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JEL classification: E62, E63, H62, H63

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Recent research and events have brought fiscal policy back into the spotlight. Fiscal Taylor rules and error correction models have represented two different ways of quantifying the feedbacks from fiscal and economic conditions to fiscal policy decisions. This paper synthesizes these two ideas, estimating a fiscal Taylor rule as a special case of an error correction model. Using quarterly postwar U.S. data, estimates of a fiscal Taylor rule find that the government sector has sought to stabilize its debt through adjustments to purchases and taxes, in that order, with very little stabilization coming through adjustments to transfer payments. Since 1981, the debt-stabilization motive has almost vanished, while the cyclical behavior of fiscal variables has not changed. This provides indirect evidence that fiscal policy may have become "non-Ricardian" in the US during recent decades. (JEL: E62, E63, H62, H63. Keywords: Taxation, government spending, transfer payments, fiscal policy, deficits, fiscal Taylor Rule).

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I. Introduction

In the period since Taylor (1993) formulated a reduced-form rule relating the Fed's interest rate target to output and inflation, the relationship between systematic monetary policy and economic performance has fueled a large amount of discussion. Much less discussion has gone into evaluating the effects of systematic fiscal policy for a number of reasons. For one thing, fiscal policymakers do not have a single instrument like the Fed Funds Rate or the growth rate of outside money to target. They can adjust purchases, transfer payments, and tax rates, or they can issue money in response to conditions. In this sense, deficits are an accounting identity, not a control variable, with components whose adjustment will tend to have varying real effects. Secondly, fiscal authorities have intertemporal considerations which they may wish to take into account when forming a budget.[1] Fiscal authorities must either fashion their policy so that the debt-GDP ratio does not explode, or else monetary authorities may lose control over their own policy instruments. A satisfactory analysis of reduced-form fiscal feedback functions will therefore necessarily account for long-run fiscal imbalances in addition to short-run cyclical conditions.

This paper proceeds in two parts. The first part lays out a general fiscal response function in a nonstationary context, relating fiscal Taylor rules to more general fiscal response functions such as what one would find in an error correction model. The second part presents estimates of this multivariate fiscal Taylor rule using quarterly data covering the entire government sector of the United States from 1947 through 2008. These

[1] Sargent and Wallace (1981) and Leeper (1991) show the importance of fiscal policy responses to debt in determining the interactions between monetary and fiscal policy. Woodford (2001) and Benigno and Woodford (2006) provide good discussions of current thinking on the subject. Bohn (1992) shows how an optimizing government might reduce spending in response to fiscal imbalances, and how this might also induce a violation of Ricardian equivalence among consumers and investors.

estimates quantify the degree to which fiscal authorities have adjusted their behavior in order to stabilize the debt-GDP ratio. The estimation strategy takes the nonstationarity of the individual fiscal variables and of the debt into account. In doing so, the results mostly confirm conventional wisdom (unlike some previous studies), with the added finding that the government sector appears particularly reluctant to stabilize the deficit by adjusting transfer payments. In addition there appears to be a trend toward a decreased responsiveness of fiscal policy, to the extent that it is not even clear whether deficits have responded to debt at all since the 1980s.

First of all, the major instruments of fiscal policy have responded exactly as one might expect in response to cyclical conditions. Government purchases rise slightly as a share of GDP when unemployment rises. Transfers as a share of GDP increase strongly, and taxes as a share of GDP fall strongly. By contrast, the major instruments of fiscal policy have responded sluggishly to fiscal imbalances. When fiscal adjustment has finally occurred, government purchases have played a surprisingly large role in that adjustment, with taxes playing a somewhat smaller role. Transfers have performed little if any role in fiscal adjustment. The findings regarding taxes and government spending reflect previous findings from the literature which uses vector error correction models (VECMs), but the finding regarding transfers is a new result. If the government behaves as it has in the past, one might expect it to restore fiscal balance by raising taxes slowly but drastically in response to an increased demand for transfer payments.

The sample at hand also indicates that fiscal authorities have not behaved in a consistent manner over time, as Crowder (1997) has proposed. For the full sample since 1947, counterfactually holding unemployment and growth-adjusted interest constant, the

fiscal Taylor rule suggests that primary *deficits* have had a quarterly persistence of about 95.6 percent, with the persistence rising to 97.8 percent if one looks at the period since 1955 (thus excluding the immediate Post-World War II and Korean War periods). Since the period surrounding the 1981 tax cuts, however, this quarterly persistence has increased to about 99.2 percent, and it is in fact statistically impossible to distinguish the observed fiscal policy since that date from one which does not directly seek to stabilize the debt-GDP ratio at all. Fiscal policy has apparently become much more active and much less responsive to debt, so much so that this is visible by looking at a plot of deficits over time. Taxes and transfers have also become somewhat less responsive to cyclical conditions, though this decline in the "automatic stabilizer" role of these instruments should not be overstated.

