**Seminar Paper No. 710**

# THE FISCAL MYTH OF THE PRICE LEVEL

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May 2002
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# The Fiscal Myth of the Price Level*

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April 2002

**Abstract**

I examine the "fiscal theory of the price level" according to which "non-Ricardian" policy and predetermined nominal government debt fiscally determine prices. I argue that the non-Ricardian policy assumption and, by implication, fiscal price level determination are inconsistent with a rational expectations equilibrium where all asset holdings reflect optimal household choices. In such a rational expectations equilibrium, policy must be Ricardian even if, in some states of nature, the government defaults or runs an exogenous real primary surplus sequence.

I propose an alternative to the fiscal theory of the price level, based on nominal flows instead of nominal stocks. While this alternative framework establishes a consistent link between fiscal policy and the price level, it does not introduce inflationary fiscal effects beyond those suggested by Sargent and Wallace.

KEYWORDS: Fiscal theory of the price level, debt issuance.
JEL CODE: E31, E61.

*I have benefited from comments by and discussions with Ricardo Caballero, John Cochrane, Guido Lorenzoni, Torsten Persson, Lars Svensson, Fabrizio Zilibotti, and seminar participants at Stockholm University, LAMES 2001, and the EEA meeting 2001. Editorial assistance by Christina Lönnblad and financial support by the Foundation for Research in International Economics are gratefully acknowledged.

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# 1 Introduction

The government's intertemporal budget constraint has several unpleasant implications. One of these concerns the interaction of fiscal and monetary policy in the determination of equilibrium inflation, as highlighted by Sargent and Wallace's (1981) "unpleasant monetarist arithmetic". Decentralized policy implies a "game of chicken" (Sargent, 1987, ch. 5) where the first mover constrains the policy options of the follower. If the fiscal authority moves first and commits to a time path of pre seignorage primary deficits, it forces the monetary authority to generate enough seignorage revenue to satisfy the government's intertemporal budget constraint. Thus, the central bank loses the ability to control average inflation.

Concerned about this threat to price stability, economists have argued that an institutional first mover advantage—central bank independence—should be assigned to the monetary authority. If the central bank can commit to its preferred monetary policy, the treasury should then alone carry the burden of balancing the budget. In a series of papers, Woodford (1995; 1998; 1999; 2001) has challenged this conventional wisdom with its emphasis on seignorage revenue. According to Woodford, even a strictly independent and committed monetary authority is unable to achieve price stability if no additional constraints are imposed on fiscal policy makers. Woodford's argument relies on two assumptions: First, some government debt is issued in nominal terms. Second, policy is "non-Ricardian" (Woodford, 1995) in the sense that the fiscal policy rule specifies an exogenous path of surpluses satisfying the government's intertemporal budget constraint, not as an identity but only in equilibrium. In other words, Woodford introduces a game of chicken between the government as a whole and the Walrasian auctioneer (Christiano and Fitzgerald, 2000). By turning the government's intertemporal budget constraint into an equilibrium condition, non-Ricardian policy imposes additional constraints on the endogenous variables. In particular, it constrains the price level since that must, in equilibrium, coincide with the ratio of outstanding nominal government liabilities and the present discounted value of real primary surpluses (net of outstanding indexed debt). Thus: the "*fiscal* theory of the price level" (FTPL).

To the extent that non-Ricardian policy imposes more constraints on the endogenous variables than standard "Ricardian" policy, an interest rate peg need not—contrary to conventional wisdom—result in price level indeterminacy.[1] This appealing feature of the FTPL in the context of one specific monetary framework becomes problematic under different, equally plausible, circumstances. In a cash-in-advance (CIA) constraint model with positive interest rates and a money supply target for example, the price level path is already uniquely pinned down under a conventional Ricardian policy; a non-Ricardian policy then implies that the equilibrium price level is over determined.[2] Even if the FTPL does not over determine the price level, it may still predict the latter to be negative, for instance if the government owns a positive stock of nominal assets and is expected to run real primary surpluses (cf. Buiter, 2000). In spite of this quite limited domain, there has been a predominantly favorable reception of the FTPL.[3] The debate has mainly focused on whether it is conceivable that the government satisfies its

[1]Contributions by Leeper (1991), Sims (1994), and Woodford (1994) that preceded the FTPL analyze the determinacy properties of money growth rate and interest rate pegs. Cf. also Kocherlakota and Phelan (1999) who interpret the FTPL as an equilibrium selection device.

