STEPPING ON A RAKE: THE ROLE OF FISCAL POLICY IN THE INFLATION OF THE 1970'S

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ABSTRACT. The inflation of the 1970's in the US is often discussed as if the only type of policy action that could have prevented the inflation were monetary policy actions and the only type of policy errors that might have induced the inflation were monetary policy errors. Yet fiscal policy underwent dramatic shifts in the 70's and economic theory makes clear that in an environment of uncertainty about future fiscal policy, monetary policy instruments may lose potency or have perverse effects. This paper documents the vagaries of fiscal policy in this period and argues that people at the time must have been uncertain about fiscal policy's future course. It also lays out a theoretical framework for understanding the effects of fiscal uncertainties on monetary policy and shows that fiscal variables have predictive value in dynamic models, even if traditional monetary policy indicators are included in the system.

Note: This paper is still under construction.

I. THE THEORY OF FISCAL AND MONETARY POLICY INTERACTION

It is a standard result in equilibrium models that recognize the government budget constraint as part of the model (sometimes called "fiscal theory of the price level"

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or "FTPL" models) that when rational, forward-looking agents believe that newly issued nominal government debt is only partially backed by future taxes, debt issue is inflationary. Furthermore, in such models, with such beliefs about future policy, policy-generated increases in the interest rate *increase*, rather than reduce, the inflation rate. The behavioral mechanisms underlying these results are fairly easy to understand. Increases in nominal debt in the hands of the public that are not accompanied by any increase in expected future tax liabilities or by any increase in the price level leave the public with apparently increased wealth, which they will try to spend, until price increases erode their wealth or expectations about future taxes or economic growth make them scale back spending. In these circumstances, an increased nominal interest rate flows directly through to increased nominal government spending. In a flexible price model, the monetary authority loses any ability to affect the price level, as interest rate increases increase the rate of expansion of nominal government debt without any restrictive effect on spending plans.

There are some high-inflation countries and time periods in which simple flex-price models like these capture much of what goes on in monetary-fiscal interactions. Interest rates are high, interest expense is a major part of the government budget, and monetary policy-makers are acutely aware that increases in interest rates are likely to increase the rate of issue of nominal debt. However in the US in the 1970's these effects were smaller and more indirect. The eventual paper will lay out the simple flex-price models that already exist in the literature and (I expect, or at least hope) will include a model with stickiness in which the monetary authority retains the ability to generate recession or accelerate recovery even though it loses control of trend inflation.

II. Fiscal policy in the 1970's

From the point of view of FTPL models the most natural single measure of fiscal stance is the primary surplus[1] as a proportion of total outstanding debt. It must over time approximately average out to the real rate of return on other investments.[2] Figure 1 shows this ratio. Note that most of the time the US has run primary surpluses, as expected, with the first period of large, sustained primary deficits beginning in 1975. This was the Ford tax cut and tax rebate. For one quarter, the primary deficit was at an annual rate of 20% of the outstanding market value of debt — a level not approached before or since in the period since 1950 — and the deficit persisted at high levels for a couple of years thereafter. The Reagan deficits of the early 80's also correspond to a period of sustained primary deficits, thought the rate never reached that of the Ford tax rebates.

People acquiring the debt that was being issued in this period had to be expecting that primary surpluses would eventually again become the norm, but it seems farfetched to suppose that they would have thought there was some simple rule,

[1]The primary surplus is revenues minus expenditures *other than interest payments*. It represents the net payments to holders of bonds, both through interest and retirement of outstanding debt.

[2]Strictly speaking, a weighted average of future primary surpluses divided by the current debt must match the discount rate, so that if primary surpluses are growing, the ratio of current primary surplus to current debt could be below the discount rate. But if primary surpluses and real investment returns grow at the same rate, it will remain true that the primary surplus over debt must on average match the ratio of current earnings to investment values.