In short, a proper estimation of fiscal response functions for the United States shows a conventional fiscal response to cyclical and fiscal imbalances, with two important qualifications. Adjustments to government purchases perform a large role alongside taxes in fiscal stabilization, while transfer payments perform a negligible role in stabilization. Models that rely purely on taxes to perform fiscal adjustment therefore miss out on an important feedback mechanism from fiscal conditions into the real economy. Also in accordance with views commonly held by the public, fiscal policy has become much less focused on fiscal stabilization since the late 1970s and early 1980s. This break in policy may have important implications for issues such as how one models inflation determination, and it suggests that researchers should put more focus on the possibility that US policy in the medium run may have become "non-Ricardian".

II. Previous literature

Previous estimates of fiscal responses for the United States have taken two main forms—simple fiscal Taylor rules and vector error correction models (or VECMs). Taylor (2000), in applying his name to fiscal rules, models fiscal deficits as a structural component plus a systematic response to cyclical conditions. He estimates a response of the federal deficit-GDP ratio to a measure of an output gap, as a percent of GDP, of about 0.5. He does not include a response of fiscal variables to fiscal imbalances in his estimates. Galí and Perotti (2003) and Claeys (2006) estimate univariate fiscal policy rules for the United States; they find evidence of sluggish fiscal adjustment and of lower responses of deficits to output than Taylor. Favero and Monacelli (2005) estimate a fiscal rule in a regime-switching framework, relating U.S. federal deficits to an output gap and the *level* of the debt-GDP ratio. They find little evidence of deliberate debt stabilization at most times by fiscal authorities. Their only estimated episodes of fiscal stabilization appear in 1975 during the Ford tax cuts and from 1995 through 2001. They do not find evidence of a sustained change in fiscal policy throughout their sample. They use a strong notion of fiscal sustainability under which fiscal stabilization implies a stationary debt-GDP ratio.

Another take on the issue of fiscal responses, which allows for nonstationarity, involves the formulation and estimation of vector error correction models (VECMs). Fiscal VECMs are basically vector autoregressions of nonstationary fiscal and economic variables, in first differences, with an additional term on the right hand side reflecting a stationary deficit-GDP ratio (but a nonstationary debt-GDP ratio).[2] Unlike reduced form

[2] In the language of time series econometrics, this is appropriate when individual deficit components such as taxes and spending as a share of GDP are nonstationary but cointegrated.

fiscal rules, VECMs take the nonstationary time-series behavior of individual deficit components and of the debt into account. Using this approach, Bohn (1991, 1998, and 2008) documents continual fiscal stabilization efforts throughout the history of the United States. Crowder (1997) also estimates a small-scale error correction model for the United States federal government using postwar data and finds evidence of a regime shift sometime late in the 1970s or early in the 1980s.

Bohn and Crowder both find that broad categories of government expenditures perform much of the adjustment necessary to keep the public debt-GDP ratio from exploding, with taxes doing less of the adjustment. More recently, Favero and Giavazzi (2007) set up and estimate something like a vector error correction model augmented by output in response to Blanchard and Perotti's (2002) and Perotti's (2005) use of vector autoregressions to estimate the dynamic effects of innovations to government spending and taxes. Favero and Giavazzi recommend using a model with explicit responses to *levels* of the debt-GDP ratio instead—their model is basically a VAR with an extra debt variable on the right-hand side. Favero and Giavazzi act as if the debt-GDP ratio to be stationary in levels rather than difference-stationary. They get the exact opposite results from Crowder. As it happens, a fiscal Taylor rule which takes proper account of nonstationarity delivers conclusions more like those of Bohn and Crowder and less like those of Favero et al.

III. The data: Debt, revenues, and expenditures

The National Income and Product Accounts contain quarterly data, dating from 1947, on revenues and expenditures by category for the entire government sector of the

United States. This allows one to properly construct series for government consumption and investment purchases, net transfer payments, and revenues. The Flow of Funds Accounts contain seasonally adjusted quarterly information on the financial assets and liabilities for the entire government sector plus the stock of outside money, dating from 1952 at a quarterly frequency and 1945 at an annual frequency. The St. Louis Fed has data on the unadjusted monetary base which can allow one to extend the monetary base series for exposition purposes. The analysis will cover the behavior of three aggregate fiscal variables as a share of GDP which the government can control: Government purchases, net transfer payments, and net revenues, shown in Figure 1.[3] The seigniorage tax (the creation of outside money) is a fourth item which acts a bit like revenue, though a glance at the large blips in Figure 1 will show why it is not included in this analysis. Most of the movements in the seigniorage tax come from four transitory episodes, the one in late 2008 being the largest. The series are constructed in such a way that the change in net liabilities equals net interest plus purchases and transfers, minus tax revenues. Quarterly net liabilities data are constructed using end-of-year balances interpolated using the intervening flows. Figure 2 shows the resulting series.[4]

Figure 3 shows the growth-adjusted deficit both before and after accounting for seigniorage, as well as the primary deficit as a share of GDP. These series each have a mean very close to zero, which indicates that the government sector has more or less

[3]Government purchases equal government consumption and gross investment expenditures, plus net purchases of nonproduced assets, less consumption of fixed capital. Net purchases of nonproduced assets are imputed using state and local net purchases of nonproduced assets for the period before 1960. Transfer payments are current transfer payments from the consolidated government account. Revenues are current revenues net of subsidies, plus capital transfer receipts net of capital transfer payments.