[2]For a different example, cf. Buiter (2000). Cf. also Christiano and Fitzgerald (2000, p. 18).

[3]FTPL related contributions, extensions and discussions include Bassetto (2000), Bergin (2000), Buiter (1998; 1999; 2000; 2002), Christiano and Fitzgerald (2000), Cochrane (1999; 2000; 2001), Cushing (1999), Daniel (2001), Dupor (2000), Leeper (1991), Loyo (1999), McCallum (2001), Schmitt-Grohé and Uribe (2000), Sims (1994; 1999a; 1999b; 2001), and Woodford (1994; 1995; 1998; 1999; 2001).

intertemporal budget constraint only in equilibrium (by pursuing a non-Ricardian policy). Disapproval by Buiter (1998; 1999; 2000; 2002) contrasts with approval by Cochrane (2000) and Sims (1999a; 2001) who propose the residual claim analogy between nominal government debt and privately issued equity.

In this paper, I offer a resolution to this debate. The fundamental problem of the FTPL, I argue, is that the feasibility of non-Ricardian policy hinges on the assumption of non-zero initial nominal government liabilities. This assumption is not well founded, since the FTPL link between non-Ricardian policy and the price level essentially constitutes a surprise asset revaluation. Households with rational expectations would anticipate the possibility of such a surprise revaluation and should therefore never have been willing to hold (as much) nominal government debt in the first place. I show that once the model encompasses a debt *issuance* stage, the existence of a rational expectations equilibrium requires fiscal policy to be standard Ricardian—the non-Ricardian policy assumption being inconsistent with optimizing household behavior under rational expectations. *Even if, in some states of nature, the government defaults or runs an exogenous real primary surplus sequence, fiscal policy has to identically satisfy the government's intertemporal budget constraint.* In a sense, the argument can be related to Bassetto's (2000) recent view of the FTPL. Bassetto revisits the assumption of government commitment and proposes to explicitly model out of equilibrium behavior. The present paper argues that the basic setup of the FTPL, outstanding nominal debt and non-Ricardian policy, *generally* constitutes an out of equilibrium constellation.

I discuss these issues in an extended Lucas (1978) asset pricing framework incorporating a transactions role for money, similar to Svensson (1985) or Sargent (1987, ch. 5). I deviate from Svensson in that I model maturing nominal government debt and money balances as perfect substitutes, and from Sargent in that I allow dividends to be partly paid out at the beginning of a period (these are timing conventions). I deviate from both authors in that I not restrict myself to a basic Clower (1967) style CIA constraint. The setup instead allows for more general monetary frictions and nests the basic CIA and money-in-the-utility-function (MIU) approaches. Section 2 clarifies the main argument within a deterministic two-period setting. Section 3 first replicates the FTPL logic in the context of the general monetary framework. It then demonstrates that the FTPL is inconsistent with a rational expectations equilibrium where all asset holdings reflect optimal household choices. The section also addresses, and refutes, potential objections to the argument. Section 4 modifies the framework to include nominal flows instead of stocks. While it is now possible to establish a link between fiscal policy and the price level even under rational expectations, the modified framework does not introduce any effects on equilibrium *inflation* beyond those already existent in Sargent and Wallace's (1981) model. Section 5 concludes.

## 2 The Argument

Consider an economy in its final period, $t = 0$. The representative household enters that period with a real endowment of $y_0$ units of the single good and a nominal endowment of $W_0$ units (dollars) of government debt. Since the household only values goods, consumption demand equals real household wealth after taxes $\tau_0$ and given the equilibrium price level $p_0$: $c_0^d = y_0 + W_0/p_0 - \tau_0$. Assume $\tau_0$ to be fixed at some exogenous level. For an equilibrium to exist, the price level $p_0$ must then adjust up to the point where implied consumption demand equals the available supply, given by the resource constraint $y_0 = c_0 + g_0$ with $g$ denoting the exogenous level of real government spending. The price level is therefore fiscally determined—the FTPL at work.

