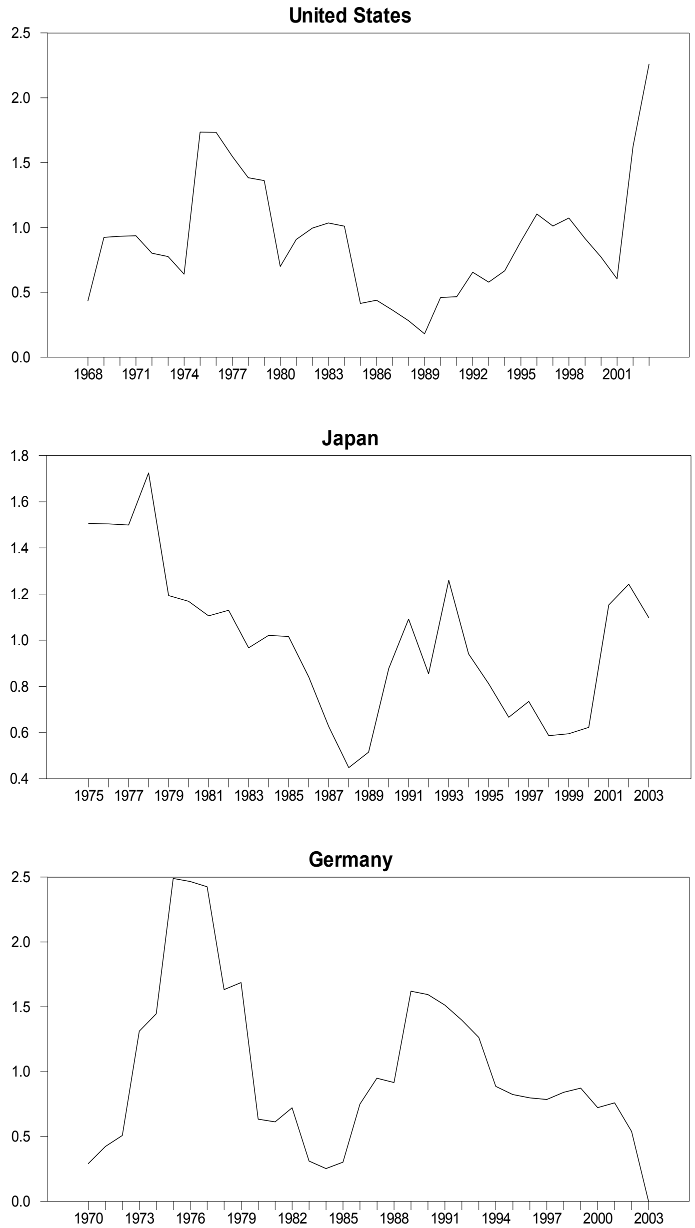
The lack of a debt stabilisation response can be due to incomplete identification of the policy reaction. Misspecification arises when responses are not time-invariant. Hence the importance of properly accounting for policy regime shifts. This has been mostly understood as a once-and-for-all shift in policy behaviour. While this may be true for a flexible policy instrument as in monetary policy, it seems much harder to considerably alter the course of policies during a limited term of government. A gradual change in policy making, responding to the evolution of the economic structure, seems a more realistic description (Blanchard and Simon, 2001).

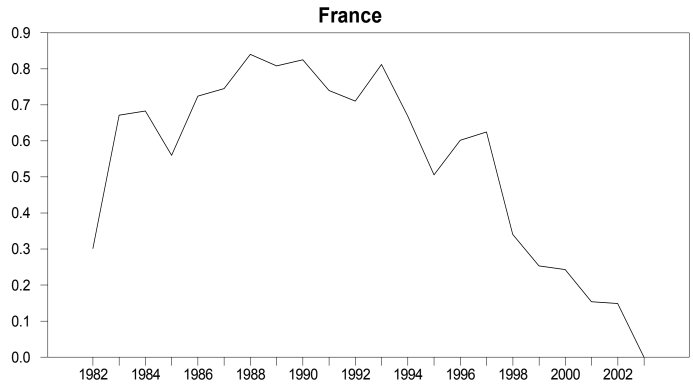
We check such gradual policy shifts with a simple exercise. Figs. 3 display a rolling window of the volatility of the fiscal policy shocks. Window width is set at five years, which is equivalent to the official term of government in many countries. It is impossible to give a detailed account of all the policy and economic factors that may underlie the volatility patterns. Yet, some tendencies are apparent. First, fiscal policy evolves slowly over time and some major periods can be discerned. The reduction in volatility is particularly pronounced for the EMU-countries since at least the introduction of the Maastricht rules. Its importance should not be overstated though, given the rather low average volatilities. Second, there are some clear crisis periods in which volatility increases greatly. Germany after Reunification, Italy in the mid-eighties and at the 1997 EMU-exam, Japan and the United States at the end of the nineties are examples of large policy shifts.

