Fiscal Policy Rules and Regime (In)Stability: Evidence from the U.S.*

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Abstract

We employ Markov-switching regression methods to estimate fiscal policy feedback rules in the U.S. for the period 1960-2002. Our approach allows to capture policy regime changes endogenously. We reach three main conclusions. First, fiscal policy may be characterized, according to Leeper (1991) terminology, as *active* from the 1960s throughout the 1980s, switching gradually to *passive* in the early 1990s and switching back to active in early 2001. Second, regime-switching fiscal rules are capable of tracking the time-series behaviour of the U.S. primary deficit better than rules based on a constant parameter specification. Third, regime-switches in monetary and fiscal policy rules do not exhibit any degree of synchronization. Our results are at odds with the view that the post-war U.S. fiscal policy regime may be classified as passive at all times, and seem to pose a challenge for the specification of the correct monetary-fiscal mix within recent optimizing macroeconomic models considered suitable for policy analysis.

Keywords. active and passive fiscal policy rule, Markov-switching estimation, monetary policy rule.

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1 Introduction

Recently we have witnessed a vivid interest in macroeconomics for the analysis of policy regimes. Yet nearly the whole literature (both theoretical and empirical) has focused on monetary policy in complete isolation, and in particular from fiscal policy. The main justification for this bias lies in the theoretically well-rooted paradigm according to which inflation stabilization should be a concern of the monetary authority only. The more independent such authority the more credible and therefore the more successful in achieving the primary goal of reducing and stabilizing inflation.[1]

This conventional view typically suffers of two shortcomings. First, it often overlooks that, as emphasized for instance by Leeper (1991), Woodford (1996, 2001), Benhabib et al. (2001), an appropriately defined monetary policy rule requires also an appropriately defined fiscal policy rule. Existence and uniqueness of rational expectations equilibria, as well as macroeconomic outcomes, hinge crucially on the underlying specification of the monetary-fiscal mix. Second, it typically assumes stability in the underlying fiscal policy regime. The latter is usually represented as *passive* (in the sense of Leeper, 1991), namely either featuring a sufficiently strong response of the fiscal deficit (and/or taxes) to variations in real debt, or, even more sharply, assuming that the government budget is balanced at all times.[2]

While research has soared in the empirical analysis of monetary policy rules,[3] it is only recently that a number of authors have shifted the attention to the specification of fiscal policy in terms of reaction function. Taylor (1996, 2000a, 2000b) argues that a fiscal rule can be specified for the U.S. by simply relating the measure of the fiscal stance to the deviation of output from its equilibrium level. He finds evidence of a countercyclical pattern of systematic fiscal policy. "Taylor fiscal rules" do not explicitly allow for a reaction to the evolution of the government debt. Bohn (1998) argues that a century of U.S. data reveals a positive correlation between the government surplus to GDP ratio and the government debt to GDP ratio.[4]

This stream of the literature is problematic for it relies on a *constant-regime* assumption. Hence the evidence (e.g., in Bohn) that fiscal policy in the U.S. can be considered (although moderately) passive at all times may be simply reflect the average effect of combined (and time-varying) fiscal regimes of opposite sign.

The possibility that fiscal regimes are indeed time-varying is difficult to dismiss. Relatively

[1] This view is at the core of the so-called New Keynesian monetary policy literature, centered around the polar star of the Taylor principle. See the widely cited work of Woodford (2003) and Clarida et al. (1999, 2000).

[2] We choose to maintain Leeper's *passive* vs. *active* terminology throughout in the paper. Hence, under a passive fiscal policy, taxes (or surplus) are adjusted "passively" to changes in government debt, while under an active fiscal policy the government tries "actively " to engineer effects of macroeconomic stabilization.

[3] To name one see the empirical results in Clarida et al. (2000).

[4] For constant-parmeter estimates of fiscal policy rules, applied to European countries, and including both a debt and an output gap stabilization motive, see also Ballabriga and Martinez-Mongay (2003) and Gali and Perotti (2003).

to monetary policy, fiscal policy is much more sensitive to the swinging pendulum of political preferences over time. Davig, Leeper and Chung (2004) describe the evolution of fiscal regimes in U.S. post-war history as an alternation between fiscal rules with a rationale for budget balancing and fiscal rules only aimed at discretionary macroeconomic stabilization, with disregard for the evolution of government debt. Woodford (1998) suggests that an interpretation of U.S. fiscal policy in the late 1960s and 1970s as active is likely to be more appropriate, while a passive characterization should more fundamentally apply to fiscal policy in the 1980s and 1990s.

To challenge the convention that fiscal policy may have been passive at all times, it suffices to gather a quick evidence on the conduct of fiscal authorities from 1960s onwards.[5] During 1965-1967 fiscal profligacy was caused by President Johnson's spending on the Vietnam War and the War on Poverty, ended by the tax increase of 1968. The period 1974-1986 contains at least three episodes of discretionary active tax policy. The 1975 fiscal expansion caused by President Ford's tax cut following the oil price increase ("We are all Keynesians now"), the military build-up started by Carter and strengthened under the Reagan's presidency, and the 1982 Reagan's tax cut. While most part of the 1990s are perceived as having marked a re-establishment of the principles of fiscal stabilization, the recent tax cuts (2001, 2002, 2003) undertaken by the Bush administration have signalled a clear return of emphasis for a countercyclical (discretionary) role of fiscal policy. The results have been an overturn in the primary surplus and a steady rise of government debt.

The approach followed in this paper differs from most of the existing literature in two main dimensions. First, it allows the fiscal regime to vary over time, and employs Markov-switching regression methods to identify such regime changes *endogenously*. Second, it proposes a specification of the fiscal policy rule aimed at capturing a gradual convergence of the fiscal instrument (primary deficit in our case) to some specified target level, in a spirit similar to the one adopted recently for the estimation and analysis of so-called Taylor rules for monetary policy (Clarida et al. 2000).

Crucial for our purposes is the specification of such target level of the primary deficit. We assume that the target deficit features a response to two main arguments. The first is the output gap, meant to capture a cyclical component of fiscal policy. The second is what we define as *debt-stabilizing deficit*, namely that level of the primary deficit that would be consistent, at each point in time, with constant government debt. Thus, in our context, the elasticity of the primary deficit to the debt-stabilizing deficit marks the distinction between active and passive fiscal rule. The inclusion of the debt-stabilizing deficit in our proposed rule, rather than the debt per se, allows to control for the time-varying effects of interest rate and growth rate of GDP on the debt-service component of the deficit. This appears as an important motive in the light of the observed historical

[5] Woodford (1998) also claims that the regime in effect prior to the 1951 Federal Reserve-Treasury accord should be considered genuinely of the active type (fiscalist or non-ricardian in his interpretation).

switch of the US economy from dynamic efficiency to dynamic inefficiency around 1980.

The results of our analysis can be summarized as follows. First, we show that the fiscal policy regime in the U.S. can be adequately described in terms of a systematic rule. In such a rule both the debt and the output gap stabilization motive enter significantly as explanatory variables.

Second, and more importantly, we find that the conduct of fiscal policy has displayed substantial *regime instability.* We believe that this poses a challenge to both the theoretical monetary policy literature that typically assumes that fiscal policy is passive at all times, and to a recent VAR-based empirical literature measuring the high-frequency effects of fiscal policy shocks within a constant fiscal regime framework.[6]

Third, and more specifically, we are able to empirically identify *two fiscal regimes* in the U.S. between 1960:1 and 2002:4. The first one runs from the beginning of 1960s until the early 1990s and resumes towards the end of our sample from 2001:3 onward. The second regime gradually takes over in the early 1990s and lasts until the beginning of 2001. The first regime is characterized by a takeoff in the government debt to GDP ratio, by a destabilizing (systematic) response of the primary deficit to the debt-stabilizing deficit, and by a relatively small concern for output gap stabilization. Consistent with Leeper's terminology, it is natural to define this as a regime of *active* fiscal policy. In the early 1990s (via a gradual transition that culminates with the beginning of 1995) a break towards a *passive* regime seems to take place in the fiscal policy conduct. The primary deficit starts to move in accordance with a debt stabilization motive (i.e., the deficit reacts significantly to our measure of the debt-stabilizing deficit), while a systematic response to the output gap plays a much larger role relative to the previous regime. As a result of this regime, we observe a steady declining trend in the debt to GDP ratio that runs throughout the 1990s. However, our estimates indicate that a new regime break (characterized by an overturn in the sign of the primary surplus and by a robust rise in government debt) has taken place in 2001:3. Interestingly enough, this seems to accord well with the general perception that the onset of the Bush administration in 2001:1 has brought about a parallel decline in the concern for fiscal stabilization.