What is wrong with this argument? For the household to initially hold any nominal debt, the latter must have been issued in an earlier period. For simplicity, assume that there was only one such previous period, $t = -1$, in which the household paid $d_{-1}$ units of the good to acquire the debt. Since the household *chose* to do so, $d_{-1}$ must satisfy an asset pricing equation. In particular, it must be true that

$$d_{-1} = \frac{1}{1+r_{-1}} \frac{W_0}{p_0},$$

with $r_{-1}$ being the real interest rate between $t = -1$ and $t = 0$. We can therefore write the government's *dynamic* budget constraint as

$$g_{-1} = \tau_{-1} + d_{-1} = \tau_{-1} + \frac{1}{1+r_{-1}} \frac{W_0}{p_0} = \tau_{-1} + \frac{c_0 + \tau_0 - y_0}{1+r_{-1}} = \tau_{-1} + \frac{\tau_0 - g_0}{1+r_{-1}},$$

where the last equality follows from the resource constraint and the last but one from household demand. Equality of the left-most and the right-most expressions implies that—contrary to the assumption of non-Ricardian fiscal policy—the existence of an equilibrium requires the government's *intertemporal* budget constraint to hold for *any* price level, $p_0$. Perfect foresight (or, in a stochastic framework, rational expectations) and the issuance of government debt at market prices are inconsistent with a non-Ricardian policy and, by implication, with an FTPL link between fiscal policy and the price level. This inconsistency persists, once the transactions role of money and the effects of uncertainty are accounted for, as shown in the remainder of the paper.

## 3 The FTPL: Revaluing Nominal Stocks

The infinitely lived representative household has the objective, as of time $s$, to

$$\max E_s \sum_{t=s}^{\infty} \beta^{t-s} u(c_t, h(v_t)), \tag{1}$$

where $0 < \beta < 1$, $h'(\cdot) \leq 0$, $h''(\cdot) \leq 0$ and $u(\cdot)$ is increasing and concave, satisfies the Inada conditions, and has positive cross partials. $c_t$ and $v_t \equiv c_t p_t / M_t$ denote consumption and velocity, respectively. High velocity is costly because higher real money balances (relative to consumption) reduce the transaction cost (cf. Sims, 1994).

The state of the economy is captured by the stochastic process, $\epsilon_t$. A specific history up to time $t$ is denoted $\epsilon^t$. Conditional on the history $\epsilon^s, s \leq t$, the probability (density) of $\epsilon^t$ equals $f(\epsilon^t|\epsilon^s)$. Equilibrium values of the endogenous variables at time $t$ will generally be functions of $\epsilon^t$. To save on notation, I suppress this argument unless there is danger of confusion.

After observing the current state, $\epsilon_t$, households enter period $t$ with real (goods denominated) financial wealth, $w_t$, and nominal (dollar denominated) financial wealth, $W_t$. (Both $w_t$ and $W_t$ are state-contingent if households chose to hold assets with state-contingent payoffs.) Households then sell goods of the amount $g_t$ to the government[4], pay lump sum taxes $\tau_t$, and trade assets on the asset market. For convenience, and without affecting the generality of the argument, I only

[4]More precisely, households commit to deliver $g_t$ units of the dividend harvested in the period (see below) and, in exchange, receive an immediate credit. This timing convention is not essential for the results and helps keep the relevant expressions simple. In particular, it implies that money demand due to both MIU and the CIA constraint depends on $c_t$ and not on $y_t$. In each period and state of nature, $g_t < y_t$ by assumption.