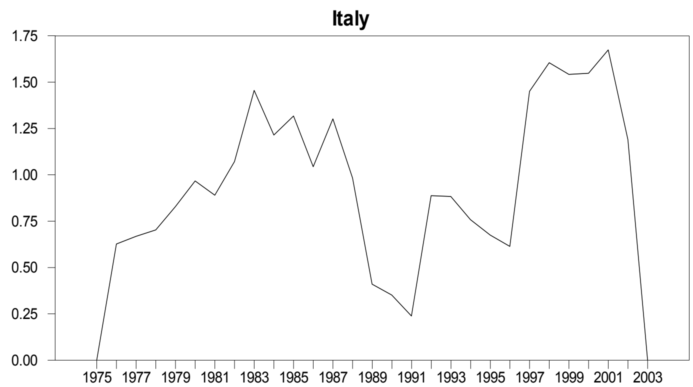
This illustrative evidence underlines the importance of policy regime shifts. We will not examine gradual shifts, but search endogenously for a single structural break in the target policy rule.[31] We apply the sup Quandt - Andrews likelihood ratio test to detect a breakdate in the coefficients of the linear target rule. Results are reported in Table 3. Structural breaks in fiscal policy are not well documented. We find it hard to detect a significant break in the entire target rule. But without exception, a break is associated with debt. In Clinton-administered United States, increasing primary surpluses paid off debt. The SGP rules had an impact on EU members: the 1992 break usually imposed in the literature may not be too far off. In some cases the true policy shift is somewhat belated though.[32] The only exceptions are German fiscal policy where the 1974 break is related to the strong debt build-up under the Brandt government,[33] and the pause in debt accumulation of Japanese governments in the early eighties. A change in the cyclical response of fiscal policy - when significant - does not occur simultaneously with

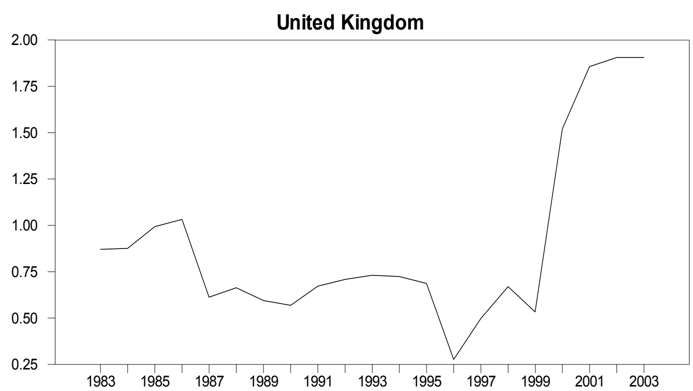
[31]We disregard changes in the persistence parameter in this way.
[32]The breakdate around 1995 for Spain, the Netherlands and Austria is consistent with evidence in Fatas and Mihov (2003).
[33]I would like to thank Albrecht Ritschl for pointing this out. See Von Hagen (1999) for descriptive evidence.

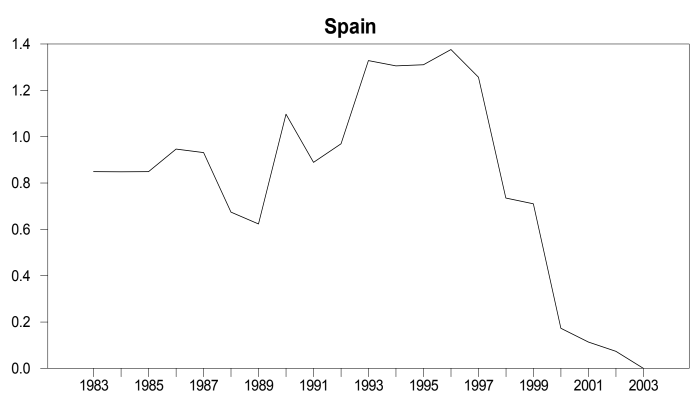
Figure 3. Rolling 5-year window of the volatility of the fiscal policy shock.

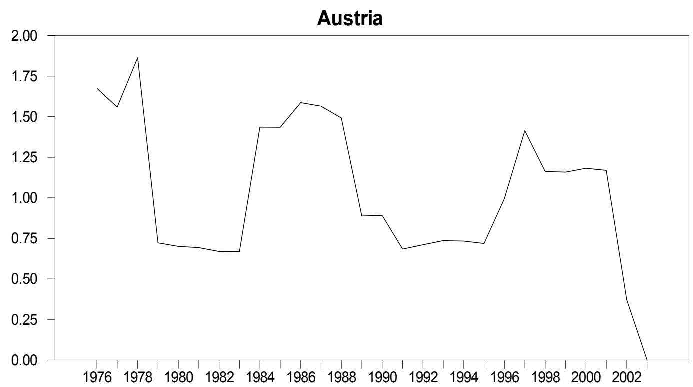



France
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
1982 1984 1986 1988 1990 1992 1994 1996 1998 2000 2002


Italy
1.75
1.50
1.25
1.00
0.75
0.50
0.25
0.00
1975 1977 1979 1981 1983 1985 1987 1989 1991 1993 1995 1997 1999 2001 2003


United Kingdom
2.00
1.75
1.50
1.25
1.00
0.75
0.50
0.25
1983 1985 1987 1989 1991 1993 1995 1997 1999 2001 2003


Spain
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
1983 1985 1987 1989 1991 1993 1995 1997 1999 2001 2003



the change in the debt response. But breaks in the interaction term are consistently coupled to the break in the debt response. The only exception here is the Netherlands: the constraint of the "hard" EMS period bite already in 1985, and cyclical changes occurred together with the fiscal EMU rules in 1995.[34]

To model the policy shift, we simply plug the breakdate for public debt in the non-linear rule with a shift dummy, also allowing the debt response to change. This model does not capture a shift in debt reactions. If there is a fiscal regime shift, it must be entirely in a rapid consolidation. In particular, in those countries in which the long term surplus ratio significantly shifts up, debt responses become weaker afterwards. But if there is a substantial loosening, debt responses turn positive. This is evidence of a "stop - go" consolidation effort. Gradual shifts in fiscal policy may not be so important after all then. This result supports also some of the political economy models of fiscal stabilisations (Alesina and Drazen, 1999). It moreover casts some doubt on rules based fiscal policy.

[34] This evidence suggests fiscal policy drastically alters course under external constraints, probably with some bipartisan agreement. The partisan view of fiscal policy does not seem to be well supported in the context of fiscal solvency.