[4] The Flow of Funds Accounts contain the data on the par value of the government's financial assets and liabilities used here. The Dallas Fed publishes figures for the market value of the federal debt. They track each other closely with some deviations because of changes in long-term rates. Hamilton and Flavin (1986), for instance, use the market value of the federal debt, but the results are not sensitive to this.

balanced its budget throughout the postwar period. Bohn (2008) finds a similar result throughout the entire history of the United States at the federal level. Properly adjusting for nominal GDP growth removes the illusory "deficit bias" from most of the post-World-War-II data since most of that bias comes from nominal interest payments.

With respect to time series properties, it appears that the series for government purchases, transfers, and revenues are not individually stationary—purchases seem to have drifted downward since the Korean War, while transfers and taxes have both drifted upward. Bohn (1998, 2008) shows that standard time-series methods cannot reject a unit root in the debt-GDP ratio, and various theories of optimal policy in fact predict a unit root. Bohn finds substantial evidence of deliberate fiscal stabilization when this nonstationarity is properly taken into account. That is, he finds that *changes* in the debt-GDP ratio, or growth-adjusted deficits, appear to be stationary and well-behaved. Nonstationary deficit components and debt, accompanied by stationary deficits, imply cointegration and error correction. If deficits become too large or small, fiscal authorities would slowly adjust fiscal variables to bring the growth-adjusted budget back into balance. In essence, one can think of fiscal responses as the systematic actions taken by the government sector, in the aggregate, to maintain a nonexplosive debt-GDP ratio in the presence of ongoing changes in fiscal and economic conditions.

IV. Error correction, and Taylor Rules

IV.A. Fiscal responses and sustainability

The definition of sustainability used here is a fairly loose one. Much of the original time-series literature on fiscal sustainability, such as Hamilton and Flavin (1986),

formulates and develops tests for the stationarity of the federal debt-GDP ratio in equilibrium ("strong sustainability"). Trehan and Walsh (1991) show that a *difference*-stationary debt-GDP ratio satisfies a form of sustainability ("weak sustainability") that still respects the government's budget constraint. Bohn (2007) extends this line of thought to its logical conclusion and shows that a debt-GDP ratio integrated of any finite order satisfies the household's budget constraint and transversality conditions, and that revenues and spending do not even need to be cointegrated ("absurdly weak sustainability"). As a result, given a finite-length sample, one cannot ever truly test for fiscal sustainability, and Cochrane (1998, 2007) shows how one cannot test for debt stabilization in every state of the world (a "Ricardian" fiscal policy). In practice, Bohn's result simply means that one must not confuse sufficient conditions for sustainability with necessary ones, and that the time-series properties of the underlying processes for spending and revenues matter when estimating feedback functions. Keeping Bohn's critique in mind, this paper will assume weak sustainability since there is not much reason to think that the debt-GDP ratio is integrated of any order greater than one.

To put the notion of systematic fiscal policy into a concrete context, one might model fiscal policy and economic feedbacks as a fiscal response function embodying a systematic response of fiscal and other economic variables to debt and to cyclical conditions. A general fiscal response function might involve responses to lags of debt and cyclical conditions as well, since it takes Congress and state legislatures time to issue legislation or to respond to fiscal imbalances. In such a case, the fiscal response might take the form

$$x_t = \alpha_b(L)b_t + \alpha_u(L)u_t + \varepsilon_t, \qquad (1)$$

where x_t represents the fiscal variables stacked into a vector; u_t equals the unemployment rate; and b_t equals the debt-GDP ratio. The exogenous process ε_t is integrated of a finite order and may have some dynamics associated with it. The response coefficients $\alpha_b(L)$ and $\alpha_u(L)$ take the form of lag polynomials and represent the explicit structural response of fiscal policymakers to current and previous values of the debt-GDP ratio and unemployment rate. In general, if the exogenous process governing fiscal policy has dynamics associated with it, it is not possible to estimate these objects without making further restrictions. The entire system has a reduced-form VECM representation and it is possible to estimate impulse responses.[5] Without further restrictions on the dynamics, though, it is not possible to estimate the structural feedback coefficients.