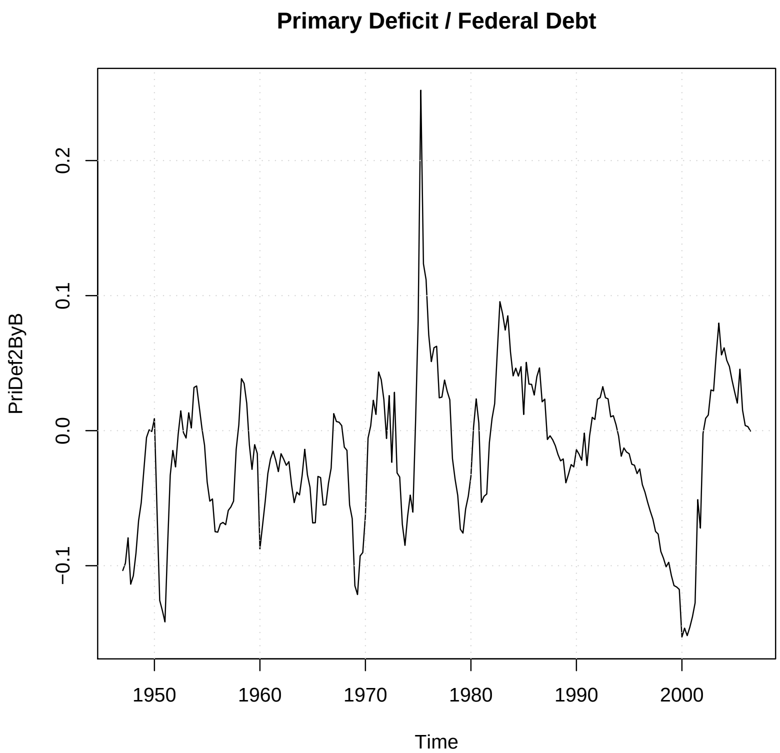

FIGURE 1.

based on historical behavior patterns, that would allow prediction of when and how primary surpluses would re-emerge.

As remarkable as the huge spike in the primary deficit in 1975 is the period of sustained and growing primary surpluses in the latter part of the 90's during the Clinton administration. How do we account for these swings in fiscal stance? I'm not sure there is any model that explains these swings, but it is interesting to look at Figure 2. Figure 2 shows interest expense as a fraction of total expenditures for the US. Until the early 80's, interest expense was a small fraction of the budget, generally well under 5%. But in the early 80's it shot up to 20% of the budget and stayed there for several years. It seems plausible that the fiscal discipline of the early Clinton

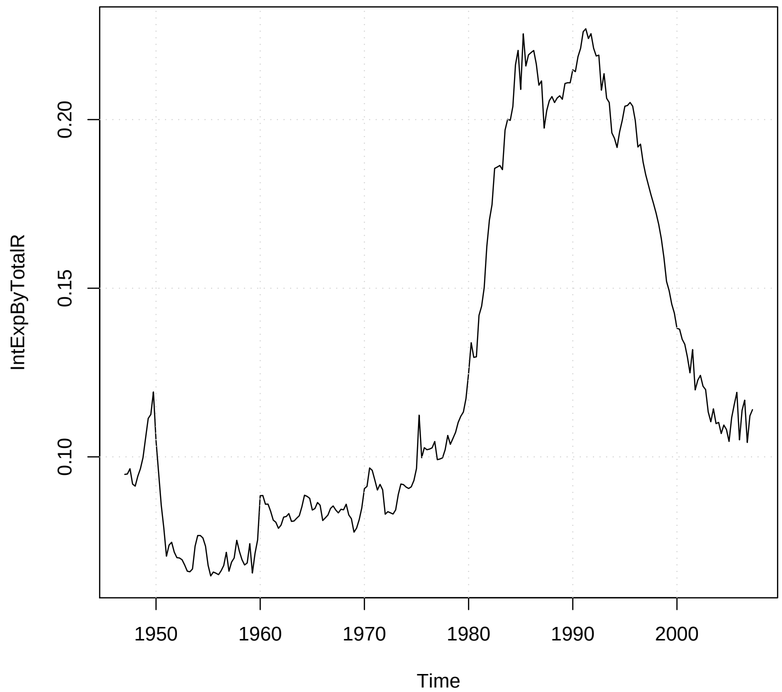

FIGURE 2. US Federal Government interest expense as proportion of total expenditures

years may have been engendered in part by these budget realities having forced Congress to recognize that its ability to tax and spend was increasingly limited by rising interest costs.