Table 2. Non-linear fiscal policy rule: GMM-estimates of equation (8).

baseline rule			rule with policy shift		
United States			**1964-2003**		
	coefficient	p-value		coefficient	p-value
ρ	0.23	0.06	ρ	0.03	0.93
β	0.38	0.02	β	0.28	0.04
γ	0.33	0.00	γ	0.38	0.00
ω	-0.12	0.56	ω	0.07	0.68
θ	0.05	0.08	θ	0.05	0.29
			dummy θ^*	-0.20	0.45
R^2	0.37		R^2	0.37	
$dw^{(a)}$	0.82		dw	0.62	
$J(4)^{(b)}$	0.40		$J(4)$	0.40	
$J_{info}^{(c)}$	0.17		$[\theta, \theta^*] = 0$	0.56	
$[\gamma]^{(d)} = .50$	0.18				
$[\beta,\omega] = 0$	0.01				
$[\beta - \omega] = 0$	0.15				
$[\beta,\theta] = 0$	0.07				
$[\omega,\theta] = 0$	0.22				
$[\beta,\omega,\theta] = 0$	0.02				
Japan			**1971-2003**		
	coefficient	p-value		coefficient	p-value
ρ	0.65	0.00	ρ	-0.10	0.93
β	-0.28	0.37	β	1.32	0.17
γ	1.23	0.00	γ	0.46	0.33
ω	-0.00	0.99	ω	-0.76	0.21
θ	-0.07	0.26	θ	-0.18	0.16
			dummy θ^*	0.17	0.45
R^2	0.78		R^2	0.63	
dw	0.95		dw	2.04	
$J(4)$	0.57		$J(4)$	0.87	
J_{info}	*0.59*		$[\theta, \theta^*] = 0$	0.00	
$[\gamma] = .50$	*0.07*				
$[\beta,\omega] = 0$	*0.66*				
$[\beta - \omega] = 0$	*0.66*				
$[\beta,\theta] = 0$	*0.49*				
$[\omega,\theta] = 0$	0.26				
$[\beta,\omega,\theta] = 0$	0.14				

Notes: (a) dw is the Durbin-Watson test statistic; (b) *J(•)* is the J-test for overidentifying restrictions; (c) J_{info} tests the null of the interest rate and inflation entering in the rule directly; (d) [•] are F-tests on coefficients.

baseline rule	coefficient	p-value	rule with policy shift	coefficient	p-value
Germany			**1966-2003**		
ρ	0.88	0.00	ρ	-0.08	0.82
β	0.91	0.27	β	0.31	0.05
γ	0.66	0.55	γ	-0.03	0.80
ω	-0.60	0.31	ω	-0.60	0.03
θ	0.46	0.51	θ	4.77	0.29
			dummy θ*	-4.72	0.30
R^2	0.10		R^2	0.35	
$dw^{(a)}$	2.10		dw	1.59	
$J(4)^{(b)}$	0.75		$J(4)$	0.46	
$J_{info}^{(c)}$	*0.52*		$[\theta, \theta^*] = 0$	0.00	
$[\gamma]^{(d)} = .50$	*0.89*				
$[\beta,\omega] = 0$	*0.95*				
$[\beta - \omega] = 0$	*0.77*				
$[\beta,\theta] = 0$	*0.79*				
$[\omega,\theta] = 0$	0.86				
$[\beta,\omega,\theta] = 0$	0.90				

	coefficient	p-value		coefficient	p-value
France			**1978-2003**		
ρ	0.82	0.00	ρ	0.05	0.89
β	0.94	0.37	β	0.02	0.92
γ	0.75	0.27	γ	0.19	0.32
ω	-3.41	0.35	ω	0.33	0.47
θ	-0.39	0.34	θ	0.44	0.45
			dummy θ*	-0.25	0.63
R^2	0.45		R^2	0.45	
dw	1.56		dw	1.83	
$J(4)$	0.54		$J(4)$	0.72	
J_{info}	*0.50*		$[\theta, \theta^*] = 0$	0.00	
$[\gamma] = .50$	*0.71*				
$[\beta,\omega] = 0$	*0.65*				
$[\beta - \omega] = 0$	*0.36*				
$[\beta,\theta] = 0$	*0.63*				
$[\omega,\theta] = 0$	0.63				
$[\beta,\omega,\theta] = 0$	0.81				

Notes: (a) dw is the Durbin-Watson test statistic; (b) *J(•)* is the J-test for overidentifying restrictions; (c) J_{info} tests the null of the interest rate and inflation entering in the rule directly; (d) [•] are F-tests on coefficients.

baseline rule			rule with policy shift		
Italy			**1971-2003**		
	coefficient	p-value		coefficient	p-value
ρ	0.26	0.14	ρ	0.51	0.38
β	0.40	0.00	β	0.29	0.68
γ	0.09	0.53	γ	0.87	0.52
ω	0.07	0.46	ω	-0.84	0.54
θ	0.19	0.00	θ	-0.22	0.65
			dummy θ*	0.35	0.45
R^2	0.89		R^2	0.78	
dw[(a)]	1.37		*dw*	2.52	
J(4) [(b)]	0.45		*J(4)*	0.37	
J_{info}[(c)]	0.89		*[θ, θ*] = 0*	0.66	
[γ] [(d)]*= .50*	0.00				
[β,ω] = 0	0.00				
[β - ω] = 0	0.00				
[β,θ] = 0	0.00				
[ω,θ] = 0	0.00				
[β,ω,θ] = 0	0.00				
United Kingdom			**1979-2003**		
	coefficient	p-value		coefficient	p-value
ρ	0.69	0.00	ρ	0.62	0.00
β	0.11	0.71	β	0.72	0.19
γ	0.22	0.26	γ	0.27	0.12
ω	0.29	0.38	ω	-0.27	0.48
θ	0.87	0.00	θ	0.56	0.03
			dummy θ*	0.13	0.58
R^2	0.80		R^2	0.83	
dw	2.35		*dw*	2.60	
J(4)	0.59		*J(4)*	0.43	
J_{info}	0.48		*[θ, θ*] = 0*	0.03	
[γ] = .50	0.16				
[β,ω] = 0	0.00				
[β - ω] = 0	0.78				
[β,θ] = 0	0.00				
[ω,θ] = 0	0.00				
[β,ω,θ] = 0	0.00				