Finally, we try to relate regime switches in the monetary policy rule with regime switches in the fiscal policy rule. Our results do not identify any systematic correlation between regime switches of monetary and fiscal policy rules. When we apply our Markov-switching identification methods to a baseline Taylor-type interest rate rule (and in contrast to much of the literature that typically imposes regime breaks exogenously), we find that a regime break in monetary policy (from passive to active) takes place much earlier than our identified fiscal policy regime break (from active to passive). In our view, this result poses interesting questions for the adequate representation of regime-switching policy regimes, including the correct characterization of rational expectations

[6] For instance, see Blanchard and Perotti (2002), Fatas and Mihov(2001), Mountford and Uhlig (2004)

equilibria within recent macroeconomic models considered suitable for policy analysis.[7]

The remainder of the paper is as follows. Section 2 describes our empirical methodology and the features of the data. Section illustrates the main results. Section 4 analyzes the synchronicity in the monetary and fiscal policy switches. Section 5 concludes..

2 Estimation of Fiscal Policy Rules

While fiscal policy is more typically characterized by implementation lags than it is monetary policy, the anticipated (endogenous) component of fiscal policy is of first order importance and, in principle, should be adequately represented by simple feedback rules. However, in practice, and unlike monetary policy rules, fiscal rules are not widely estimated.

There are a number of potential reasons for this lack of evidence. First, less immediate availability of fiscal policy indicators. As discussed in Perotti (2004), reliable quarterly measures of fiscal variables are available only for a very limited number of countries. Second, unsatisfactory empirical results, especially relative to the success of popular Taylor-type monetary rules. Third, parameter instability. In fact, fiscal rules are best understood by relating them to different regimes. The literature on monetary policy rules strongly emphasizes the presence of alternative policy regimes: typically, the pre vs. post Volcker-Greenspan in the U.S. It should be noticed, though, that such regimes for monetary policy are usually exogenously imposed rater than endogenously estimated.

A more general issue concerns identification. This is more problematic for empirical fiscal feedback rules than it is for monetary policy rules. First, an issue relates to the automatic stabilization component in fiscal rules. Identifying the discretionary response of fiscal policy to output is complicated by the presence of automatic stabilizers.[8] Second, fiscal policy surprises are difficult to identify with macroeconomic data. Mountford and Uhlig (2004) illustrate this point by considering the typical example of the (unexpected) success in political elections of a candidate who will implement a different fiscal package from the one currently in place. Hence it is clear that the change in expectations for fiscal policy is generated much earlier than the policy is implemented. While this problem is very relevant when the main focus of the analysis are shocks, it is of second order importance when the researcher is interested in the systematic component of fiscal policy. A third problem relates to the correct identification of passive fiscal regimes, and is discussed towards

[7] See also Lubik and Schorfheide (2004).

[8] Blanchard and Perotti (2002) propose a mixed structural VAR event-study approach in which identification is achieved by using institutional information about the tax and transfer system and the timing of tax collections to identify the automatic response of taxes and spending to activity. Fatas and Mihov (2001) discriminate discretionary fiscal policy from automatic stabilizers by assuming that government spending does not react to macroeconomic conditions within a quarter

the end of the paper.

2.1 Dynamic (In)Efficiency of the U.S. Economy

Before turning to our estimation strategy, we consider the historical evidence on the behavior US government debt, nominal interest rates and nominal GDP growth in the U.S..

Figure 1 plots the U.S. *government debt* as a ratio of GDP. There is a downward trend that spans the period 1960-1980, with only a couple of mild episodes of debt accumulation in 1970-72 and 1975-77. Conversely, after 1980, the debt-to-GDP ratio displays a clear upward trend which starts to revert only after 1995.

Insert Figure 1 here

Figure 2 plots the nominal interest cost of the debt versus the nominal growth rate of GDP.

Insert Figure 2 here

Before 1980, the gap between the two variables is negative while it turns mostly positive throughout then. As a result, the U.S. economy appears *dynamically inefficient* until 1980 and dynamically *efficient* afterwards. Notice that the data reveals sufficient variability in the gap $r_t - g_t$. Hence it seems important to control for this factor in our empirical specification of the fiscal rule.

2.2 Specification and Estimation

In specifying a feedback rule for the fiscal authority we assume that the instrument of policy is the primary deficit. Then we consider a specification capturing a gradual convergence of the actual primary deficit to some specified target value, and capable of accommodating both an *output gap* stabilization motive (which in principle can also capture the mechanics of automatic stabilizers) and a *debt* stabilization motive.

We incorporate a motive for debt stabilization in the following manner. Let us define d_t^* as the *debt-stabilizing* real primary deficit, i.e., the deficit consistent with stabilization of the government debt . Consider the flow government debt equation expressed in nominal terms:

$$B_t = (1 + r_t)B_{t-1} + D_t \tag{1}$$

where is nominal debt , r_t is the average net nominal cost of debt and D_t is the nominal primary deficit. By expressing the above equation in real terms and in terms of ratios to GDP, we obtain

$$b_t = \frac{(1 + r_t)}{(1 + g_t)} b_t + d_t \tag{2}$$

where b_t is the real debt to GDP ratio, g_t is the growth rate of nominal GDP and d_t is the real primary deficit to GDP ratio.[9]

Imposing $b_t = b_{t-1}$ for all t we obtain our measure of the debt-stabilizing deficit:

$$d_t^* \equiv -\frac{(r_t - g_t)}{(1 + g_t)} b_{t-1} \tag{3}$$

Notice that the sign of the relationship between (past) debt and d_t^* depends on the difference between $r_t - g_t$. Figure 3 shows that the the transition in 1980 illustrated above (from dynamic inefficiency to efficiency) marks also a sign-switch in the debt-stabilizing deficit d_t^*. Interestingly, before 1980 and due to nominal GDP growth exceeding the interest cost, persistent *positive* realizations of d_t^* remain consistent with debt stabilization.

Insert Figure 3 here

We estimate the following empirical specification:

$$d_t = \rho(s_t)\ d_{t-1} + (1 - \rho_t(s_t))\ \overline{d}_t\ +\ v_t \tag{4}$$

$$\overline{d}_t \equiv \gamma_0(s_t) +\ \gamma_1(s_t)\ d_t^*\ +\ \gamma_2(s_t)\ x_t \tag{5}$$

where $\overline{d}_t$ is the *target* level of the real primary deficit, x_t is the output gap, v_t is a term that captures discretionary exogenous deviations from the rule (interpretable as a fiscal policy shock), and where s_t indicates that the coefficients (i.e., the features of the underlying fiscal regime) are allowed to evolve stochastically over time.[10]

The above specification differs from some adopted in the available literature in two dimensions. First, it employs a non-constant parameter approach. In fact, it allows for multiple regimes in the conduct of fiscal policy and estimates a Markov-switching model in which the probability of each regime can vary endogenously.

Second, the specification in (4) differs from typical Leeper-type empirical feedback rules which relate deficit and debt linearly. Our specification, in fact, assumes that the debt-stabilization motive

[9] See below for a description of our data.

[10] Notice the analogy with the typical formulation of Taylor-type interest rate rules with smoothing behavior (see, e.g., Clarida et al., 2000). In that case, the monetary policy instrument (the short-term nominal interest rate) is assumed to evolve according to the following rule:

$$i_t = \rho\ i_{t-1} + (1 - \rho)\ \bar{i}_t$$

where $\bar{i}_t = i(\mathbf{X}_t)$ is the equilibrium value of the nominal rate, determined endogenously as a function of a vector of target variables $\mathbf{X_t}$.

requires that the target deficit depends on the debt-stabilizing deficit d_t^*. Hence, and recalling (3), primary deficit and government debt are non-linearly related.

In this context we identify as *passive* a fiscal rule where d_t^* enters significantly in (4) with a coefficient $\gamma_3\left(s_t^f\right)$ not statistically different from one and a coefficient $\gamma_0\left(s_t^f\right)$ not statistically different from zero. Importantly, our specification will detect some parameter instability when the relation between d_t and d_t^* changes regardless of a switch from dynamic efficiency to dynamic inefficiency of the economy.

In order to control for the cyclical component of fiscal policy, we include the output gap among the determinants of the equilibrium level of the fiscal deficit. Notice that our measure of the fiscal instrument is the *actual* deficit. Some authors (see e.g., Gali and Perotti (2003) for a study on European countries) use instead a *cyclically adjusted* measure of the deficit (or surplus). This distinction is particularly important when trying to disentangle the truly discretionary part of fiscal policy thereby controlling for the component whose variations are due to causes outside the direct control of the fiscal authorities.[11] The implicit assumption in our analysis is that the output gap is the indicator that captures the cyclical component of fiscal policy and therefore may very well contain the feedback resulting from the operation of automatic stabilizers.[12]

It should be noticed that fiscal policy rules as in (4) may suffer from two sources of simultaneity. First, there is a potential joint dependence between primary deficit and debt. This works via the interaction of the fiscal rule with a the debt flow equation (2) (see also below for more on this point). Second, there is a potential simultaneity between output gap and deficit. This follows from the fact that the fiscal policy shock v_t is likely to be correlated with the output gap.[13]

We address these problems as follows. First, the inclusion of the debt-stabilizing deficit d_t^* allows implicitly to instrument current debt with lagged debt (see equation (3)). Second, we notice that a potential debt-deficit simultaneity bias is likely to affect both regimes (active and passive), therefore not affecting the difference in the estimated coefficients. Third, in order to disentangle the effect of output fluctuations on the fiscal rule from the effect of the fiscal shock on output, we instrument the output gap x_t via its own lagged values.