In the absence of explicit feedback rules, fiscal policy would follow the process ε_t which is exogenous to the system. For instance, changes in demographics affect the politics of transfer payments—with rising numbers of elderly voters, expansions of Social Security and Medicare tend to follow. International events such as the Soviet invasion of Afghanistan in 1979 or the Vietnam escalation in 1965 or the Korean War initiated periods of relatively high levels of government purchases. Political events such as the California property tax revolt or the divisions between the executive branch and Congress in the late 1990s (or the end of that situation in early 2001) represent independent shocks to taxes.[6] These shocks have dynamics of their own—the post-1979 military buildup did not fully play out until the mid-1980s but much of it was forecastable. Demographic and political considerations regarding transfer payments and taxes—the percentage of the

[5] Hamilton (1994) goes through the algebra which follows after taking the fiscal rule in first differences and substituting the budget constraint in the form $\Delta b_t = mx_t$.
[6] Romer and Romer (2008), for instance, document a number of large, discontinuous changes in the tax code which correspond with well-known political events.

population over 65 or with children in school, for instance—may show some dynamics as well.

Formulated this way, statements about fiscal stability are actually statements about the joint equilibrium behavior of fiscal and economic variables as expressed by the budget constraint and fiscal response function. Debt is nothing more or less than the sum of past deficits (also equal to the sum of future surpluses), properly scaled. What determines the stability or instability of debt is precisely the total feedback effect that debt has upon the individual elements of x_t in equilibrium. Insofar as the fiscal variables themselves are concerned, if policy acts in such a manner so as to reduce deficits in response to a rise in debt, then this satisfies weak sustainability. In this sense, fiscal response functions capture the government's deliberate response to fiscal conditions undertaken in order to keep the debt-GDP ratio from exploding.

IV.B. Fiscal Taylor Rules

Assuming no dynamics for ε_t and no delays in fiscal responses to debt or unemployment, it is possible to estimate a fiscal response function such as (1) rather easily. It is necessary to take the possible endogeneity of current-period unemployment into account, but apart from that, it means that taking first differences of (1) will yield a simple estimation problem. Since levels of debt and their lags are predetermined at time t, past deficits can instrument for themselves. Past levels and changes in unemployment provide additional valid and relevant instruments for current-period changes in unemployment. The instrument vector also contains one lag of output growth since unemployment lags output slightly in the data.

As a result, for each fiscal variable of interest, estimating a fiscal Taylor rule boils down to estimating individual rows of the expression

$$\Delta x_{it} = \mu + \alpha_{bi}\Delta b_t + \alpha_{ui}\Delta u_t + \eta_{it}. \qquad (2)$$

Estimates of the fiscal Taylor rule deliver a rough idea of the response of individual fiscal variables to fiscal and cyclical conditions. To the extent that budget deficits are highly autocorrelated, it does not matter much whether the government responds to current debt or debt with a slight lag. One possible problem might arise if taxes are adjusted preemptively to accommodate future increases in spending. Ramey (2008) finds a large example of this during onset of the Korean War, so an alternative set of results is given beginning in 1955 rather than in 1947 in order to exclude this period. The results do seem to be sensitive to this.

Taking a fiscal Taylor rule in first differences, so long as the omitted dynamics do not cause much of a problem, can therefore provide reasonable estimates of the response of different fiscal variables to fiscal and economic conditions. Because of the inclusion of both a fiscal and a cyclical indicator, the coefficient on changes in debt will capture the response of individual policy categories to long-term fiscal imbalances, while the coefficient on unemployment will capture those short-term imbalances attributable to business cycle conditions. A fiscal Taylor rule does not represent a complete model of debt and deficit dynamics with which to estimate impulse responses—for this, a larger-scale model like a VECM or a DSGE model is necessary. Nonetheless, it gives a good indication about how fiscal authorities adjust fiscal variables in response to fiscal imbalances and cyclical conditions.

V. Results

V.A. Coefficients on unemployment

The estimates for the fiscal Taylor rule for the full sample suggest a strong, Keynesian-style response of fiscal variables to the business cycle. Table 1 contains two-stage least squares estimates for the simplified fiscal Taylor rule over the entire 1947-2008 and 1955-2008 samples. Based on the coefficients on unemployment from the two-stage estimates, government purchases as a share of GDP tend to fall by 0.28 points in response to a one percentage point increase in unemployment. A coefficient of this magnitude, given a 0.179 share of GDP for government purchases and an Okun's Law coefficient of 1.82 (obtained from regressing output growth on changes in unemployment rates), implies that the *level* of government purchases does not vary much in response to a rise in unemployment.[7] The government seems to do a reasonably good job of smoothing government purchases, in levels, over the business cycle.

Both levels of transfers and their share of GDP, on the other hand, rise vigorously in response to unemployment, with a response coefficient between 0.4 and 0.5. Unemployment insurance and welfare payments naturally respond in a strong way when unemployment rises. A glance at Figure 3 shows large increases in transfers as a share of GDP during every major recession from the early 1970s onward, followed by decreases during recoveries. The other major portions of transfer payments, mostly Social Security payments and medical programs, do not typically change much during recessions. The result of this is that transfers account for a large portion of the countercyclicality of budget deficits, somewhat out of proportion to their share of the economy.