Notes: (a) dw is the Durbin-Watson test statistic; (b) *J(•)* is the J-test for overidentifying restrictions; (c) J_{info} tests the null of the interest rate and inflation entering in the rule directly; (d) [•] are F-tests on coefficients.

baseline rule			rule with policy shift		
Spain			**1979-2003**		
	coefficient	p-value		coefficient	p-value
ρ	0.46	0.15	ρ	0.44	0.39
β	-2.21	0.13	β	0.62	0.60
γ	-0.48	0.47	γ	-0.20	0.77
ω	-0.37	0.27	ω	-1.39	0.13
θ	-0.42	0.09	θ	-0.14	0.60
			dummy θ	0.29	0.12
R^2	0.28		R^2	0.68	
dw[(a)]	1.94		*dw*	2.86	
J(4) [(b)]	0.87		*J(4)*	0.91	
J_{info}[(c)]	0.69		*[θ, θ*] = 0*	0.17	
[γ] [(d)] *= .50*	0.14				
[β,ω] = 0	0.10				
[β - ω] = 0	0.24				
[β,θ] = 0	0.21				
[ω,θ] = 0	0.13				
[β,ω,θ] = 0	0.00				
The Netherlands			**1972-2003**		
	coefficient	p-value		coefficient	p-value
ρ	0.11	0.69	ρ	0.18	0.58
β	0.27	0.00	β	-0.39	0.02
γ	0.36	0.00	γ	0.13	0.66
ω	-0.33	0.00	ω	0.36	0.17
θ	0.04	0.03	θ	0.08	0.22
			dummy θ*	-0.26	0.64
R^2	0.50		R^2	0.53	
dw	1.13		*dw*	1.77	
J(4)	0.50		*J(4)*	0.94	
J_{info}	0.45		*[θ, θ*] = 0*	0.13	
[γ] = .50	0.02				
[β,ω] = 0	0.00				
[β - ω] = 0	0.00				
[β,θ] = 0	0.02				
[ω,θ] = 0	0.00				
[β,ω,θ] = 0	0.00				

Notes: (a) dw is the Durbin-Watson test statistic; (b) *J(•)* is the J-test for overidentifying restrictions; (c) J_{info} tests the null of the interest rate and inflation entering in the rule directly; (d) [•] are F-tests on coefficients.

baseline rule			rule with policy shift		
	Austria		**1972-2003**		
	coefficient	p-value		coefficient	p-value
ρ	0.35	0.00	ρ	0.55	0.38
β	0.68	0.00	β	0.21	0.73
γ	0.37	0.04	γ	-0.39	0.40
ω	-0.30	0.00	ω	0.86	0.61
θ	0.07	0.01	θ	0.04	0.84
			dummy θ*	1.43	0.65
R^2		0.13	R^2	0.49	
dw[(a)]		1.05	*dw*	1.31	
J(4) [(b)]		0.46	*J(4)*	0.36	
J_{info}[(c)]		0.64	*[θ, θ*] = 0*	0.58	
[γ] [(d)]*= .50*		0.48			
[β,ω] = 0		0.00			
[β - ω] = 0		0.00			
[β,θ] = 0		0.00			
[ω,θ] = 0		0.00			
[β,ω,θ] = 0		0.00			

Notes: (a) dw is the Durbin-Watson test statistic; (b) *J(•)* is the J-test for overidentifying restrictions; (c) J_{info} tests the null of the interest rate and inflation entering in the rule directly; (d) [•] are F-tests on coefficients.

Table 3. Andrews-Quandt breakdates in target fiscal policy rule.

break in coefficients	**United States**	**Japan**	**Germany**	**France**	**Italy**
all	1993	1983	1974	1991	1989
β	1995**	1977**	1974**	1992*	1985*
γ	1991	1987	1974	1988	1980
ω	1992*	1983*	1974	1991	1984*
θ	1995*	1983*	1974**	1992**	1991*
residual variance	1997	1989	1998	1992	1990

break in coefficients	**United Kingdom**	**Spain**	**The Netherlands**	**Austria**
all	1990	1985	1990	1976
β	1998*	1983**	1980	1996
γ	1990*	1986	1995	1976
ω	1998**	1995**	1985*	1996**
θ	1997*	1994*	1995**	1996**
residual variance	1992	1987	1988	1976

Note: (a) * indicates significance at 5%, ** at 10%.

Even if the SGP has been effective in putting consolidation on the agenda of European governments, the rewriting of the procedure once again reflects the consolidation fatigue.[35] Nevertheless, there is no strong evidence of a trade-off between debt and output stabilisation. This was already suggested by the diverse breakdates. In contrast to Artis and Buti (2001), we find that output responses turn acyclical after Maastricht, but only in those countries where the initial fiscal outlook was unfavourable already (Austria and the Netherlands). A model with the dummy on the cyclical response confirms this trade-off (results not reported). With respect to policy interaction, there is no significant evidence of non-autonomous fiscal policy anymore.