[11] For instance variations in the tax base due to cyclical conditions and/or in the unemployment rate triggering swings in the size of the unemployment benefits.

[12] See also Fatas and Mihov (2003) for a similar approach.

[13] In principle the sign of this correlation is ambiguos. In fact, an exogenous rise, e.g., in government spending affects both *actual* output (possibly via wealth effects on employment) and the *natural* level of output. The sign of the impact would typically depend on the elasticity of labor supply, and on the degree of persistence of the shock (see Baxter and King, 1993).

2.2.1 Data

Our estimates rely on a sample of quarterly observation from 1961:1-2002:4. All our data are retrieved from the NIPA Table and from the FRED II database.[14] The cost of financing the debt, r_t, is obtained as the ratio of the the federal government interest payment (NIPA Table 3.2) to the federal government debt (NIPA Table 3.2). The primary deficit is obtained by subtracting the Federal Government Current Expenditure (FGEXPND in FRED), net of interest payments, from the Federal Government Current Receipts (FGRECPT in Fred). The primary deficit to GDP ratio, d_t, is constructed by dividing the primary deficit by the GDP. The debt to GDP ratio, b_t, is constructed by dividing the Federal Debt by the GDP. The output gap x_t is constructed as the percentage difference between the Gross Real Domestic Product and the Potential Real Gross Domestic Product as estimated by the Congress and made available in FRED. The debt stabilizing primary deficit, d_t^* is then constructed as in (3). Finally, we measure inflation as the annualized quarterly rate of change in the Consumer price index (CPIAUCNS in FRED) and the short-term monetary policy instrument as the Effective Federal Funds Rate (FEDFUNDS in FRED).

3 Results

We begin by considering a Markov-switching (MS henceforth) specification for the fiscal rule as described in (4), allowing for an arbitrary number of regimes.[15] We find that the best statistical characterization is in terms of *two regimes.*[16] The results of our estimation are reported in Table 1.

Insert Table 1 here

We find that the critical factor that distinguishes the two regimes is the sign-switch in the coefficient $\gamma_1(s_t)$. Under one regime $\gamma_1(s_t)$ is negative (and hardly significant), while under the alternative regime $\gamma_1(s_t)$ is significantly positive and close to one. Following the notation proposed in Leeper (1991) we label the two regimes as *FA (fiscal active)* and *FP (fiscal passive)* respectively.

It is of particular interest to analyze the different time patterns of the two regimes. We find that the two regimes span the following time periods respectively:

$$FA \equiv \text{[1961:1-1974:3], [1975:3-1995:1] ,[2001:3 - 2002:4]} \quad (Active)$$
$$FP \equiv \text{[1974:4 - 1975:2], [1995:2 - 2001:2]} \quad (Passive)$$

[14] http://research.stlouisfed.org/fred2.

[15] We implement our estimation by using MSVAR for Ox (see Krolzig, 1998).

[16] In our preliminary results a formulation in terms of three regimes was accounting only for a very limited number of observations.

Figure 4, in turn, plots the time-varying estimated probabilities associated to each regime over the sample period.

Insert Figure 4 here

Thus it is clear that 1995:2 marks a clear break in the conduct of fiscal policy. After a prolonged phase characterized by a neglect of a debt stabilization motive (with the exception of the short window 1974:4 - 1975:2), fiscal policy starts to gradually incorporate such a motive into its reaction function in the early 1990s. As suggested by the dynamic behavior of the smoothed probabilities, it is interesting to notice that while 1995:2 marks the strict "statistical date" of the regime-switch, such a transition is phased-in gradually beginning with late 1992. However, such a concern for government debt stabilization seems to come to an end with late 2001. By 2001:3, in fact, our estimates detect a new change of regime, from passive to active. Needless to say, this is broadly consistent with the view that the fiscal policy conduct under the G.W. Bush administration can be hardly characterized as one of fiscal discipline. In practice, that administration has approved three consecutive tax cuts in 2001, 2002 and 2003, with a resulting turn in the downward trend in government debt and a large increase in the primary deficit (see Figure 3 and Figure 4, top panel). Interestingly, also the response of fiscal authorities to the output gap changes across regimes, being very aggressive in the FP regimes and not statistically different from zero in the FA regime.

Figure 5 reports the estimated long-run elasticity of the primary deficit to (past) debt from the MS rule (4).

Insert Figure 5 here

Such elasticity is the value of the parameter:

$$\phi(s_t) \equiv -\gamma_1(s_t)\frac{(r_t - g_t)}{(1 + g_t)}$$

The figure is suggestive for two reasons. First, it describes the time-varying feature of such elasticity. Second, it illustrates the importance of controlling for the time-series behavior of r_t and g_t (and therefore of the term $\frac{(r_t-g_t)}{(1+g_t)}$) in assessing the debt stabilization motive in our estimated fiscal rule. Notice, in fact, that estimated switches in the elasticity $\phi(s_t)$ do not coincide with estimated switches in $\gamma_1(s_t)$ (as from Table 1). As an illustration, consider the sign switch in $\phi(s_t)$ from negative to positive around 1980. If we were basing our interpretation of fiscal regimes on the elasticity $\phi(s_t)$ (rather than on $\gamma_1(s_t)$) we would conclude that the fiscal rule was passive until around 1980, switching to active about that date. However, this result would entirely be driven by the historical behavior of interest rates and GDP growth during that period. In other words, the dynamic inefficiency feature of the US economy before 1980 ($r_t < g_t$) would lead us to conclude that the debt-stabilization motive of fiscal policy was statistically significant when, in reality, it was not. In fact, and more generally, our estimates of $\gamma_1(s_t)$ lead us to detect active fiscal policy rules much more frequently than it would be the case if we were assuming a standard specification in (3) with government debt b_{t-1}, rather than d_t^*, on the right-hand side.

3.1 Constant-Regime Estimates

It is important to compare the above results with those obtained by estimating our fiscal rule under the constraint of a *constant fiscal regime* ($s_t = s$ for all t). We report such results in the right-hand side panel of Table 3. This approach would correspond to the one followed in Bohn (1998), although with a variant represented by the inclusion of the output gap as an argument in the estimated rule. Thus we see that in the constant-regime case γ_1 features a point estimate consistent with a *passive* regime throughout. However, this coefficient is not statistically different from zero. Notice also that, as suggested by the standard error of the residuals and compared to the MS specification, the rule restricted to a unique a regime would represent a worse fit of the data.

The evidence in the constant-regime case, taken as a face value, seems to confirm the result in Bohn (1998) that fiscal policy may generally have been passive in the U.S. postwar history. However, the results based on the MS specification dramatically overturn this conclusion. If anything, a strict characterization of fiscal policy as passive starts to emerge only in the early 1990s. Before that, and conditional on our specification of fiscal policy in terms of a rule like (4) being correct, a representation of fiscal policy as passive at all times seems to be strongly at odds with the data and, historically, more the exception than the rule.

3.2 MS-Consistent Deficit

How important is allowing for switching regimes to capture the evolution of fiscal policy behavior over time? To address this point let us define $\overline{d}_t^{MS}$ as the long-run primary deficit consistent with our MS model. This is computed by taking into account the time-varying estimated probabilities of each regime as follows:

$$\overline{d}_t^{MS} = [\Pr(s_t = FP)] * \overline{d}_t^{FP} + [1 - \Pr(s_t = FA)] * \overline{d}_t^{FA} \tag{6}$$

$$\overline{d}_t^{FA} = -0.49\ d_t^* - 0.18\ x_t \tag{7}$$

$$\overline{d}_t^{FP} = 1.4\ d_t^* - 1.2\ x_t \tag{8}$$

where $\overline{d}_t^{FP}$ is the long-run deficit conditional on the fiscal policy rule being passive and $\overline{d}_t^{FA}$ is the long-run deficit conditional on the fiscal policy rule being active. In Figure 6, and in order to provide a visual impression of the empirical performance of our regime-switching estimation, we report the relation between $\overline{d}_t^{MS}$, the actual deficit d_t and the deficit consistent with a constant-parameter estimation of the fiscal rule $\overline{d}_t^c$.

Insert Figure 6 here

Thus we see that allowing for a regime-switching fiscal rule does indeed capture well the deficit dynamics over the time period considered in our exercise. To gauge whether a MS estimation statistically improves upon a constant-parameter estimation we compute the following fiscal instrument "gaps":

$$\widetilde{d}_t^c \equiv d_t - \overline{d}_t^c$$

$$\widetilde{d}_t^{MS} \equiv d_t - \overline{d}_t^{MS}$$

where $\widetilde{d}_t^c$ and $\widetilde{d}_t^{MS}$ measure the deviation of the actual primary deficit from the estimated equilibrium value under the constant-parameter specification and Markov-switching specification respectively. A relevant statistics compares the persistence in $\widetilde{d}_t^c$ with the persistence in $\widetilde{d}_t^{MS}$. Therefore we run a regression of each gap variable on its own lagged values obtaining:

$$\widetilde{d}_t^c = 0.83_{(0.04)}\ \widetilde{d}_{t-1}^c + \varepsilon_{d,t}^c \tag{9}$$

$$\widetilde{d}_t^{MS} = 0.68_{(0.06)}\ \widetilde{d}_{t-1}^{MS} + \varepsilon_{d,t}^{MS} \tag{10}$$

Hence we see that the deviations of the actual deficit from its equilibrium value are more persistent in the case of a constant-parameter estimation of the fiscal rule than in the case of a MS estimation.