[7] Conventional estimates of Okun's Law find, statistically, a two percent increase in output for a one percentage point decrease in the unemployment rate. The data on hand deliver a slightly lower estimate of 1.82.

Tax revenues as a share of GDP also respond strongly to business cycles, varying positively with unemployment and negatively with output. Average tax rates fall by around 0.6 percentage points for every percentage point increase in unemployment. Much of this is due to the progressive nature of the tax code and its interactions with asset prices; Romer and Romer (2008) identify only a handful of deliberate large policy changes in the postwar period. A few such deliberate changes coincide with periods of rising unemployment, particularly the tax cuts of Ford, Reagan, and George W. Bush. Average tax rates move rather strongly with the business cycle through some combination of automatic and discretionary responses to cyclical conditions.

All in all, the responses of the deficit and its individual components to unemployment follow their conventional storyline. The government sector in the United States smoothes out purchases during recessions. It increases transfer payments, especially to the unemployed. It adjusts average tax rates over the business cycle, using the progressivity of the tax code to automatically raise taxes during good times and reduce them during bad times. For every one percent increase in unemployment, the government sector runs an average primary deficit of about 1.3 or 1.4 percent of GDP.

V.B. Coefficients on debt

The coefficient estimates on debt for the full sample suggest that adjustments to government purchases perform about half of all primary deficit stabilization (especially during the Korean War period). Taxes and transfer payments do not appear to adjust much in response to fiscal imbalances. Counterfactually holding unemployment, seigniorage, and growth-adjusted interest constant, the deliberate portion of fiscal

adjustment seems like a sluggish process, with some ambiguity in the post-1955 period as to whether the government makes the necessary adjustments at all.

The large share of adjustments to government purchases in stabilization has interesting consequences. It suggests that any fiscal reaction function that fails to have government purchases respond to debt suffers from a specification error. Bohn (1991) finds similar results in a VECM using annual federal data which combines government purchases with transfers—there, he finds that adjustments to total government spending (mostly military spending) together make up the majority of fiscal adjustments undertaken by the federal government. The results here show that this is robust to the inclusion of state and local spending, which comprise the majority of government spending in the US. The coefficient of government purchases on debt of -0.0342 for the entire post-1947 period is in fact the only coefficient on debt which is more than two standard errors away from zero, and this is sensitive to the time period chosen.

The government sector does not adjust transfers much, if at all, in response to fiscal imbalances, with a coefficient of transfers on debt of -0.0050 after 1955 and above zero for the entire 1947-2008 period (possibly driven by a blip in 1949-50 related to the payment of bonuses to war veterans). By and large, transfers seem to respond mostly to business cycle conditions and to exogenous factors such as demographics. Given past history, this suggests that if demographic imbalances in the United States ever bring about large fiscal imbalances, the government sector as a whole would tend to respond by economizing on purchases and raising taxes.

Tax rates appear to respond to debt in an economically significant but statistically insignificant way. The estimates suggest that taxes perform about a third of the task of

deficit stabilization. It seems interesting that politicians in the United States tend to adjust government spending rather than taxes to stabilize the fiscal situation in the long run. The full-sample coefficient of taxes on debt of 0.0130 (or 0.0069 after 1955) indicates that taxes adjust extremely slowly to fiscal imbalances if at all. In the aggregate, the estimates from the Taylor rule confirm Bohn's analysis of federal spending, with the additional qualification that most fiscal adjustment in response to long-run fiscal imbalances comes through government purchases, then taxes, then transfers, with considerable ambiguity as to whether these variables respond at all.

V.C. Are fiscal responses stable over time?

Favero and Monacelli (2005) estimate a simple deficit feedback rule subject to frequent regime switches, where the level of the debt-GDP ratio feeds back to deficit decisions. They find evidence of regime instability, with regimes of debt stabilization punctuating an otherwise nonstabilizing policy rule. From the VECM literature, Crowder (1997) finds evidence of a possible regime switch in fiscal policy during the late 1970s or early 1980s, with particularly strong evidence of a break in late 1981 toward less fiscal stabilization.[8] A visual examination of the debt-GDP ratio and of the various measures of deficits suggests this as a distinct possibility. Favero et al. and Crowder get different results because they assume different orders of integration for debt and different notions of sustainability. It is interesting to ask if an estimated fiscal Taylor rule can corroborate Crowder, taking his break date as given.

[8] An attempt by the author to estimate a break date mechanically using a deficit rule did provide evidence of a break somewhere in the 1978-83 period. The exact date was ambiguous.

Table 3 contains the estimates for the response coefficients for the simple fiscal Taylor rule from the first quarter of 1955 through the third quarter of 1981, followed by estimates from the fourth quarter of 1981 through the fourth quarter of 2008. Indeed, fiscal policy appears to have changed dramatically since the early 1980s. Before 1981, policymakers acted swiftly to undo any possible fiscal imbalances. In contrast with the full sample, taxes followed by government purchases bore the largest role in fiscal stabilization, while transfers bear a statistically insignificant but economically significant role. The government sector would close fiscal imbalances at the rate of 10% per quarter or at the rate of 35% per year.