There are three important caveats to this interpretation. First, only modelling the shift in public debt understates the importance of policy interaction. The simultaneous breakdate on the interaction term suggests that a more complete model of the regime shift is needed. Experiments with a shift dummy on the interaction term do not provide a better model though (results not reported). Second, the inclusion of a dummy is a too coarse way to model policy shifts. In particular, we disregarded breaks in the persistence parameter of the non-linear rule. It may well be that debt consolidations come about by a sudden rapid adjustment to the target level of primary surplus. Third, the "stop - go" consolidations that leave systematic fiscal policy reactions unchanged, may just reflect that a few large swings in public debt provide insufficient identifying restrictions.

4.2. Robustness analysis

It can be argued that the empirical rule does not completely correspond to the theoretical model. Indeed, the diversity of fiscal policy models - which reflects the heterogeneity of policy instruments and targets - suggests many extensions. We check the robustness of the results against some different data measures and specifications. Results are in Table 4.

4.2.1. Systematic discretionary policy

[35] The positive news is that the deficit rule could be replaced with a debt rule. Legislated rules may indeed be a necessary condition for stable systematic sustainability responses (see Section 4.2).

As in Galí and Perotti (2003), we would like to assess cyclical properties of discretionary policy apart from the constructed automatic stabilisers. The true instrument of fiscal policy makers is then considered to be the (budgeted) structural surplus ratio. So far, we remained agnostic about the use of filters and analysed the actual indicator s directly. We now take as the fiscal indicator the cyclically adjusted primary surplus ratio to potential output.[36]

The cyclical response obviously decreases, and in theory, this ratio should be acyclical. The procyclical tendency of European fiscal policies is clearly demonstrated though, and particularly so in Italy and Austria. That the debt response for Austria and the Netherlands turns insignificant proves that there is some trade-off with cyclical stabilisation in these countries.

4.2.2. Debt stabilisation revisited

Political economy models of public debt argue that debt stabilisation is not a smooth process. Only when fiscal conditions worsen beyond some sustainable level, does debt arrive on the politician's agenda. Even with a non-linear specification, these sudden "urgencies" are hard to detect empirically.[37]We therefore specify a target rule that is non-linear in the debt measure.

This may still be an incomplete characterisation of debt reduction though. While there usually is a period of linear debt accumulation (or non-response) of the primary surplus, it is not offset by the sudden consolidation reaction. Even if this small reaction is important in absolute terms, the result once more underlines the "stop-go" consolidation property of fiscal policy.[38] Policy behaviour out of these crisis periods barely alters. Incorporating fiscal rules into legislation may help to establish smoother reactions, as the positive linear reaction coefficients for the United Kingdom and the Netherlands suggest.

[36] This under the caveat that estimation on filtered variables may merely capture the filter properties.
[37] The lack of a positive feedback on debt over the sample period may have another interpretation. With a non-linear rule, a positive response may not be present if debt never exceeded some threshold value after which the reaction coefficient is bounded away from zero. Only model-based evidence could shed light on this. The missing feedback may thus be a consequence of insufficient identification in the dataset.
[38] This supports the modelling of the policy change in Section 4.1.

4.2.3. Output gap measures

The use of a mechanically calculated output gap is debatable in an empirical examination of a theoretical relationship that derives from a New Keynesian model. As in the targeting rule of Benigno and Woodford (2003) such a theoretical gap is present, we follow Galí et al. (2001) to substitute the gap with a measure of real marginal cost i.e. the (log deviation of) real unit labour cost.

There is actually a close inverse correspondence between this theory-based gap and the surplus ratio for the non-European countries. It thus results in a significant countercyclical surplus response, even in Germany and Austria. For the other EMS countries, acyclicality is confirmed. If anything, debt stabilisation is not as strong as in the baseline model. We rather find a significant destabilising response for Japan and Germany. On all other accounts, this model performs rather well: inflation and the interest rate are never rejected as elements of the rule, even if they may rather belong to the information set. Fiscal policy is a non-autonomous complement to monetary policy in Japan, the United Kingdom and Austria, but a substitute in the Netherlands and Spain.

4.2.4. Tax and spending rules

The surplus ratio is a rest category that hides much of the information on the composition of the fiscal policy instrument. Theoretical models usually take the level of government spending as given, and define tax rules that determine the future sequence of primary surpluses. We want to exploit the extra information in both expenditure and revenues to assess fiscal solvency, and specify a tax and spending rule with the same basic specification as in (8).[39] This is still a gross simplification as distortionary tax effects operate differently across tax categories.[40] But this summary specification corresponds closely to the rule in Benigno and Woodford (2003).

When there is a significant stabilising response to debt in the baseline model, then this is

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[39] The fiscal indicator is replaced with the ratio of gross revenues or primary government expenditure, to potential output.
[40] See Lane (2003) for such evidence.

Table 4. Non-linear fiscal policy rule: GMM-estimates of equation (8).