4 Do Monetary and Fiscal Policy Rules Switch Synchronously?

The theoretical presumption in recent general equilibrium models considered suitable for policy analysis is that the monetary-fiscal policy mix is crucial for the determination of the underlying rational expectations equilibrium.[17] A simple corollary of this view, in our setting where policy

[17] See, for instance, Leeper (1991), Woodford (1996), Benhabib et al. (2001).

regimes can vary stochastically, is that monetary and fiscal regimes should be expected to switch synchronously.

It is shared opinion among macroeconomists that the main change in the U.S. monetary policy regime should be attributed to the transition from the pre-Volcker-Greenspan era to the Volcker-Greenspan era in late 1979.[18] The view holds that this transition has marked the onset of the so-called Taylor principle for monetary policy, which requires that the monetary authority adjusts the nominal interest rate actively (i.e., more than one-for-one) to changes in inflation. This broad literature, coupled with our results on regime switches in fiscal policy rules, is already suggestive of one piece of evidence. Namely, that endogenously estimated fiscal policy regime switches do not match the traditionally estimated monetary policy regime switches.

However, it is recurrent practice in the empirical work on monetary policy Taylor-type rules to impose the timing of the regime switch exogenously. Here, and in order to contrast the behavior of monetary and fiscal policy regimes in a consistent manner, we adopt a more general approach and estimate a two-regime Markov-switching monetary policy rule as follows:

$$i_t = \beta_1(s_t)\ i_{t-1} + (1 - \beta_1(s_t))\ \overline{i}_t + u_t \tag{11}$$

$$\overline{i}_t = \beta_0(s_t) + \beta_2(s_t)\ \ (E_t\{\pi_{t+4}\} - 2) + \beta_3(s_t)\ x_t \tag{12}$$

where i_t is the effective Federal Funds rate, and where one-year ahead expected inflation is instrumented by lags of the following variables: inflation, Federal Funds rate, the output gap and the IMF world non-oil commodity price index ($lpcm_t$). We estimate the rule by GMM correcting the standard errors for MA errors over two different samples 1961:3-1979:2 and 1982:2 - 2002:4. We choose to omit the period 1979-1982 from our estimation. In fact it is commonly perceived that an interest rate rule can barely describe the behavior of the Federal Reserve during that period, when probably some form of reserve targeting was implemented in practice (see, for instance, Bernanke and Mihov (1997)).[19]

The results of our MS estimation of the monetary policy rule are reported in Table 2. Figure 7 reports estimated probabilities associated to each regime.

Insert Table 2 here

Insert Figure 7 here

[18] Taylor (1993), Clarida et al. (2000), Woodford (2003).

[19] We also tried to implement a MS estimation on the whole sample allowing for three regimes, hoping that one regime would capture the 1979-1982 period and the other two regimes would signal (in)consistency with the Taylor principle. We decided against reporting these results since the estimates of parameters and regimes were highly unstable and too sensitive to initial values.

It is interesting to notice that already during the pre-Volcker era (sample 1961:3-1979:2) there is evidence of *two* monetary regimes, which differ in terms of their respective degree of stabilization of the output-gap and (expected) inflation. However, and in accordance with the results in Clarida et al. (2000), in neither regime the Taylor principle is satisfied (i.e., $\beta_2(s_t) < 1$ for all t). The same difference of regimes emerges in the Volcker-Greenspan era (sample 1982:2 - 2002:4), but in this case the Taylor principle is always satisfied (i.e., $\beta_2(s_t) > 1$ for all t), although only barely in the first regime.[20] Notice also that, in both subsamples, an important difference across regimes lies in the estimated output gap coefficient. In the pre-Volcker era, the estimated $\beta_3(s_t)$ turns from negative to positive (although statistically insignificant). In the Volcker-Greenspan era, $\beta_3(s_t)$ turns from positive to negative.

The main point we would like to emphasize here is not only that there is evidence of regime instability in the estimated monetary policy regimes, but that this instability seems to go beyond the one usually identified by the literature in the 1979 regime break.

4.1 Policy-Induced Equilibria

Our results based on endogenous-switching (monetary and fiscal) policy rules are strongly at odds with the presumption that monetary and fiscal policy regimes should switch synchronously. Hence a number of interesting implications emerge. To begin with, the evidence that fiscal policy has been active throughout the pre-1979 era matches well with the presumption (also confirmed by our estimates) that monetary policy was passive during that period. Based on the theoretical results of Leeper (1991) and Woodford (1996) this rule-based policy mix would be consistent with the existence of a unique rational expectations equilibrium (and therefore a price level pinned down uniquely). On the other hand, the result that fiscal policy continued to be active during the 1980s, in conjunction with an allegedly active (Taylor-rule based) monetary policy, is challenging, for in principle points to an active-active policy regime incapable per se to pin down an equilibrium. However, one should recall that our estimation method aims at identifying policy regimes in a *probabilistic* sense. In other words, an interpretation of these results requires a theory of how rational expectations equilibria are determined in the presence of stochastically time-varying policy regimes. Davig (2004) and Davig, Leeper and Chung (2004) have made important steps in the direction of developing macroeconomic frameworks in which the possibility of switching (in the future) to different fiscal and/or monetary policy regimes affect the formation of agents' expectations.

[20] In fact, one should notice that, in the whole subsample 1982-2002, a typical estimated coefficient $\beta_2 > 1$ is the average result of two regimes with a sizeable diiference. In the first regime, β_2 is barely above one, while in the second β_2 is above two.

4.2 Identification of Passive Regimes

As emphasized by Cochrane (1998), assessing the debt stabilization motive in fiscal feedback rules by simply running a regression of the deficit (surplus) on real debt suffers of a typical regime identification problem. This may lead to detecting a negative relationship between deficit and real debt in the data (i.e., an apparently passive regime) even in the presence of purely active (e.g., strictly exogenous) rules for the primary deficit. For an illustration, consider a simple two-period model. The debt-flow equation reads:

$$b_1 = \left(\frac{1+r_0}{1+g_0}\right) b_0 + d_0 \tag{13}$$

with b_0 given and where all variables are expressed in real terms. Integrating forward and imposing the terminal condition $b_2 = 0$ we have:

$$b_0 = -\left(\frac{1+g_0}{1+r_0}\right) d_0 - \frac{(1+g_1)(1+g_0)}{(1+r_1)(1+r_0)} E_0 \{d_1\} \tag{14}$$

where $E_0\{\bullet\}$ denotes conditional expectations. Suppose the real deficit behaves according to an extreme form of active rule, namely it evolves as an exogenous AR1 process:

$$d_1 = \rho d_0 + \varepsilon_1 \tag{15}$$

where $\rho < 1$ and ε_1 is an iid shock. Substituting (15) into (14) it yields:

$$b_0 = -\Gamma d_0 \tag{16}$$

with $\Gamma \equiv \left(\frac{1+g_0}{1+r_0}\right)\left(1+\rho\left(\frac{1+g_1}{1+g_0}\right)\right)$. Notice that, under empirically plausible parameterizations, Γ is generally positive. However, nothing prevents from rewriting (16) as:

$$d_0 = -\Phi b_0 \tag{17}$$

where $\Phi \equiv \Gamma^{-1}$, and conclude that (17) is a purely passive rule for the primary deficit. Hence, in general, a passive rule is not uniquely identified in the data, for it is observationally equivalent to an exogenous process for the deficit. This implies that a certain caution must be exercised in interpreting our evidence on passive fiscal regimes. In fact, even within those time windows that we interpret as passive fiscal regimes, it is impossible to rule out an off-equilibrium behavior that makes debt stabilization consistent with a fiscal theory of the price level.[21]

[21] See Cochrane (1998) and Woodford (2001) on this point.

This general problem notwithstanding, the bulk of our result remains. Namely, that "apparently passive" fiscal regimes are by no means the rule in our estimates, and that fiscal regimes exhibit a sizeable degree of instability.

4.3 Relative Performance of Policy Instruments

Empirical Taylor-type interest rate rules owe their popularity to their proved ability in tracking well the historical behavior of nominal interest rates in the U.S. (although especially during the 1990s). It is then natural to ask whether our estimated fiscal policy rule can perform at least as well. To this end, we report, in Figure 8 , the time-series behavior of the monetary instrument i_t, along with its long-run equilibrium value $\bar{i}_t^{MS}$ implied by the estimated Markov-switching monetary policy rule.