By contrast, none of the fiscal variables in the post-1981 sample shows a statistically or economically significant effect of fiscal imbalances on policymaking. The point estimates show weak responses of taxes and government purchases to imbalances, and they even shows a weak positive effect of fiscal imbalances on transfers. The estimates show a minuscule response of total primary deficits to debt of about 0.84 percent per quarter, meaning that fiscal imbalances have a persistence of 99.2% per quarter or 96.7% per year. This is statistically indistinguishable from no deliberate fiscal stabilization whatsoever. It confirms Crowder's finding, to a stunning degree, that the government sector has not responded strongly to close fiscal imbalances since the late 1970s or early 1980s.

The coefficients on unemployment show much more stability between subsamples. They are slightly stronger within each subperiod than those estimated for the full sample, but the differences between subsamples are not statistically or economically significant. Their interpretation remains unchanged from their

interpretation in the full sample. The aggressiveness of fiscal policy in pursuing long-run fiscal stabilization has disappeared, but the cyclical behavior of fiscal policy has not changed much. There is a slightly smaller response of revenues or transfers ("automatic stabilizers") to unemployment but the magnitude of the difference is not large.

In general, these estimates indicate a disappearing role for fiscal stabilization in setting fiscal policy but also indicate that fiscal responses to business cycle conditions have not really changed. Changes to government purchases have also become less volatile and changes to taxes more volatile, hence one possible explanation for the declining role of shocks to government purchases in driving output fluctuations noted by Perotti (2005) and confirmed by Favero and Giavazzi (2007). It appears that fiscal policy has changed radically during the postwar period and it has changed in interesting ways.

VI. Conclusion

Carefully taking the issues of nonstationarity and the multiplicity of fiscal instruments into account, it is possible to estimate reduced-form fiscal feedback functions relating fiscal policy decisions to fiscal and economic imbalances and to come up with sensible estimates. An estimate of a multivariate fiscal Taylor rule as a special case of an error correction model for the entire U.S. government sector, using postwar data, suggests that adjustments to government purchases have performed a large role in fiscal stabilization, with adjustments to tax rates accounting for most of the rest. Transfers have performed very little role in fiscal adjustment—policymakers seem to prefer to adjust government purchases and taxes before they adjust transfers. All three major components of fiscal policy appear to have responded in expected ways to cyclical

conditions. During periods of high unemployment, deficits as a share of GDP have risen by about 1.3 or 1.4 percentage points for each one percentage point increase in unemployment, with taxes and transfers accounting for most of that increase. Notably, these estimates imply quantitatively important feedback from fiscal imbalances to government purchases. Structural models that do not allow for such a feedback miss out on a potentially important source of real effects for fiscal shocks.

The postwar period also shows important evidence of structural instability in fiscal feedback mechanisms, as estimated by a fiscal Taylor rule. This break is even visible to the naked eye when presented with a deficit series. Up through the late 1970s or early 1980s, fiscal policymakers had responded aggressively to close fiscal imbalances. Since that time, fiscal policymakers have responded in a statistically and economically insignificant way to fiscal imbalances. Innovations to government purchases have also become less volatile while innovations to taxes have become more volatile. Interestingly, a fiscal policy change in 1981 also corresponds with a period with a radical shift in monetary policy toward inflation stabilization. The persistent change toward a less stabilizing fiscal policy brings up the possibility that U.S. policy has become "non-Ricardian" in the sense of the Fiscal Theory of the Price Level. The fiscal policy change also corresponds with evidence of reduced Keynesian effects of government purchases in the U.S. Both of these issues deserve further investigation.

Tables and figures

Table 1: Estimates of response coefficients from Fiscal Taylor Rule, full sample.

Dependent Variable	*1947.III-2008.IV*		*1955.I-2008.IV*	
(share of GDP)	*Coeff. on u*	*Coeff. on b*	*Coeff. on u*	*Coeff. on b*
Govt. Purchases	**0.2814**	**-0.0342**	**0.2757**	**-0.0100**
(Std. Err.)	0.0933	0.0063	0.0830	0.0074
Transfers	**0.4978**	**0.0036**	**0.4391**	**-0.0050**
(Std. Err.)	0.0936	0.0064	0.0691	0.0062
Revenues	**-0.6113**	**0.0130**	**-0.5735**	**0.0069**
(Std. Err.)	0.1273	0.0086	0.1434	0.0128
Revenues - Transfers	**-1.1091**	**0.0094**	**-1.0126**	**0.0119**
(Std. Err.)	0.1630	0.0111	0.1641	0.0147
Primary Deficit	**1.3905**	**-0.0436**	**1.2883**	**-0.0219**
(Std. Err.)	0.1816	0.0123	0.1728	0.0155

Table 2: Properties of residuals from Fiscal Taylor Rule, full sample.