	marginal cost gap		squared debt ratio		tax-rule		spending rule	
United States								
	coefficient	p-value	coefficient	p-value	coefficient	p-value	coefficient	p-value
ρ	0.35	0.14	0.49	0.01	0.56	0.00	0.95	0.00
β	0.88	0.00	-1.32	0.15	0.19	0.30	0.82	0.69
γ	-1.94	0.04	1.39	0.02	0.39	0.00	-1.87	0.56
ω	0.16	0.60	0.83	0.08	-0.18	0.44	-0.72	0.73
θ	-0.07	0.35	-4.40	0.11	0.08	0.01	0.17	0.72
			θ^2=0.04	0.10				
R^2	*0.66*		*0.48*		*0.75*		*0.91*	
dw[(a)]	*0.97*		*1.16*		*1.40*		*1.26*	
J(4) [(b)]	*0.83*		*0.65*		*0.39*		*0.39*	
J_{info}[(c)]	*0.30*		*0.20*		*0.23*		*0.45*	
[γ] [(d)]*= .50*	*0.01*		*0.15*		*0.45*		*0.46*	
[β,ω] = 0	*0.03*		*0.22*		*0.58*		*0.93*	
[β – ω] = 0	*0.04*		*0.12*		*0.33*		*0.70*	
[β,θ] = 0	*0.03*		*0.26*		*0.04*		*0.92*	
[ω,θ] = 0	*0.61*		*0.21*		*0.03*		*0.92*	
[β,ω,θ] = 0	*0.08*		*0.13*		*0.01*		*0.98*	
Japan								
	coefficient	p-value	coefficient	p-value	coefficient	p-value	coefficient	p-value
ρ	0.36	0.07	0.67	0.00	0.64	0.00	0.88	0.00
β	-0.64	0.00	-0.39	0.39	-0.24	0.04	-0.72	0.47
γ	-1.03	0.00	1.64	0.03	1.00	0.00	-1.83	0.49
ω	0.60	0.01	-0.18	0.74	0.58	0.00	0.31	0.70
θ	-0.06	0.01	-0.20	0.26	0.08	0.00	-0.04	0.85
			θ^2=0.00	0.52				
R^2	*0.73*		*0.71*		*0.94*		*0.89*	
dw	*1.51*		*0.99*		*1.81*		*1.15*	
J(4)	*0.72*		*0.55*		*0.66*		*0.84*	
J_{info}	*0.67*		*0.54*		*0.65*		*0.71*	
[γ] = .50	*0.00*		*0.14*		*0.00*		*0.38*	
[β,ω] = 0	*0.01*		*0.57*		*0.00*		*0.68*	
[β – ω] = 0	*0.00*		*0.79*		*0.00*		*0.38*	
[β,θ] = 0	*0.00*		*0.51*		*0.00*		*0.43*	
[ω,θ] = 0	*0.00*		*0.26*		*0.00*		*0.83*	
[β,ω,θ] = 0	*0.00*		*0.69*		*0.00*		*0.15*	

Notes: (a) dw is the Durbin-Watson test statistic; (b) *J(•)* is the J-test for overidentifying restrictions; (c) J_{info} tests the null of the interest rate and inflation entering in the rule directly; (d) [•] are F-tests on coefficients.

	marginal cost gap		squared debt ratio		tax-rule		spending rule	
Germany								
	coefficient	p-value	coefficient	p-value	coefficient	p-value	coefficient	p-value
ρ	-0.13	0.75	0.90	0.00	0.73	0.00	0.76	0.00
β	-0.40	0.02	0.26	0.95	1.41	0.18	0.32	0.39
γ	0.22	0.00	-0.93	0.98	0.65	0.22	0.54	0.08
ω	0.09	0.58	0.09	0.97	-0.95	0.27	-0.29	0.22
θ	-0.03	0.04	-0.79	0.71	0.30	0.11	0.02	0.84
			θ^2=0.01	0.69				
R^2	*0.24*		*0.11*		*0.37*		*0.70*	
dw[(a)]	*1.28*		*2.01*		*1.67*		*1.29*	
J(4) [(b)]	*0.37*		*0.75*		*0.64*		*0.33*	
J_{info}[©]	*0.80*		*0.62*		*0.62*		*0.71*	
[γ] [(d)]*= .50*	*0.00*		*0.67*		*0.78*		*0.90*	
[β,ω] = 0	*0.00*		*0.98*		*0.28*		*0.45*	
[β – ω] = 0	*0.13*		*0.98*		*0.21*		*0.29*	
[β,θ] = 0	*0.06*		*0.93*		*0.28*		*0.68*	
[ω,θ] = 0	*0.12*		*0.93*		*0.21*		*0.47*	
[β,ω,θ] = 0	*0.00*		*0.98*		*0.62*		*0.66*	
France								
	coefficient	p-value	coefficient	p-value	coefficient	p-value	coefficient	p-value
ρ	0.90	0.00	0.71	0.06	0.77[(e)]	0.15	1.07[(e)]	0.15
β	2.30	0.54	0.56	0.57	-0.83	0.61	0.48	0.86
γ	-1.48	0.54	0.80	0.10	-1.01	0.75	0.60	0.79
ω	-5.54	0.55	-2.19	0.43	-0.32	0.90	-2.33	0.80
θ	-0.77	0.54	-1.37	0.17	-0.25	0.80	0.30	0.74
			θ^2=0.01	0.17				
R^2	*0.41*		*0.33*		*0.34*		*0.87*	
dw	*1.53*		*1.31*		*2.03*		*2.52*	
J(4)	*0.58*		*0.55*		*0.51*		*0.02*	
J_{info}	*0.53*		*0.58*		*0.62*		*0.21*	
[γ] = .50	*0.42*		*0.54*		*0.63*		*0.96*	
[β,ω] = 0	*0.82*		*0.62*		*0.87*		*0.63*	
[β – ω] = 0	*0.55*		*0.45*		*0.83*		*0.81*	
[β,θ] = 0	*0.83*		*0.38*		*0.85*		*0.63*	
[ω,θ] = 0	*0.83*		*0.37*		*0.95*		*0.90*	
[β,ω,θ] = 0	*0.94*		*0.38*		*0.35*		*0.59*	

Notes: (a) dw is the Durbin-Watson test statistic; (b) *J(•)* is the J-test for overidentifying restrictions; (c) J_{info} tests the null of the interest rate and inflation entering in the rule directly; (d) [•] are F-tests on coefficients; (e) three smoothing lags on this rule are needed.