Insert Figure 8

Similarly to above, and in order to assess the performance of the monetary instrument relative to the fiscal instrument, we compute the monetary gap variable:

$$\widetilde{i}_t^{MS} \equiv i_t - \bar{i}_t^{MS}$$

where $\widetilde{i}_t^{MS}$ measures the deviation of the actual monetary policy rate from its estimated equilibrium value. We then run a regression of the gap variable on its own lagged value in the two sub-samples 1961:3-1979:2 and 1982:1-2002:4 obtaining:

$$\widetilde{i}_t^{MS} = 0.85_{(0.03)} \widetilde{i}_{t-1}^{MS} + \varepsilon_{i,t}^{MS} \quad (18)$$

[sample 1961:3-1979:2]

$$\widetilde{i}_t^{MS} = 0.88_{(0.05)} \widetilde{i}_{t-1}^{MS} + \varepsilon_{i,t}^{MS} \quad (19)$$

[sample 1982:1-2002:4]

The results in (18) and (19) should be compared with the analog obtained for the fiscal instrument gap $\widetilde{d}_t^{MS}$ in (10). Hence we see that, regardless of the sub-sample considered in the estimation of the Taylor rule, deviations of the monetary policy rate from the equilibrium value (predicted by the forward-looking Taylor rule (4)) are more persistent than the same deviations of the primary deficit from the equilibrium level (predicted by the fiscal rule (4)). In light of the widespread popularity of Taylor-type rules in the empirical literature of monetary policy, we take this evidence as encouraging for the relative performance of the Markov-switching representation of the fiscal policy regime employed here.

5 Conclusions

It is conventional wisdom among macroeconomists that the features of policy regimes fluctuate over time. While this view has been widely embraced in the analysis of monetary policy rules, it has received scant attention in the case of fiscal policy. In this paper we provide an empirical framework that explicitly embeds the idea that fiscal policy regimes may vary stochastically.

We can summarize the main conclusions of our analysis as follows. First, fiscal policy may be characterized as active from the 1960s throughout the 1980s, switching gradually to passive in the early 1990s and switching back to active in early 2001. Second, regime-switching fiscal policy rules are capable of tracking the time-series behavior of the U.S. primary deficit better than rules based on a constant-parameter specification. Third, regime switches in monetary and fiscal policy do not exhibit any degree of synchronization.

Our results are at odds with the view that the post-war U.S. fiscal policy regimes may be classified as passive at all times. Rather, stochastic variations in fiscal regimes seem a prominent feature of U.S. data. This evidence has interesting implications for the correct specification of the monetary-fiscal policy mix within macroeconomic models considered suitable for policy analysis. For instance, in the workhorse New-Keynesian stream of the monetary policy literature, the typical approach has been to assume that an active monetary policy rule (governed by the so-called Taylor principle) is matched by an invariably passive fiscal policy rule (typically in the form of a balanced-budget rule). Our results grant instead support to recent contributions aimed at specifying macroeconomic optimizing models in which the instability in the fiscal regime is explicitly taken into account, as in Schmitt-Grohe and Uribe (2003), Davig (2004), Davig, Leeper and Chung (2004) and Sala (2003).

Furthermore, our evidence may also be interpreted as posing a challenge for a recent VAR literature trying to assess the effects of appropriately identified fiscal shocks on a series of macroeconomic variables at the business cycle frequency.[22] Typically, in this stream of the literature, the issue of regime instability in fiscal policy has been overlooked. In a related fashion, our results may also question the derivation of fiscal shocks from constant parameter VARs which omit the inclusion of a debt stabilization motive in the systematic component of fiscal policy.

[22] See references cited in the introduction.

References

[1] Ballabriga, F. and C. Martinez-Mongay [2003], "Has EMU Shifted Monetary and Fiscal policies?", in Buti (ed.) Monetary and Fiscal Policies in EMU, Cambridge University Press.

[2] Bernanke, B. S. and I. Mihov [1998]. 'Measuring monetary policy'. *Quarterly Journal of Economics,* 113, 3: 869-902.

[3] Benhabib J., S. Schmitt-Grohe and M. Uribe [2001]. "Monetary Policy and Multiple Equilibria", *American Economic Review*, 91, March 2001, 167-186.

[4] Blanchard O. and R. Perotti (2002), "An Empirical Investigation of the Dynamic Effects of Shocks to Government Spending and Taxes on Output, *Quarterly Journal of Economics.*

[5] Bohn H. [1998] "The Behaviour of U.S. Public Debt and Deficits", *Quarterly Journal of Economics,* 113, 949-963.

[6] Canzoneri M.and B.Diba[1999]. "The Stability and Growth Pact: A Delicate Balance or an Albatross?" *Empirica*, 26, 241-258.

[7] Canzoneri M, R.E. Cumby and B. Diba [2002]. "Should the European Central Bank and the Federal Reserve Be Concerned about Fiscal Policy?", paper presented at the Federal Reserve Bank of Kansas City symposium on "Rethinking Stabilization Policy", Jackson Hole, August 2002.

[8] Clarida, R., J. Galí, and M. Gertler (1999): "The Science of Monetary Policy: A New Keynesian Perspective," *Journal of Economic Literature*, vol. 37, 1661-1707.

[9] Clarida R., J.Gali and M.Gertler [2000] "Monetary Policy Rules and Macroeconomic Stability: Evidence and Some Theory" *Quarterly Journal of Economics,115[1], 147-180*

[10] Cochrane, John H. [1998] "A Cashless View of U.S.Inflation," In Ben S. Bernanke and Julio Rotemberg, eds., *NBER Macroeconomics Annual* Cambridge, Mass., MIT Press, pp. 323–84.

[11] Davig, T. [2004] "Regime-switching Debt and Taxation", *Journal of Monetary Economics* 51, 837-859.

[12] Davig T., E. Leeper and H. Chung [2004] "Monetary and Fiscal Policy Switching", unpublished, The College of William and Mary.

[13] Cogley T. and T.J. Sargent[2001] "Evolving Post-World War II U.S. Inflation Dynamic" paper presented at the 2001 NBER Macro Annual Conference and available from the website www.stanford.edu/~sargent.

[14] Fatas A. and I. Mihov [2001], "The Effects of Fiscal Policy on Consumption and Employment", mimeo Insead.

[15] Gali J. and R. Perotti [2003]. "Fiscal Policy and Macroeconomic Integration in Europe", *Economic Policy,* October.

[16] Krolzig H-M.[1998] "Econometric Modelling of Markov-Switching Vector Autoregressions using MSVAR for OX" paper available at http://www.economics.ox.ac.uk/research/hendry/krolzig/hmktoolbar.html.

[17] Leeper, E. M. [1991], "Equilibria Under 'Active' and 'Passive' Monetary and Fiscal Policies," *Journal of Monetary Economics* 27, February, 129-47.

[18] Lubik T. and F. Schorfheide [2004], "Testing for Indeterminacy: An Application to U.S. Monetary Policy", *American Economic Review*, 94(1), 190-217.

[19] Mountford A. and H. Uhlig [2004], "What are the effects of fiscal policy shocks?", Mimeo University of London and Humboldt University of Berlin.

[20] Sala L.[2003] "Testing the Fiscal Theory of the Price Level", unpublished manuscript, Igier Bocconi.

[21] Schmitt-Grohe S. and M. Uribe, (2003), "Optimal, Simple, and Implementable Monetary and Fiscal Rules", mimeo Duke University.

[22] Taylor J..B [1996] "Monetary Policy Implications of Greater Fiscal Discipline" in *Budget Deficits and Debt: Issues and Options*, Federal Reserve Bank of Kansas City.

[23] Taylor J.B.[2000a] "The Policy Rule Mix: A Macroeconomic Policy Evaluation" in *Robert A. Mundell Festschrift,* G.Calvo, M.Obstfeld and R.Dornbusch (Eds.) Cambridge: MIT Press

[24] Taylor J.B.[2000b] "Reassessing Discretionary Fiscal Policy" mimeo, available at http://www.stanford.edu/~johntayl/.

[25] Woodford M. [1996] "Control of the Public Debt: A Requirement for Price Stability?", NBER w.p 5684.

[26] Woodford M. [1998] “A Cashless View of U.S.Inflation. A Comment”. In Ben S. Bernanke and Julio Rotemberg, eds., *NBER Macroeconomics Annual* Cambridge, Mass., MIT Press, pp. 323–84.

[27] Woodford M. [2001] ”Fiscal Requirements for Price Stability”, *Journal of Money, Credit and Banking* 33: 669-728 (2001).

[28] Woodford, M. (2003), *Interest and Prices: Foundations of a Theory of Monetary Policy*, Princeton University Press.