consider short-term maturities. At the beginning of period $t$, the household's dynamic budget constraint is

$$w_t + W_t/p_t + g_t - \tau_t - (M_t/p_t + \int_{\epsilon^{t+1}|\epsilon^t} Q_t n_t/p_t + q_t m_t \, d\epsilon^{t+1}) = 0, \tag{2}$$

with $m_t$ and $n_t$ denoting the prices of real and nominal Arrow-Debreu securities, respectively. That is, $m_t(\epsilon^{t+1}|\epsilon^t)$ denotes the goods denominated price as of time $t$, state $\epsilon^t$, of one unit of the good at time $t+1$, state $\epsilon^{t+1}$; and $n_t(\epsilon^{t+1}|\epsilon^t)$ denotes the dollar denominated price as of time $t$, state $\epsilon^t$, of one dollar at time $t+1$, state $\epsilon^{t+1}$. The quantities of real and nominal Arrow-Debreu securities purchased by the household are denoted $q_t(\epsilon^{t+1}|\epsilon^t)$ and $Q_t(\epsilon^{t+1}|\epsilon^t)$, respectively. $p_t$ denotes the price level.

Each household owns a tree generating state-contingent real dividends $y_t$. Households are prohibited from consuming dividends of their own tree. Thus, they must interact with other producers/consumers to sell their own production (net sales to the government) and to buy consumption goods. These purchases must be made in cash and consumers must therefore satisfy a CIA constraint which requires velocity not to exceed unity:

$$p_t c_t - M_t \leq 0. \tag{3}$$

The contingent claims bought at the beginning of period $t$, money balances not used for consumption in period $t$, and revenues from sales to other households constitute next period's initial household wealth:

$$q_t + (Q_t + (M_t - p_t c_t) + p_t(y_t - g_t))/p_{t+1} - (w_{t+1} + W_{t+1}/p_{t+1}) = 0, \ \forall \epsilon^{t+1}|\epsilon^t. \tag{4}$$

At the beginning of period $t = 0$, households observe $\epsilon^0$ as well as the state-contingent price and tax sequences $\{m_t, n_t, p_t, \tau_t\}_{t=0}^{\infty}$. Given those and $w_0$, $W_0$, households maximize their expected utility subject to (2), (3), (4), and a no-Ponzi-game condition that prohibits explosive debt schemes. Substituting the definition of velocity into the household's objective function and assigning multipliers $\lambda_t(\epsilon^t)\beta^t f(\epsilon^t|\epsilon^0)$, $-\mu_t(\epsilon^t)\beta^t f(\epsilon^t|\epsilon^0)$, and $\tilde{\lambda}_{t+1}(\epsilon^{t+1})\beta^{t+1} f(\epsilon^{t+1}|\epsilon^0)$ to (2), (3), and (4), respectively, we find $\lambda_t(\epsilon^t) = \tilde{\lambda}_t(\epsilon^t)$ as well as the following first-order conditions (omitting arguments of functions):

$$\begin{aligned} u_{1,t} + u_{2,t} h' p_t/M_t &= E_t[\beta\lambda_{t+1} p_t/p_{t+1}] + \mu_t p_t, &(5)\\ E_t[\beta\lambda_{t+1}/p_{t+1}] + \mu_t &= u_{2,t} h' p_t c_t/M_t^2 + \lambda_t/p_t, &(6)\\ m_t &= \beta\frac{\lambda_{t+1}}{\lambda_t} f(\epsilon^{t+1}|\epsilon^t), &(7)\\ n_t &= \beta\frac{\lambda_{t+1}}{\lambda_t}\frac{p_t}{p_{t+1}} f(\epsilon^{t+1}|\epsilon^t). &(8) \end{aligned}$$