	marginal cost gap		squared debt ratio		tax-rule		spending rule	
Italy								
	coefficient	p-value	coefficient	p-value	coefficient	p-value	coefficient	p-value
ρ	0.31	0.05	0.43	0.00	0.62	0.00	0.53	0.00
β	0.47	0.00	-0.06	0.85	-0.40	0.00	-0.46	0.00
γ	0.04	0.58	0.64	0.06	0.96	0.00	0.41	0.00
ω	0.16	0.17	0.76	0.04	0.15	0.49	0.40	0.00
θ	0.20	0.00	-0.64	0.07	0.12	0.00	-0.04	0.05
			θ^2=0.00	0.02				
R^2	*0.89*		*0.83*		*0.95*		*0.79*	
dw[(a)]	*1.42*		*1.63*		*2.33*		*2.60*	
J(4) [(b)]	*0.52*		*0.56*		*0.66*		*0.77*	
J_{info}[©]	*0.81*		*0.94*		*0.87*		*0.65*	
[γ] [(d)]*= .50*	*0.00*		*0.68*		*0.06*		*0.34*	
[β,ω] = 0	*0.00*		*0.04*		*0.01*		*0.00*	
[β – ω] = 0	*0.01*		*0.18*		*0.01*		*0.00*	
[β,θ] = 0	*0.00*		*0.00*		*0.00*		*0.00*	
[ω,θ] = 0	*0.00*		*0.13*		*0.00*		*0.00*	
[β,ω,θ] = 0	*0.00*		*0.01*		*0.00*		*0.00*	
United Kingdom								
	coefficient	p-value	coefficient	p-value	coefficient	p-value	coefficient	p-value
ρ	0.75	0.00	0.72	0.00	0.86	0.00	0.91	0.00
β	-0.30	0.53	0.22	0.53	0.22	0.74	0.12	0.79
γ	-0.56	0.40	0.08	0.74	-0.20	0.51	-1.34	0.04
ω	1.03	0.00	0.19	0.59	0.41	0.47	-0.79	0.48
θ	0.90	0.00	0.20	0.94	1.15	0.11	-0.89	0.28
			θ^2=0.01	0.77				
R^2	*0.67*		*0.78*		*0.82*		*0.96*	
dw	*1.69*		*2.48*		*2.25*		*2.10*	
J(4)	*0.52*		*0.52*		*0.72*		*0.77*	
J_{info}	*0.56*		*0.56*		*0.67*		*0.83*	
[γ] = .50	*0.11*		*0.06*		*0.02*		*0.00*	
[β,ω] = 0	*0.00*		*0.02*		*0.03*		*0.69*	
[β – ω] = 0	*0.03*		*0.97*		*0.87*		*0.54*	
[β,θ] = 0	*0.00*		*0.82*		*0.11*		*0.54*	
[ω,θ] = 0	*0.00*		*0.87*		*0.07*		*0.51*	
[β,ω,θ] = 0	*0.00*		*0.05*		*0.06*		*0.64*	

Notes: (a) dw is the Durbin-Watson test statistic; (b) *J(•)* is the J-test for overidentifying restrictions; (c) J_{info} tests the null of the interest rate and inflation entering in the rule directly; (d) [•] are F-tests on coefficients.

	marginal cost gap		squared debt ratio		tax-rule		spending rule	
Spain								
	coefficient	p-value	coefficient	p-value	coefficient	p-value	coefficient	p-value
ρ	0.26	0.61	0.08	0.80	0.38	0.00	0.63	0.00
β	-1.20	0.00	-1.27	0.01	-0.71	0.00	0.94	0.01
γ	0.08	0.34	-0.02	0.92	0.57	0.00	1.25	0.00
ω	-0.40	0.05	-0.23	0.22	0.05	0.65	0.12	0.51
θ	-0.25	0.00	-0.38	0.00	-0.02	0.56	0.24	0.03
			θ^2=0.00	0.05				
R^2	*0.06*		*0.53*		*0.96*		*0.90*	
dw[(a)]	*1.60*		*2.20*		*2.77*		*1.85*	
J(4) [(b)]	*0.95*		*0.96*		*0.64*		*0.67*	
J_{info}[©]	*0.74*		*0.75*		*0.66*		*0.71*	
[γ] [(d)]*= .50*	*0.00*		*0.02*		*0.20*		*0.00*	
[β,ω] = 0	*0.00*		*0.01*		*0.00*		*0.00*	
[β – ω] = 0	*0.00*		*0.07*		*0.00*		*0.00*	
[β,θ] = 0	*0.00*		*0.00*		*0.00*		*0.01*	
[ω,θ] = 0	*0.00*		*0.00*		*0.04*		*0.00*	
[β,ω,θ] = 0	*0.00*		*0.00*		*0.00*		*0.00*	
The Netherlands								
	coefficient	p-value	coefficient	p-value	coefficient	p-value	coefficient	p-value
ρ	0.71	0.00	-0.24	0.35	0.31[(e)]	0.00	0.70[(e)]	0.10
β	-0.87	0.31	0.45	0.00	-0.22	0.21	-0.90	0.09
γ	-0.76	0.21	0.58	0.00	0.18	0.25	-0.34	0.03
ω	-0.59	0.04	-0.31	0.00	0.16	0.16	0.81	0.03
θ	-0.41	0.22	0.65	0.02	0.04	0.18	-0.06	0.61
			θ^2=-0.00	0.03				
R^2	*0.36*		*0.15*		*0.45*		*0.89*	
dw	*1.31*		*1.06*		*2.82*		*1.80*	
J(4)	*0.39*		*0.67*		*0.67*		*0.65*	
J_{info}	*0.45*		*0.55*		*0.87*		*0.36*	
[γ] = .50	*0.00*		*0.48*		*0.04*		*0.00*	
[β,ω] = 0	*0.00*		*0.00*		*0.02*		*0.08*	
[β – ω] = 0	*0.54*		*0.00*		*0.01*		*0.05*	
[β,θ] = 0	*0.93*		*0.00*		*0.00*		*0.00*	
[ω,θ] = 0	*0.03*		*0.00*		*0.29*		*0.00*	
[β,ω,θ] = 0	*0.00*		*0.00*		*0.00*		*0.00*	