Table 1: **Markov-Switching Fiscal Policy Rule**

$$d_t = \rho(s_t)\, d_{t-1} + (1-\rho(s_t))\,(\gamma_0(s_t) + \gamma_1(s_t)\; d_t^* + \gamma_2(s_t)\;\; x_t) + v_t$$
$$d_t^* \equiv -\frac{(r_t - g_t)}{(1+g_t)} b_{t-1}$$

	Regime FA			*Regime FP*			*Constant Regime*		
	Coeff	**S. E.**	**t-ratio**	**Coeff**	**S. E.**	**t-ratio**	**Coeff**	**S. E.**	**t-ratio**
ρ	**0.724**	0.0403	19.14	**0.577**	0.0341	16.74	**0.874**	0.032	26.78
γ_0	**-0.005**	0.0017	-0.037	**-0.0037**	0.1242	-0.025	**-0.003**	0.004	-0.63
γ_1	**-0.496**	0.2012	-1.93	**1.416**	0.1311	10.19	**0.703**	0.463	1.52
γ_2	**-0.186**	0.0629	-1.23	**-1.20**	0.0717	-11.90	**-0.558**	0.156	-3.56

$S.E.resid. = 0.005089$	$S.E.resid. = 0.002191$	$S.E.resid. = 0.0059$
Regime Classification (Probability)		
Active Rule (FA)	*Passive Rule (FP)*	
1961:1 - 1974:3	1974:4 - 1975:2	
1975:3 - 1995:1	1995:2 - 2001:2	
2001:3 - 2002:4		

Table 2: **Markov-switching Forward-Looking Taylor Rule**						
$i_t = \beta_1(s_t)i_{t-1} + (1-\beta_1(s_t))\left(\beta_0(s_t) + \beta_2(s_t)\left(E_t\left\{\pi_{t+4}\right\} - 2\right) + \beta_3(s_t)x_t\right) + u_t$						
GMM estimation with correction for MA(4) in the residuals						
Instruments: constant, $i_{t-1}, i_{t-2}, i_{t-3}, i_{t-4}, \pi_{t-1}, \pi_{t-2}, \pi_{t-3}, \pi_{t-4}$						
$x_{t-1}, x_{t-2}, x_{t-3}, x_{t-4}, lpcm_{t-1}, lpcm_{t-2}, lpcm_{t-3}, lpcm_{t-4}$						
Sample 1961:3-1979:2						
	Regime 1			*Regime 2*		
	Coeff.	**S. E.**	**t-ratio**	**Coeff.**	**S. E.**	**t-ratio**
β_1	0.7088	0.117	32.971	0.7981	0.081	9.862
β_0	3.047	0.192	4.489	5.137	4.324	1.187
β_2	-0.799	0.496	4.137	0.282	0.223	1.265
β_3	0.589	0.163	4.135	1.056	0.502	2.103
$\sigma(u) = 0.21631$				$\sigma(u) = 0.87084$		
Regime Classification						
1961:3-1968:3				1968:4 - 1979:2		
Sample 1982:1-2002:4						
Regime 1				*Regime 2*		
	Coeff.	**S. E.**	**t-ratio**	**Coeff.**	**S. E.**	**t-ratio**
β_1	0.880	0.031	28.031	0.7574	0.063	12.092
β_0	3.182	0.786	4.059	-0.069	0.632	-0.108
β_2	1.00	0.266	3.732	2.017	0.444	4.540
β_3	1.412	0.373	3.785	-0.976	0.181	-5.388
$\sigma(u) = 0.33929$				$\sigma(u) = 0.45227$		
Regime Classification						
1985:2 - 2000:4				1982:4 - 1985:1		
2002:2 - 2002:4				2001:1 - 2002:1		