Equation (5) equalizes the marginal benefit and costs of spending an additional unit of wealth on consumption: The former is given by the marginal utility of consumption; the latter are composed of the cost from higher velocity, the expected value of decreasing next period's wealth, and a more tightly binding CIA constraint. Equation (6) (multiplied by $p_t$) equalizes the marginal benefits and cost from spending an additional unit of wealth for real balances: The former equal the associated marginal utility and the value of easing the CIA constraint; the latter amounts to foregone interest. Conditions (7) and (8) are familiar representations of the asset pricing kernel that links current and future marginal utilities of wealth. The riskless real and nominal interest rates, $r_t$ and $i_t$ respectively, are defined by

$$(1+r_t)^{-1} \equiv \int_{\epsilon^{t+1}|\epsilon^t} m_t \, d\epsilon^{t+1}, \tag{9}$$

$$(1+i_t)^{-1} \equiv \int_{\epsilon^{t+1}|\epsilon^t} n_t \, d\epsilon^{t+1}. \tag{10}$$

To simplify (5) and (6), it is useful to introduce a reduced form representation of the felicity function, $\tilde{u}(c_t, M_t/p_t) \equiv u(c_t, h(c_t p_t/M_t))$. Since $\tilde{u}_{1,t} = u_{1,t} + u_{2,t}h' p_t/M_t$ and $\tilde{u}_{2,t} = -u_{2,t}h' c_t p_t^2/M_t^2$, we can rewrite (5) and (6) as

$$\tilde{u}_{1,t} = \lambda_t(1+i_t)^{-1} + \mu_t p_t, \tag{5'}$$

$$\tilde{u}_{2,t} + \mu_t p_t = \lambda_t(1-(1+i_t)^{-1}). \tag{6'}$$

Combined, these two conditions imply $\lambda_t = \tilde{u}_{1,t} + \tilde{u}_{2,t}$: the marginal utility of wealth equals the sum of the marginal utilities from holding (during $t$) and spending (at the end of $t$) the marginal unit of real balances. Substituting out $\lambda_t$ instead of $i_t$, we find $i_t = (\tilde{u}_{2,t} + \mu_t p_t)/(\tilde{u}_{1,t} - \mu_t p_t)$. Finally, solving (6) forward yields

$$\begin{aligned} \lambda_t/p_t &= E_t[\beta\lambda_{t+1}/p_{t+1} + \mu_t + \tilde{u}_{2,t}/p_t] \\ &= \lim_{T\to\infty} E_t\left[\sum_{j=t}^{T-1} \beta^{j-t}(\mu_j + \tilde{u}_{2,j}/p_j) + \beta^{T-t}\lambda_T/p_T\right], \end{aligned}$$

such that the price of money is given by the above expression divided by $\lambda_t$.[5]

The model features both MIU and a CIA constraint. I allow for both of these monetary frictions in order to maintain generality.[6] The following examples discuss standard monetary frameworks as special cases of this setup.

**Example 1 (No monetary frictions)** *The CIA constraint is not present, $\mu_t \equiv 0$, and utility does not depend on velocity, $h'(v_t) \equiv 0$. For an equilibrium to exist, $i_t$ must be zero or a bound on money balances must be imposed. In particular, for $i_t > (<)\ 0$, $M_t \geq (\leq)\ \bar{M}_t$, say. Without such a bound, households would wish to issue (hold) infinite nominal balances to realize riskless profits. We then have $\lambda_t = u_{1,t}(1+i_t)$ and $\nu_t p_t = \lambda_t(1-(1+i_t)^{-1})$, where $\nu_t$ denotes the multiplier on the boundedness constraint. Moreover, $E_t[\beta(1+r_t)(u_{1,t+1} + \nu_{t+1}p_{t+1})/(u_{1,t} + \nu_t p_t)] = 1$. If $i_t = 0$ the boundedness restriction is not binding, $\nu_t = 0$.*

**Example 2 (Standard CIA constraint)** *Utility does not depend on velocity, $h'(v_t) \equiv 0$, but the CIA constraint holds. We then have $\lambda_t = u_{1,t}$, $\mu_t p_t = \lambda_t(1-(1+i_t)^{-1})$, and $E_t[\beta(1+r_t)u_{1,t+1}/u_{1,t}] = 1$. If $i_t = 0$, the CIA constraint does not bind, $\mu_t = 0$. With positive nominal interest rates, it binds so that $c_t p_t = M_t$. To exclude negative nominal interest rates, one must impose a boundedness restriction on nominal balances. Without such a bound, households would wish to hold infinite nominal balances to realize riskless profits.*

[5] This generalizes a result in Svensson (1985).