III. MODELS

III.1. **A globally soluble model.** The first model is a simple flex-price model of an endowment economy, with functional forms chosen for convenience. It can be solved analytically, which allows us to see how explosive time paths for prices or money may, or may not, be excludable as competitive equilibria. Its purpose here is to illustrate how in principle such existence and uniqueness issues should be resolved, to show that explosive equilibria can exist, and to provide an example in which an interest-rate-rule policy that satisfies the Taylor Principal (more than one-for-one eventual response of the policy rate to inflation) can be consistent with a unique equilibrium in which inflation explodes — even though there is a monetary policy (fixed money stock) that could rule out such equilibria.

The consumer's problem is

$$\max E\left[\sum_{t=0}^{\infty}\beta^t \log C_t\right] \text{ s.t.} \tag{1}$$

$$C_t(1+\gamma v_t)+\frac{B_t+M_t}{P_t}=\frac{R_{t-1}B_{t-1}+M_{t-1}}{P_t}+Y_t+g_t \tag{2}$$

$$v_t=\frac{P_tC_t}{M_t} \tag{3}$$

Monetary and fiscal policy are characterized by

$$R_t=\beta^{-1}\left(\frac{P_tC_t}{P_{t-1}C_{t-1}}\right)^{\theta} \qquad \text{Taylor Rule} \tag{4}$$

$$\frac{B_t+M_t}{P_t}=\frac{R_{t-1}B_{t-1}}{P_t}+g_t \qquad \text{Gov't Budget Constraint} \tag{5}$$

$$g_t=g_0-\phi\frac{B_{t-1}}{P_{t-1}}+\varepsilon_t \qquad \text{Fiscal Policy} \tag{6}$$

The Taylor rule equation, if logged, would look a lot like standard policy rules in the literature. except that it constrains the coefficients on inflation and output growth to be identical. This constraint is to allow easy solution of the model.

The first order conditions of the consumer, together with the other equations, produce

$$R_t = (1 - \gamma v_t^2)^{-1} \tag{7}$$

$$\left(\frac{1 - \gamma v_t^2}{\beta}\right)^{1-1/\theta} Z_t = E_t Z_{t+1} \tag{8}$$

$$Z_t = \frac{(1 - \gamma v_t^2)^{1/\theta}}{1 + 2\gamma v_t} \tag{9}$$

Note that Z_t is monotone decreasing in v_t. (8) has a solution with constant Z (and hence constant v) and is locally unstable if $\theta > 1$ (the Taylor principle). We treat Y_t and ε_t as i.i.d.

But can we rule out the locally unstable paths as equilibrium solutions? The paths in which Z increases, and hence v decreases, can be ruled out. Once Z goes above its steady state, equilibrium requires that it be unbounded above, but this cannot happen even with $v \to 0$, as can be seen from (9)

The paths in which Z decreases, and hence v increases, cannot be ruled out. On these paths, v approaches a finite upper limit as $Z \to 0$, while R and P_t/P_{t-1} approach infinity. No feasibility constraint is violated if such a path persists forever, with ever accelerating inflation. This reflects the fact that agents in this model will hold positive real balances even if they know that they will lose all their value next period.

The stationary equilibrium has R, M, PC and PY constant. We have not used the government budget constraint or the fiscal rule. They simply determine a stationary time path for government debt. What if policy were not a Taylor-principle Taylor rule, but instead $R_t = \beta^{-1}$, i.e. a pure interest rate peg? What if, further, fiscal policy were to make the primary deficit (in equilibrium a surplus, if debt is positive) exogenous, but following the same stochastic process (as a function of Y_t and ε_t) as in the Taylor-principle Taylor rule? Equilibrium with this policy combination results in *exactly the same* stochastic process for the variables in the model.