Dependent Variable	*1947.III-2008.IV*		*1955.I-2008.IV*	
(share of GDP)	*Std (η_{it})*	*R^2*	*Std (η_{it})*	*R^2*
Govt. Purchases	0.0036	0.1905	0.0028	0.1667
Transfers	0.0036	0.1322	0.0023	0.2021
Revenues	0.0049	0.1403	0.0048	0.1092
Revenues - Transfers	0.0062	0.2204	0.0054	0.2118
Primary Deficit / GDP	0.0069	0.3171	0.0057	0.3424

Table 3: Estimates of response coefficients from Fiscal Taylor Rule, split sample.

Dependent Variable	***1955.I – 1981.III***		***1981.IV – 2008.IV***	
(share of GDP)	***Coeff. on u***	***Coeff. on b***	***Coeff. on u***	***Coeff. on b***
Govt. Purchases	**0.3649**	**-0.0356**	**0.3816**	**-0.0066**
(Std. Err.)	0.1324	0.0162	0.0993	0.0079
Transfers	**0.5355**	**-0.0179**	**0.3721**	**0.0016**
(Std. Err.)	0.0973	0.0119	0.1073	0.0085
Revenues	**-0.7628**	**0.0476**	**-0.6840**	**0.0034**
(Std. Err.)	0.1774	0.0218	0.2452	0.0195
Revenues – Transfers	**-1.2983**	**-0.0655**	**-1.0560**	**0.0018**
(Std. Err.)	0.2123	0.0260	0.2760	0.0220
Primary Deficit	**1.6632**	**-0.1011**	**1.4376**	**-0.0084**
(Std. Err.)	0.2258	0.0277	0.2807	0.0223

Table 4: Properties of residuals from Fiscal Taylor Rule, split sample.

Dependent Variable	***1955.I – 1981.III***		***1981.IV – 2008.IV***	
(share of GDP)	***Std (η_{it})***	***R^2***	***Std (η_{it})***	***R^2***
Govt. Purchases	0.0032	0.2070	0.0021	0.1953
Transfers	0.0023	0.2489	0.0023	0.1196
Revenues	0.0043	0.1501	0.0052	0.0709
Revenues - Transfers	0.0051	0.2712	0.0059	0.1311
Primary Deficit / GDP	0.0054	0.4485	0.0060	0.2372

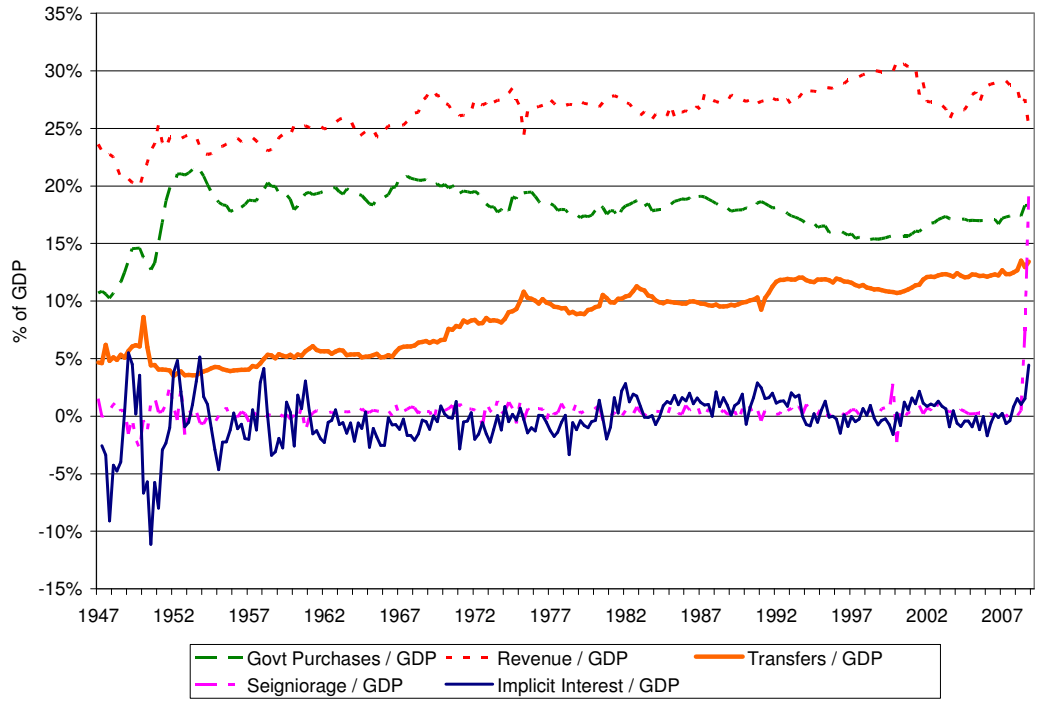

Figure 1: Government flows as a percent of GDP.