[6] The CIA constraint represents the limit of MIU as the elasticity of substitution between consumption and real balances approaches zero (cf. Feenstra, 1986). However, in this limit case, the equilibrium relations between marginal utilities and the nominal interest rate cease to hold since money demand is no longer elastic with respect to the nominal interest rate. For that reason, I explicitly and separately model the CIA constraint.

**Example 3 (MIU framework)** *Utility depends on velocity,* $h'(v_t) < 0$, *but the CIA constraint is absent,* $\mu_t \equiv 0$. *We then have* $\lambda_t = \tilde{u}_{1,t}(1+i_t)$, $\tilde{u}_{2,t} = \lambda_t(1-(1+i_t)^{-1})$, $\tilde{u}_{2,t}/\tilde{u}_{1,t} = i_t$, *and* $E_t[\beta(1+r_t)(\tilde{u}_{1,t+1}(1+i_{t+1}))/(\tilde{u}_{1,t}(1+i_t))] = 1$. *(To allow for preferences that are additively separable in consumption and real balances,* $h(v_t)$ *must be modified to* $h(p_t/M_t)$*.)*

The government faces an exogenous state-contingent stream of resource requirements, $\{g_t\}$. This expenditure stream as well as the interest payments on previously issued liabilities are financed out of lump sum taxes and seignorage. In line with the FTPL literature, I model monetary policy as following a nominal interest rate peg. (Whereas the FTPL literature often *needs* to make this assumption[7], it is of no significance for my argument.) In particular, I assume this peg to be an exogenous, bounded, strictly positive sequence.[8] Lump sum taxes are collected in either a Ricardian or a non-Ricardian fashion. Whereas both Ricardian and non-Ricardian policies identically satisfy the government's dynamic budget constraint, only the former identically satisfy its intertemporal budget constraint:[9]

**Definition 1** *A* Ricardian policy *under* $\{g_t, i_t\}$ *consists of policy rules for* $\{\tau_t, q_t, Q_t, M_t\}$ *which guarantee that, given* $\{g_t, i_t\}$, *the government's dynamic and intertemporal budget constraints are satisfied for any sequence of prices.*

*A* non-Ricardian policy *under* $\{g_t, i_t\}$ *consists of policy rules for* $\{\tau_t, q_t, Q_t, M_t\}$ *which guarantee that, given* $\{g_t, i_t\}$, *the government's dynamic budget constraint is satisfied for any sequence of prices whereas its intertemporal budget constraint is satisfied for some, but not all, sequences of prices.*

In equilibrium, $g_t$ must equal the amount of resources not consumed by the private sector,

$$y_t = c_t + g_t. \tag{11}$$

Using (11), the sequence of intertemporal budget constraints of the private sector (which incorporate (2), (4), and the no-Ponzi-game condition) can be expressed as a sequence of intertemporal budget constraints for the government:[10]

$$\omega_s \equiv w_s + W_s/p_s = \sum_{t=s}^{\infty} \int_{\epsilon^t|\epsilon^s} \left(\tau_t + \frac{M_t}{p_t}\frac{i_t}{1+i_t} - g_t\right)\left(\prod_{j=s,\epsilon^s}^{t-1,\epsilon^{t-1}} m_j\right) d\epsilon^t. \tag{12}$$

Condition (12) states that, in equilibrium, initial government liabilities in real terms equal the market value of future tax revenue (lump sum taxes plus seignorage) minus the market value of future government expenditures. We can now define equilibrium.

[7]A money supply target, for example, will directly determine the price level if the CIA constraint is binding and the equilibrium interest rate is positive. The FTPL link will then over determine the price level.

[8]Generalizations are possible, see below.

[9]To the extent that one government authority "moves before" another, a Ricardian regime triggers a game of chicken: The follower's choices are restricted to policy rules that identically satisfy the government's intertemporal budget constraint (cf. Sargent, 1987, ch. 5).