While the Taylor-principle Taylor rule equilibrium price level we derived is not unique, this interest-rate peg equilibrium does deliver a unique price level. The unstable equation is no longer the Z equation, but the government budget constraint. Deflationary deviations in which real debt explodes upward are ruled out by transversality. Inflationary deviations in which real debt shrinks toward zero are ruled out as infeasible from the viewpoint of private agents — they would see themselves as having insufficient resources, in real bonds and discounted present value of Y, to support both the SRC level of C and the discounted value of current and future taxes g_t, so they would reduce their demand, reduce prices, bring the price level back to the equilibrium path.

Leeper's analysis of local uniqueness of stable paths suggests that no equilibrium may exist when active monetary policy (interest rate highly responsive to inflation) is combined with active fiscal policy (surplus unresponsive to the level of the debt). But in this model, a unique equilibrium exists even when we combine an exogenously fixed primary surplus with a Taylor-principle Taylor rule. The result is (except for a knife-edge special case) a unique, explosive, equilibrium. A shock to the policy rule that lowers the coefficient on inflation *reduces* inflation and its rate of growth.

There is a way for the monetary authority to end the explosiveness: Lower the interest rate and keep it fixed. Here the fiscal authority cannot necessarily end the explosiveness by switching to a passive fiscal policy, because that leaves the equilibrium non-unique.

If the monetary authority follows a fixed-M or fixed-M-growth rule, there is no equilibrium with active fiscal policy and passive fiscal policy delivers a unique equilibrium. The reason is that in this case, as inflation explodes, eventually real balances reach a level such that, with fixed M and prices expected to grow greatly, next period's real balances would have to shrink below the minimum level that agents are willing to hold. Since this implies money will be more in demand, and hence more valuable, than the explosive path implies, it will raise the value of money this period, and hence unravel the equilibrium as we work backward in time.

III.2. **A very simple FTPL model.** To fix ideas before we take up sticky price models, we begin with a bare-bones flexible-price, cashless-economy FTPL model with only instantaneous short government debt:

$$\begin{aligned}
&M \text{ policy}: && \dot{r} = -\gamma(r-\rho) + \theta\dot{p} + \varepsilon_m && (10)\\
&\text{Fisher}^{\star}: && r = \rho + \dot{p} && (11)\\
&\text{Govt. Budg. Cnstr.}: && \dot{b} = -b\dot{p} + rb - \tau && (12)\\
&\text{Fiscal policy}: && \dot{\tau} = \varepsilon_\tau\,. && (13)
\end{aligned}$$

The starred equation is forward-looking. τ is the primary surplus, and the fiscal policy equation is saying that the primary surplus evolves exogenously, not responding to the real value of the debt. It is important to note that the coefficient of b on the right-hand side of the GBC (equation (12)) is $r - \dot{p}$, the ex post real rate of return on government debt, not $\rho = r - \hat{\dot{p}}$, where $\hat{\dot{p}}$ is the right-derivative at t of the expected future path of prices. We assume in this first model that the real interest rate ρ is an exogenously given constant. Because τ in this model does not grow exponentially, the government budget constraint can be solved forward to yield $b_t = B_t/P_t = \tau_t/\rho$. Because there is only one asset, nominal debt, the amount of nominal debt outstanding at t, B_t, is fixed by history, so the $B/P = \tau$ condition uniquely determines the price level at any date. Substituting (11) into (10) to eliminate r produces the following equation in p:

$$\hat{\ddot{p}} = -\gamma \hat{\dot{p}} + \theta \dot{p} + \varepsilon_m \,. \tag{14}$$

If $\theta > \gamma$, this equation is unstable, so expected future inflation rates explode exponentially upward or downward, unless $\dot{p} \equiv 0$. If instead $\theta < \gamma$, the equation is stable and the model has a unique, stable solution. When the equation is unstable, the model may still have a unique equilibrium solution. The question is whether we can rule out explosive time paths for inflation. Note that we have already used the assumption that real debt, the only asset, has a path that does not explode exponentially, and this uses up the implications of transversality. Explosive inflation paths would coincide with non-explosive real wealth and (implicitly) constant income and consumption. Of course these paths would be accompanied by, indeed in some sense can be seen as produced by, a fiscal policy that runs exploding *conventional* deficits as the inflation proceeds. This is required to maintain a constant primary surplus as interest expense explodes.