Figure 1. U.S. Government Debt to GDP Ratio

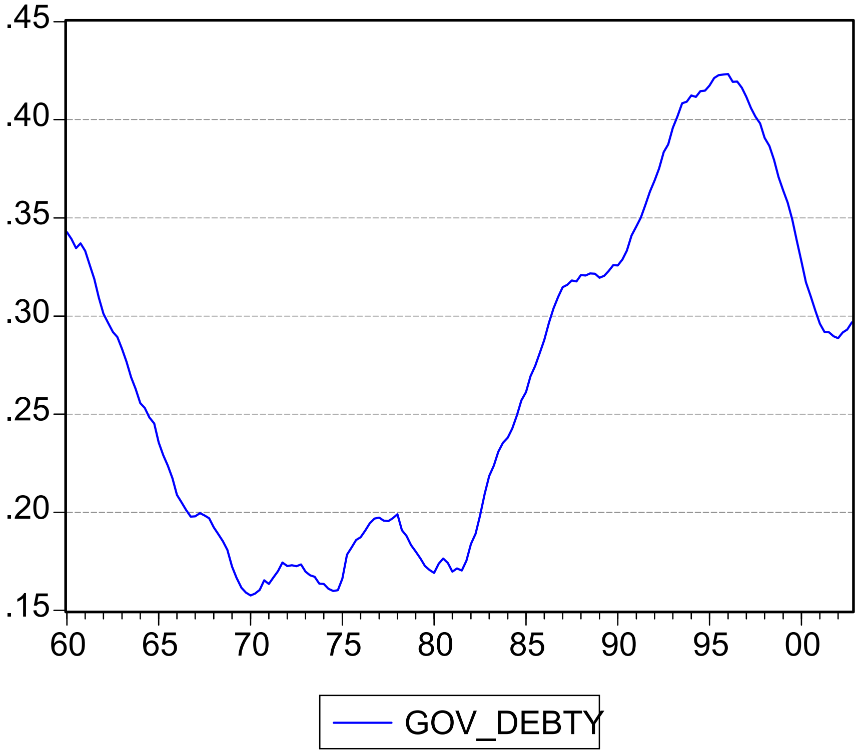


Figure 2. Interest Cost of US Debt and Nominal GDP Growth

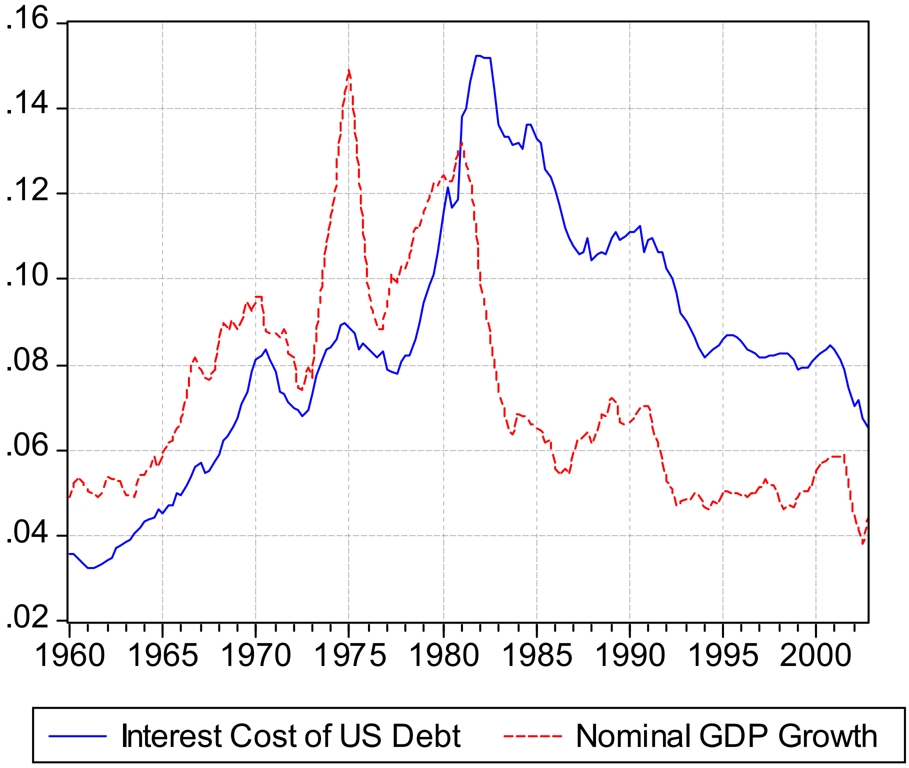
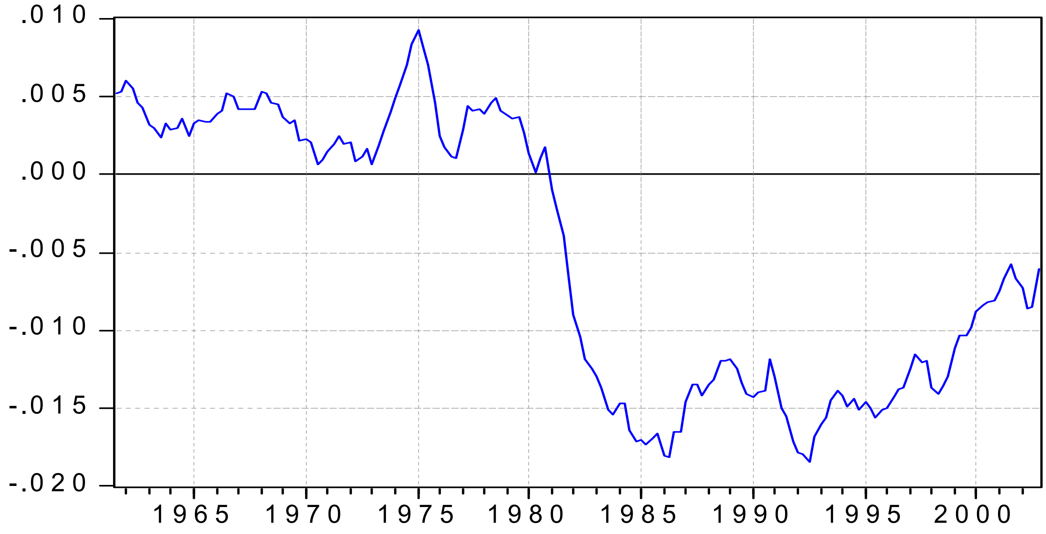
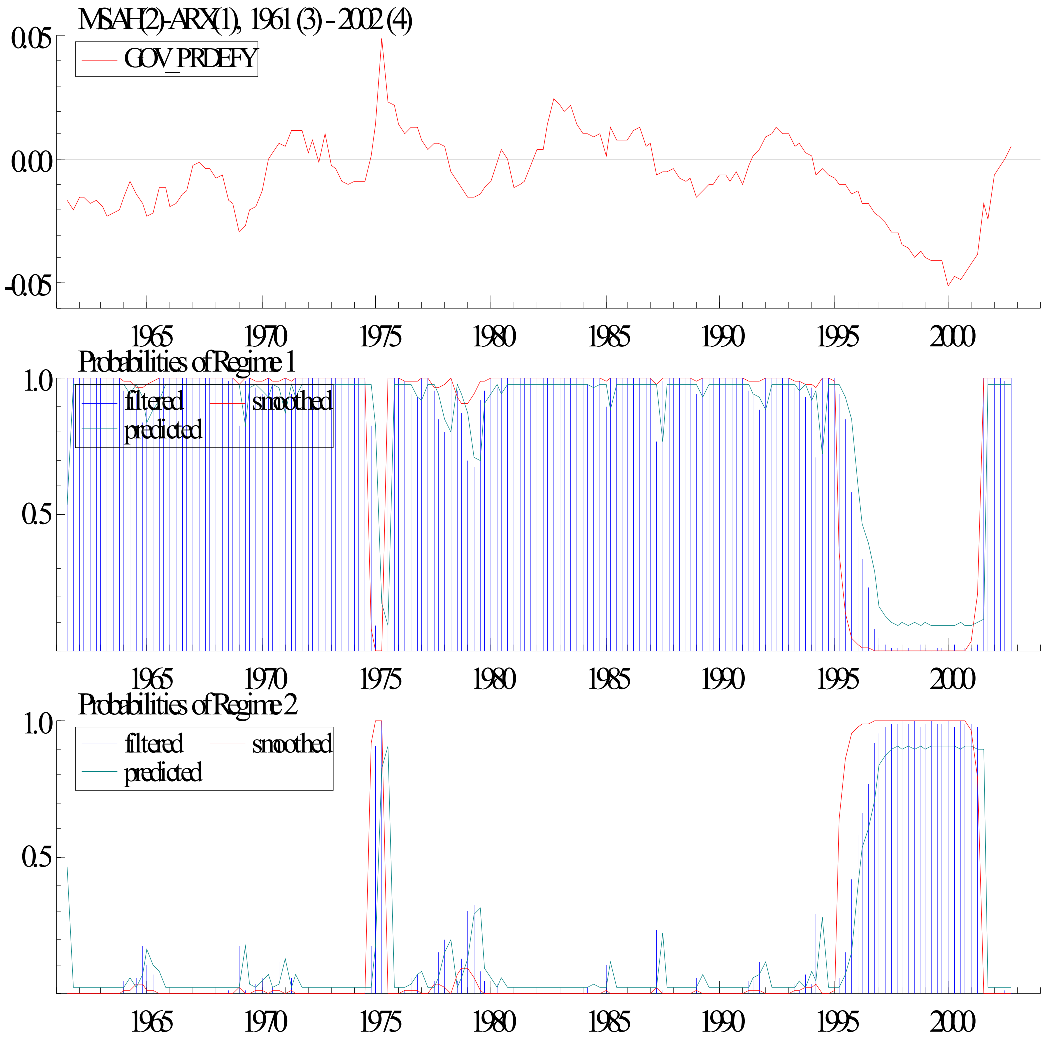


Figure 3. The Debt-Stabilizing Primary Deficit in the US



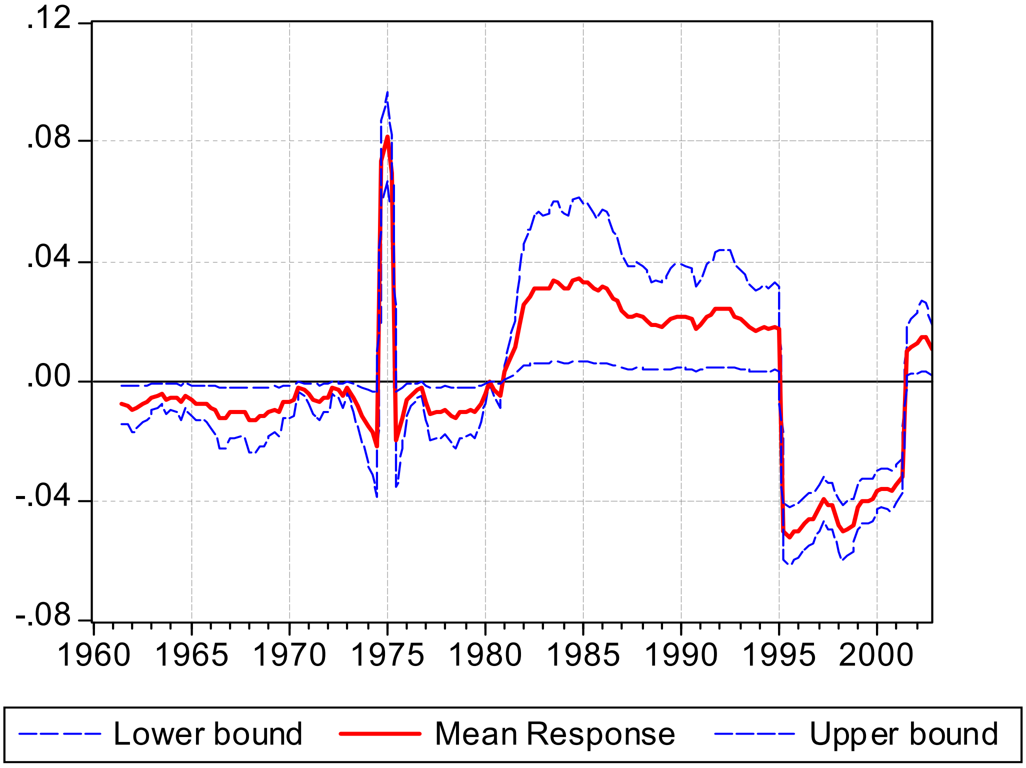
Note: The debt-stabilizing primary deficit is the level of the consistent with debt stabilization as from equation (3).

Figure 4: Probability of Regime 1 (*Passive*) and Regime 2 (*Active*) in a Two-Regime MS Estimation of the Fiscal Policy Rule



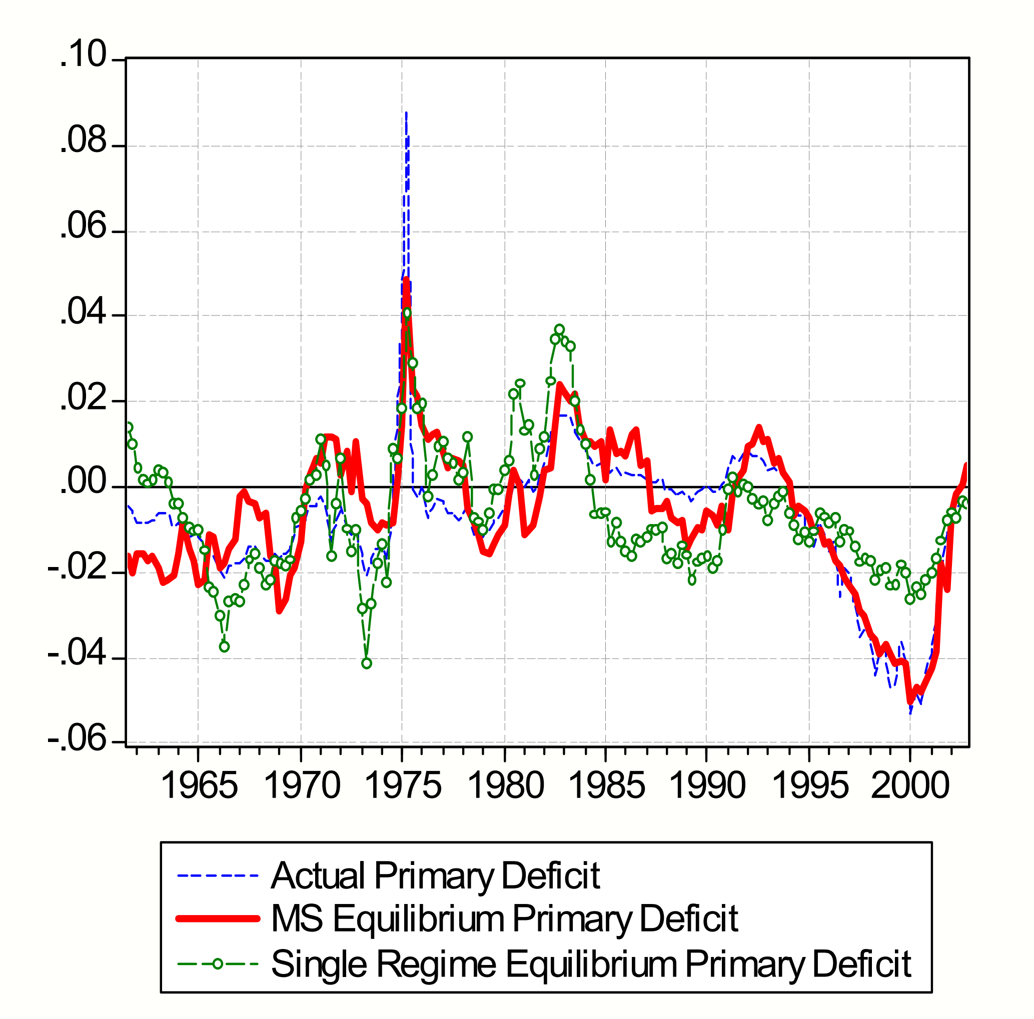
Note. Top panel: primary deficit to GDP ratio. Medium panel: estimated probability of Active regime. Bottom panel: estimated probability of Passive regime.