Notes: (a) dw is the Durbin-Watson test statistic; (b) *J(•)* is the J-test for overidentifying restrictions; (c) J_{info} tests the null of the interest rate and inflation entering in the rule directly; (d) [•] are F-tests on coefficients; (e) two smoothing lags on this rule are needed.

	marginal cost gap		squared debt ratio		tax-rule		spending rule	
Austria								
	coefficient	p-value	coefficient	p-value	coefficient	p-value	coefficient	p-value
ρ	0.21	0.26	0.31	0.31	0.48	0.00	0.71	0.00
β	0.06	0.75	-0.47	0.26	-0.04	0.91	-0.72	0.00
γ	-0.28	0.00	-1.19	0.02	0.72	0.07	-0.38	0.21
ω	0.22	0.03	1.28	0.00	0.02	0.90	-0.02	0.95
θ	0.01	0.70	-1.10	0.00	0.13	0.00	-0.19	0.00
			θ^2=0.01	0.00				
R^2	*0.36*		*0.32*		*0.89*		*0.65*	
dw[(a)]	*1.31*		*1.77*		*1.24*		*0.95*	
J(4) [(b)]	*0.39*		*0.87*		*0.71*		*0.48*	
J_{info}[(c)]	*0.45*		*0.67*		*0.95*		*0.45*	
[γ] [(d)]*= .50*	*0.00*		*0.00*		*0.58*		*0.00*	
[β,ω] = 0	*0.00*		*0.00*		*0.99*		*0.00*	
[β - ω] = 0	*0.54*		*0.03*		*0.89*		*0.13*	
[β,θ] = 0	*0.93*		*0.00*		*0.00*		*0.00*	
[ω,θ] = 0	*0.03*		*0.01*		*0.02*		*0.00*	
[β,ω,θ] = 0	*0.00*		*0.00*		*0.00*		*0.00*	

Notes: (a) dw is the Durbin-Watson test statistic; (b) *J(•)* is the J-test for overidentifying restrictions; (c) J_{info} tests the null of the interest rate and inflation entering in the rule directly; (d) [•] are F-tests on coefficients.

mostly brought about by tax increases. Decreases in spending are rather rare or insignificant. Italy and Austria are clear examples of debt stabilisations taking place on the two sides of the budget. When initial fiscal conditions are dreadful, consolidation probably needs to occur on both government revenues and expenditures. With well-behaved policymaking, there is probably less urgency to cut expenses drastically. The reluctance to reduce government expenditure is also obvious in the cyclical responses. Revenues stream in during cyclical upswings, and are spent immediately. This explains the procyclicality of European fiscal policies. Such an effect is absent in the United States or the Netherlands for example.

The distinction between revenues and expenditures allows us to consider some alternative hypotheses on the effect of inflation and interest rates. The positive responses to inflation are mostly explained for by spending cuts that are more than offset by the revenue shortfall. Non-indexation of expenditure categories may thus be more important in containing government expansion than creeping tax-bracket effects. That interest rates are an important determinant of tax revenues is not a hypothesis that can be maintained, as responses are hardly significant. Nor do higher rates seem to induce compensation for higher interest payments in expenditures. Overall, in the tax and spending rules, the joint effects of inflation and interest rates are hard to accept. Of course, such effects may be blurred by the stronger inertia.

5. CONCLUSION

The problematic fiscal policy experiences of recent years have fuelled vivid academic and policy discussions on the sustainability of fiscal policies. This debate is nowadays cast in terms of policy rules, and focuses also on the policy mix between fiscal and monetary policies. Debt is the nexus of interaction between both. Despite these recent advances, the incorporation of both fiscal and monetary policy in an empirical analysis of systematic policy behaviour is currently missing.

The aim of this paper is to characterise rules-based fiscal policy as a means of testing fiscal sustainability. The main contributions of this paper are twofold. First, we derive from theory a testable specification that we then identify as a fiscal rule. Second, we perform a comparative cross-country analysis of fiscal rules on annual OECD data.

The examination of rules based policy leads us to two main conclusions on fiscal sustainability. First, as a rule, there is a significant stabilising reaction to debt. Taking into account interaction with monetary policy importantly accounts for the success of the model. The exceptions to the rule are Germany, France and Japan, for which the model is not able to reject insolvency. Second, there are regime shifts in fiscal policy that are mainly related to debt. The effect of the Maastricht rules in Europe and the Clinton administration made consolidation become a major policy concern over the last decade. This occurred without important effects on other policy parameters. That is, consolidation follows a “stop - go” cycle and does not get incorporated into systematic policy reactions. Consolidation did not really impede cylical stabilisation. The effect of monetary union on fiscal policy setting is not negligible. In small EMS countries, fiscal policies are a substitute to monetary policy, and inflation becomes an important policy objective.

The limitations of the current analysis are obvious, but need qualification. First, the GMM-methodology corrects the estimates for the endogeneity of fiscal policy. It may be less successful in capturing systematic monetary policy. However, it is a first step in controlling for the policy mix. Second, debt is hard to model as a few large oscillations in the process hamper identification. On all accounts, the model we use to test sustainability of fiscal policies performs rather well.

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