The combination of $\theta > \gamma$ monetary policy with the fiscal policy of (13) (Active Money/Active Fiscal in the terminology of Leeper (1991)) as a permanent configuration may be implausible, even if it does constitute an equilibrium system. It seems likely that people would at least contemplate the possibility that the fiscal authorities would cease expanding the conventional deficit along such a path, or that the central bank would at some very high interest rate recognize the futility of future rises (and that the rises were themselves producing the inflation, by expanding the conventional deficit). It would be interesting to consider cases where the public has evolving beliefs about when and how the active/active configuration will be abandoned. But we focus attention here on the case where inflation is stable, or very slowly exploding, i.e. $\theta < \gamma$, or θ/γ slightly above one.

In this case a permanent upward shift in τ (a δ-function shock to ε_τ) makes the price level jump downward and has no other effect. A δ-function shock to ε_m makes both $\hat{\dot{p}}$ and r jump upward by equal amounts, after which both decay back toward 0 and ρ exponentially, as $e^{-(\gamma-\theta)t}$. In other words, monetary contraction has no effect on inflation, except to increase it.

III.3. **A New Keynesian style model of boomerang monetary policy.** While this stark model is instructive, it is unrealistic in assuming perfectly flexible prices, and also importantly in assuming that all government debt is instantaneously short debt. With inertial prices, actions that might in a flexible-price model produce downward jumps in the price level might be expected instead to produce recessions and smoother declines in the price level or the inflation rate. With long debt, the requirement that the real value of government debt match the present value of future primary surpluses can be met by jumps in the interest rate, which changes the value of outstanding long debt even if the price level does not change.

To get realistic dynamics, we need to make consumers prefer smooth consumption paths, which we do by adding a penalty on the squared derivative of consumption to the utility function. Finally we need to recognize that actual primarily surpluses respond automatically to the business cycle. To reflect that, we add a term making the primary surplus depend positively on the level of output. (It actually appears as making the growth of the primary surplus depend on the growth of output.)

Below is a model that adds these elements.

$$\text{M policy}: \quad \dot{r} = -\gamma(r - \bar{\rho}) + \theta\dot{p} + \phi\dot{c} + \varepsilon_m \tag{15}$$

$$\text{Fisher}^\star: \quad r = \rho + \dot{p} \tag{16}$$

$$\text{IS}^\star: \quad \rho = -\frac{\dot{\lambda}}{\lambda} + \bar{\rho} + \varepsilon_r \tag{17}$$

$$\text{Govt. Budg. Cnstr.}: \quad \dot{b} = -b\dot{p} - b\frac{\dot{a}}{a} + ab - \bar{\tau} - \tau \tag{18}$$

$$\text{term struct.}^\star: \quad r = a - \dot{a}/a \tag{19}$$

$$\text{Phillips curve}^\star: \quad \ddot{p} = \beta\dot{p} - \delta c - \varepsilon_{pc} \tag{20}$$

$$\text{Fiscal policy}: \quad \dot{\tau} = \omega\dot{c} + \varepsilon_\tau \tag{21}$$

$$\text{habit}^\star: \quad \lambda = e^{-\sigma c} + \psi(\ddot{c} - \dot{c}^2)e^{-c} \tag{22}$$

Starred equations again are forward-looking, which means, since for the time being all shocks are white noise, that ε_r and ε_{pc} have no effect. a is the consol rate, i.e. one over the price of a consol yielding a one-dollar per period permanent flow. b is the real value of the government debt, i.e. $B/(aP)$, where a is the consol rate, P is the price level, and B is the number of outstanding consols. λ is the Lagrange multiplier on the consumer's budget constraint, which depends on both consumption and its rate of change.