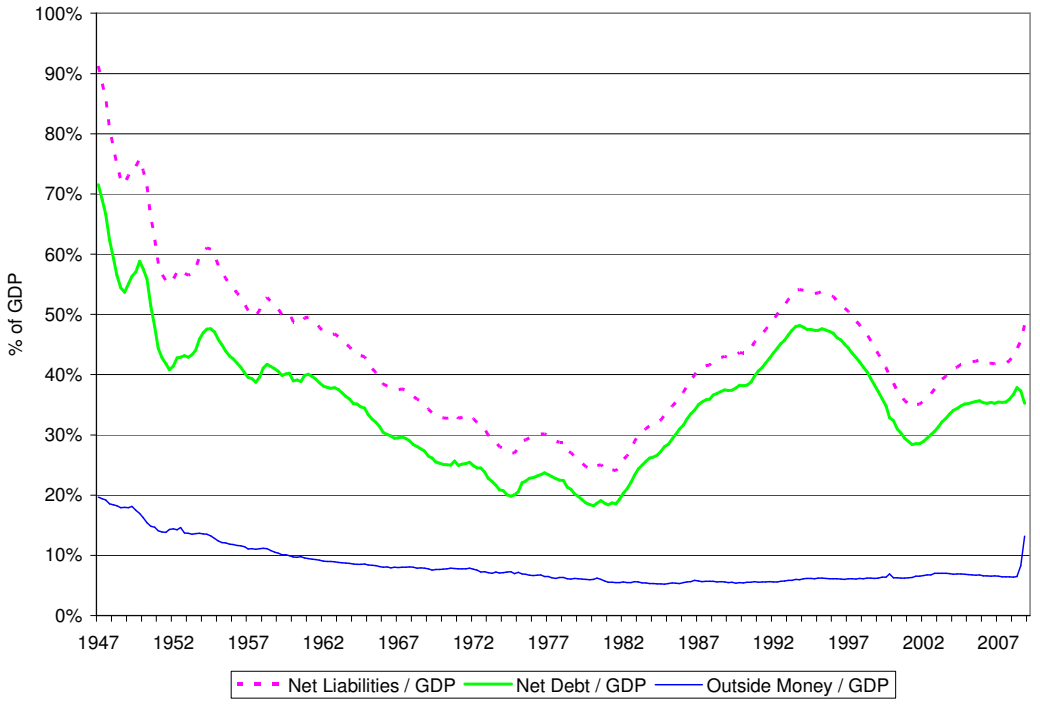

Figure 2: Net liabilities for the government sector as a percent of GDP.

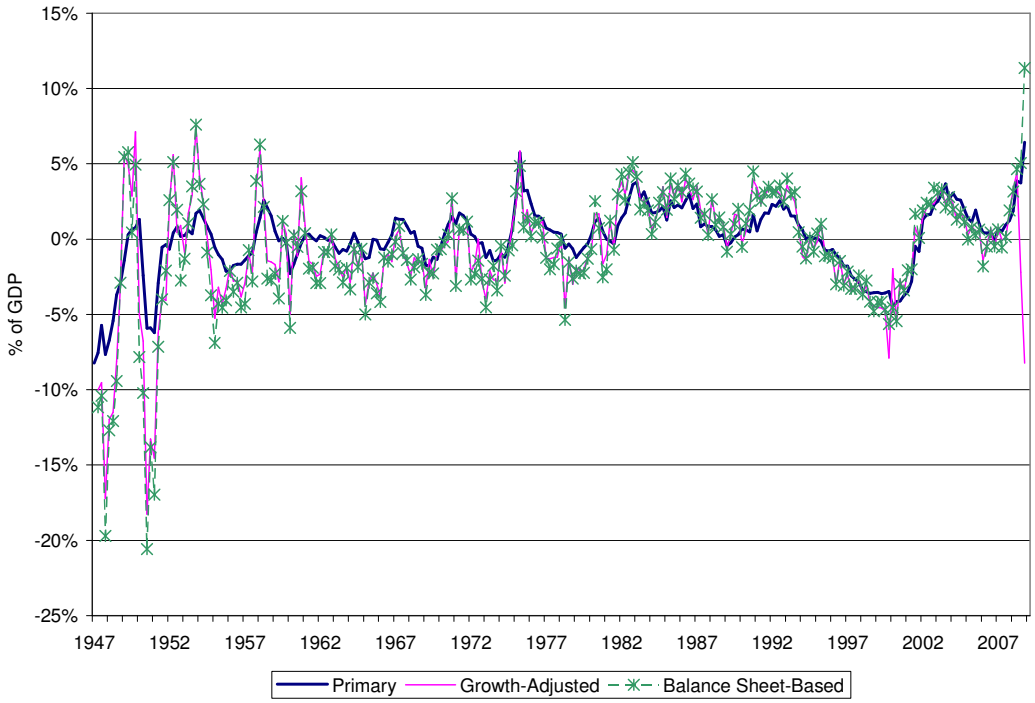

Figure 3: Deficits as a percent of GDP.

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