Figure 5: Estimated MS Fiscal Policy Rule: Long-Run Elasticity of Primary Deficit to Past Level of Debt



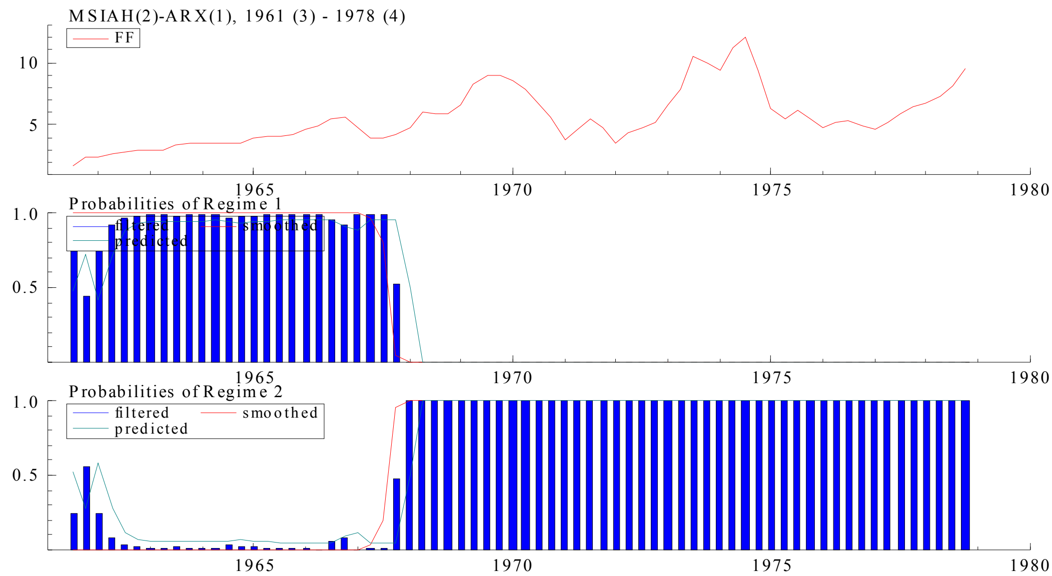
Note: the long-run elasticity of the deficit to debt is $\phi(s_t) \equiv -\gamma_1(s_t)\frac{(r_t - g_t)}{(1+g_t)}$

Figure 6: Observed Primary Deficit vs. MS Long-Run Primary Deficit vs. Single-Regime Long-Run Primary Deficit.

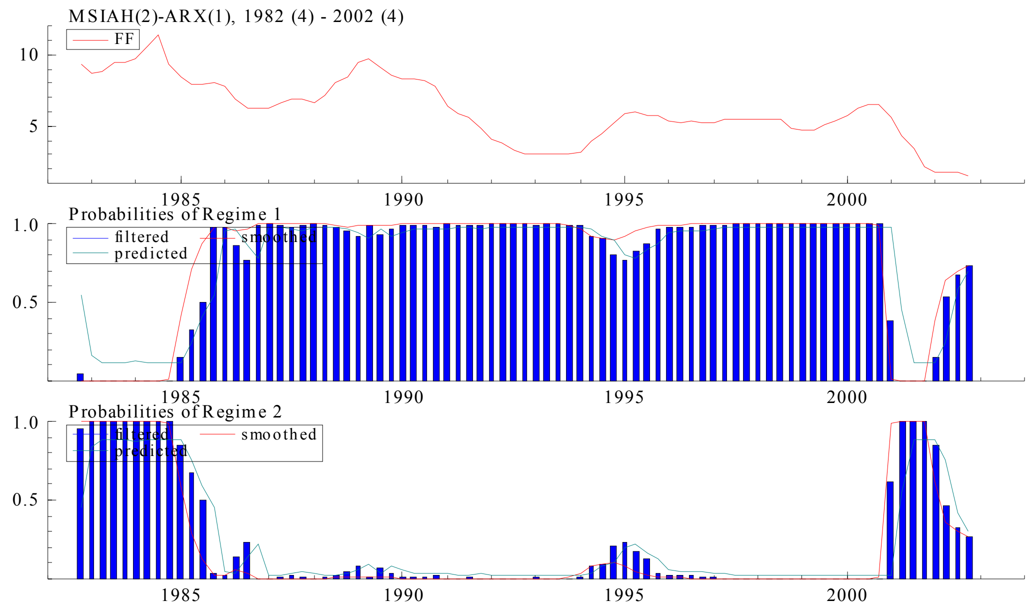


Note: all variables are expressed as ratios to GDP.

Figure 7: Probability of Regime 1 and Regime 2 in a Two-Regime MS Estimation of the Monetary Policy Rule.

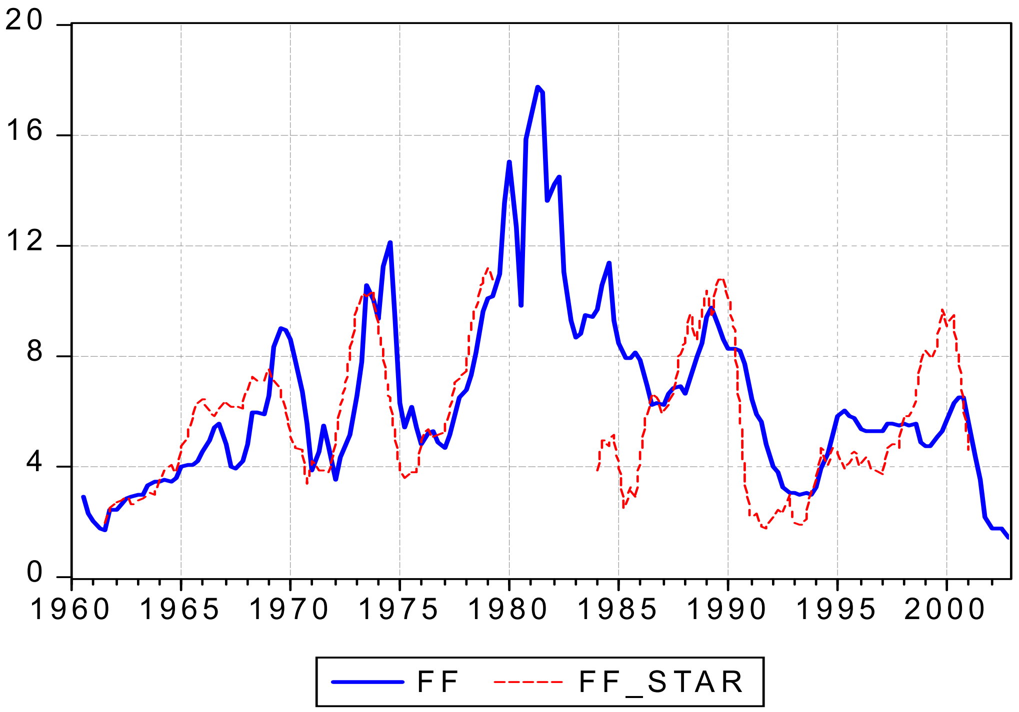


Note: sample 1961:3-1979:2. In neither regime the Taylor principle is satisfied



Note: sample 1982:2 -2002:4. In both regimes the Taylor principle is satisfied

Figure 8: Estimated Monetary Policy Rule: Observed Federal Funds Rate vs Equilibrium Federal Funds Rate



Note. FF is the observed Federal Funds rate, FF_STAR is the estimated equilibrium Federal Funds rate from rule (11)