Figures 3 and 4 display the responses of this system to monetary and fiscal delta-function shocks. The parameter values used in generating these graphs were

γ	θ	ϕ	σ	$\bar{\rho}$	$\bar{\tau}$	β	δ	ω	ψ
0.50	0.40	0.75	2.00	0.05	0.10	0.10	0.20	1.00	2.00

[Note: These impulse responses change — not in sign, but shape, when $\theta > \gamma$. At the conference I will also have an example of these responses for the $\theta > \gamma$ case.]

The parameter $\bar{\tau}$ does not appear in the equation system. It is the value of τ around which the model was linearized, which can be chosen arbitrarily because τ is non-stationary. The variable labeled "w" in the graphs is, in an unfortunate choice of notation, $\hat{\dot{p}}$, the inflation rate.

The point here is that in this model, though we are still in an "active fiscal, passive money" equilibrium, monetary contraction still has powerful effects, in the expected directions, on both real activity and inflation. The fact that monetary policy does not control the long run rate of inflation shows up in the behavior of the response of inflation w. After initially dropping, The inflation rate rises back above its steady state level by as much as it initially fell, and the rise is more sustained than the initial drop. This is the "stepping on a rake" phenomenon: Apparently effective measures to reduce inflation come back, after a delay, to produce precisely the opposite of the desired effect.

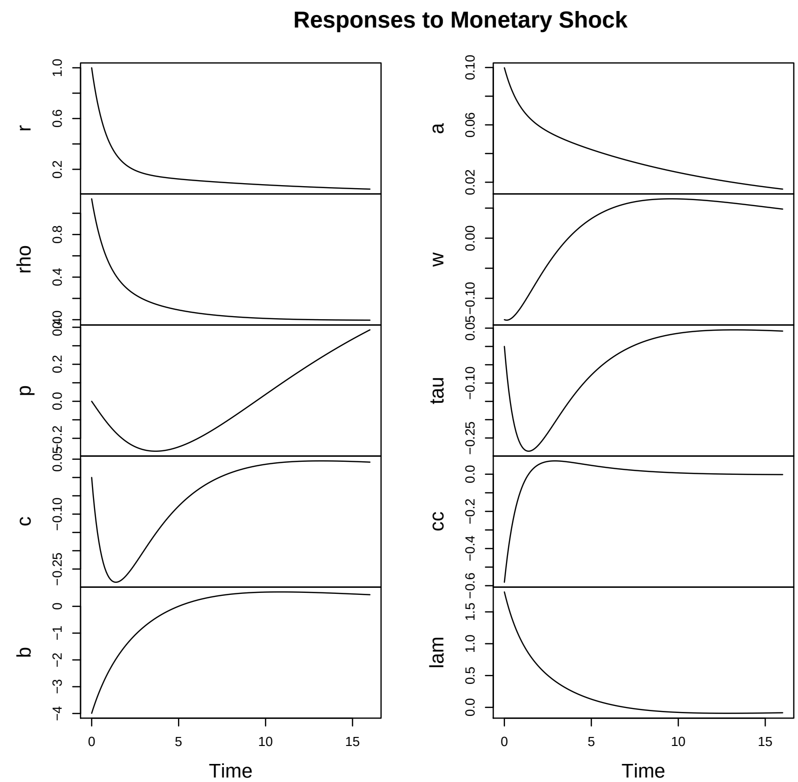

FIGURE 3.

The expansionary fiscal shock[3], shown in Figure 4, creates a boom in consumption and an upward jump in the inflation rate. Monetary responds by increasing the interest rate, bringing the output boom and the increased inflation to an end. But the fiscal shock has permanently changed the price level and has financed the increased debt issue via delayed, but unanticipated at the time of the fiscal shock, inflation.

[3]This is a negative shock to ε_τ.

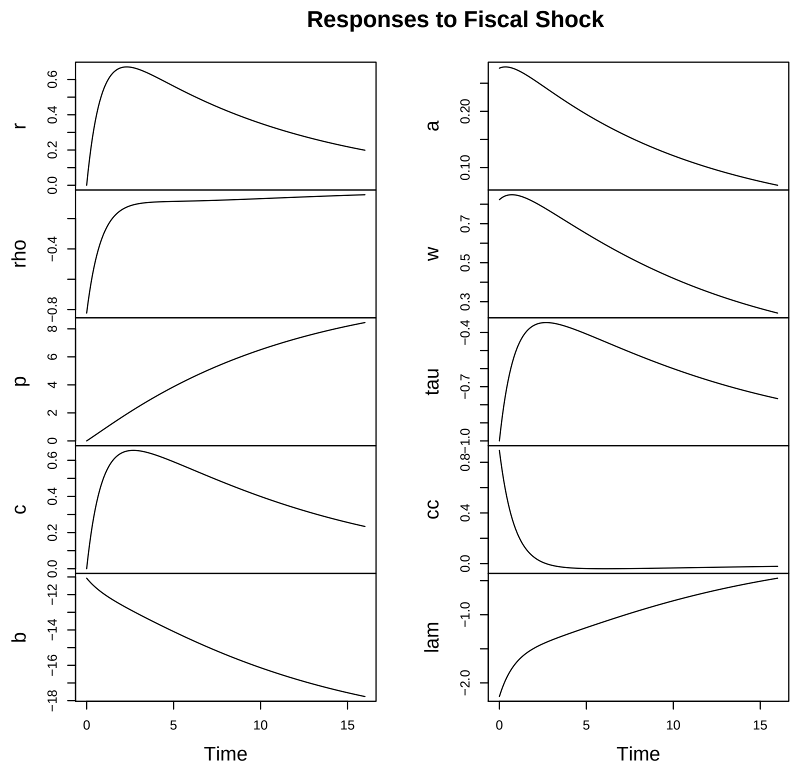

FIGURE 4.

IV. ESTIMATION

It would be a good idea to fit the model of the preceding section to the data, at least roughly[4], to see if parameter values that produce the behavior shown in figures 3 and 4 are supported by the data. One can't be too optimistic about success with this, however, because the model is based on an assumption that current behavior of the monetary and fiscal authorities and the public's expectations about future policy behavior are the same, and that both are unchanging. Part of the point of the graphs in the early sections of the paper is that it is unrealistic to suppose that people in

[4]Perhaps using it to generate a prior for a structural time series model, as in DelNegro, Schorfheide, Smets, and Wouters (2007) or Sims (2006).

general, and bond market participants in particular, had a stable, accurate view of fiscal policy, because the policy behavior was apparently undergoing drastic shifts.

It is possible, though, to investigate what happens to a non-structural descriptive model of the joint behavior of aggregate time series when primary surplus divided by market value of debt is added to the usual list of variables.

Shown in Figure 5 are responses of GDP, CPI, and the federal funds rate to a shock in the primary deficit divided by market value of debt. The responses are non-trivial and of the expected direction. In Figure IV we see that the responses to the part of federal funds rate shocks not correlated with the primary deficit shocks also have plausible shapes. If the primary deficit variable is omitted from the VAR, the "price puzzle" — a positive initial response of prices to an interest rate shock — is present, and including the primary deficit variable has gotten rid of it. These results are highly preliminary, however. There are no error bands on them, and they present an obvious identification problem — the primary deficit tends to rise at the same time that interest rates fall. Furthermore, it is difficult to rationalize this simultaneity as common response to the business cycle, since output does not move contemporaneously with the shock — it responds with a delay. It could be that the shock represents a common perception, either mistaken or based on information outside this collection of variables, that an expansionary policy move is necessary. Or it could represent a tendency of monetary policy to accommodate fiscal shifts. A model with more structure (i.e., more debatable assumptions) would be required to distinguish monetary and fiscal policy effects.

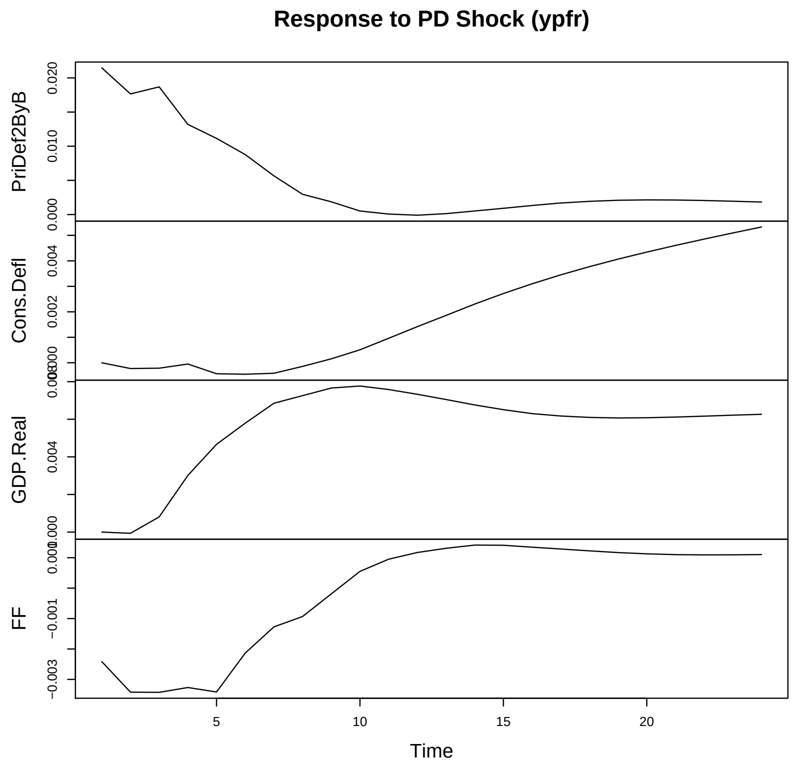

FIGURE 5.

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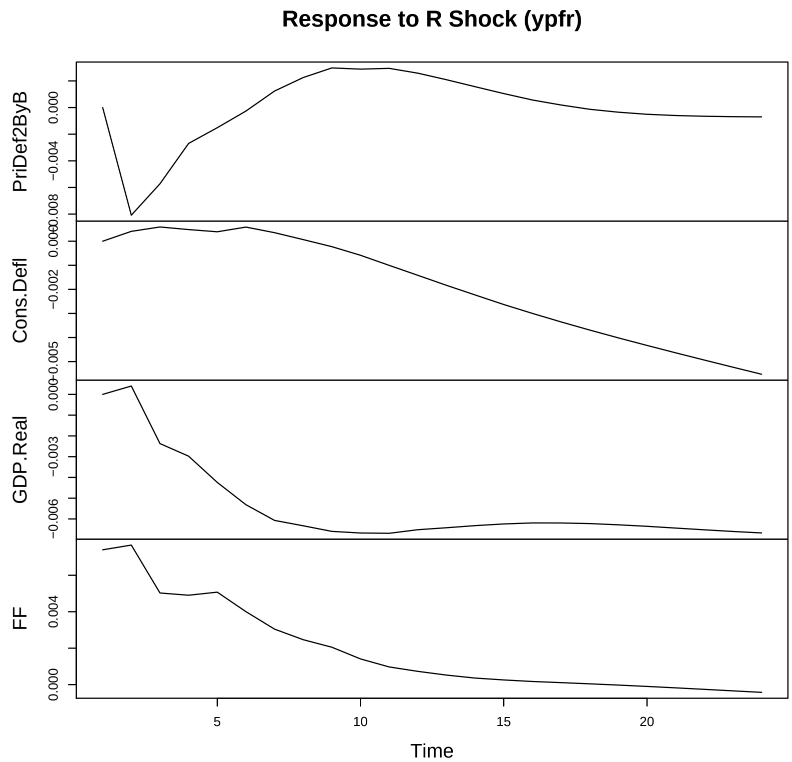
Response to R Shock (ypfr)
PriDef2ByB
Cons.Defl
GDP.Real
FF
Time
5
10
15
20