[10]Using (7) and (8), the household's dynamic budget constraint, (2) and (4), can be expressed as

$$\omega_t = \tau_t - g_t + \frac{M_t}{p_t}\frac{i_t}{1+i_t} + (c_t + g_t - y_t)\frac{1}{1+i_t} + \int_{\epsilon^{t+1}|\epsilon^t} \omega_{t+1}\, m_t\, d\epsilon^{t+1}.$$

Recursive substitution, application of the resource constraint and the no-Ponzi-game condition yield (12).

**Definition 2** *A* rational expectations equilibrium (REE) *under* $\{g_t, i_t\}$ *consists of a Ricardian or non-Ricardian policy* $\{\tau_t, \tilde{q}_t, \tilde{Q}_t, \tilde{M}_t\}$ *and prices* $\{m_t, n_t, p_t\}$ *such that, given those and* $\{y_t\}, w_0, W_0$*, the household choices* $\{c_t, q_t, Q_t, M_t\}$ *and multipliers* $\{\lambda_t, \mu_t\}$ *(and possibly* $\{\nu_t\}$*) solve (3), (4), (5'), (6'), (7), (8), (12) and the aggregate consistency requirements (9), (10), (11),* $\{\tilde{q}_t\} = \{q_t\}, \{\tilde{Q}_t\} = \{Q_t\}, \{\tilde{M}_t\} = \{M_t\}$ *are satisfied.*

In the following, I will assume at least one monetary friction to be present. (The results trivially extend to the case without monetary frictions, where households hold zero real balances.) That is, (i) households face a CIA constraint (although it might not bind) and/or (ii) $h'(v_t) < 0, h''(v_t) < 0$.[11] I refer to the three possible constellations as case (a) if only (i) applies; case (b) if only (ii) applies; and case (c) if both (i) and (ii) apply. Further, to avoid unnecessary repetition, I impose the market clearing conditions for asset markets by no longer distinguishing between $\tilde{x}_t$ and $x_t$ for $x = q, Q, M$.

To characterize equilibrium, the following Lemmas prove useful.

**Lemma 1** *If an REE exists, then* $c_t = y_t - g_t$ *and*

$$M_t/p_t = \begin{cases} y_t - g_t & \text{if case (a)} \\ z_t & \text{if case (b)} \\ \max(y_t - g_t, z_t) & \text{if case (c)} \end{cases}$$

*where* $z_t$ *solves* $i_t = \tilde{u}_{2,t}(y_t - g_t, z_t)/\tilde{u}_{1,t}(y_t - g_t, z_t)$.

Proof. The first result follows directly from (11). The second result follows from (3), (5'), and (6'): (5') and (6') imply $i_t = (\tilde{u}_{2,t} + \mu_t p_t)/(\tilde{u}_{1,t} - \mu_t p_t)$, the right-hand side of which decreases in $M_t/p_t$ (if $h' < 0$) and increases in $\mu_t p_t$. The result immediately follows for case (a) (the CIA constraint binds, since $i_t > 0$) and case (b) ($\mu_t \equiv 0$). For case (c), first suppose that $\mu_t = 0$. Then, $M_t/p_t > c_t$ and the result follows. Suppose otherwise that the CIA constraint binds, $\mu_t > 0$. Then, $M_t/p_t = c_t > z_t$. ■

**Lemma 2** *If an REE exists, then the state-contingent equilibrium sequences* $\{i_t, c_t, M_t/p_t, \mu_t p_t, \lambda_t, m_t, r_t, \omega_t\}$ *are unique.*

Proof. The monetary policy rule specifies $i_t$. $c_t, M_t/p_t, \mu_t p_t$ follow from Lemma 1. $\lambda_t$ equals $\tilde{u}_{1,t}(c_t, M_t/p_t) + \tilde{u}_{2,t}(c_t, M_t/p_t)$ from (5') and (6'). $m_t$ and $r_t$ follow from (7) and (9). $\omega_t$ follows from (12). ■

**Lemma 3** *If an REE exists, then the state-contingent inflation rates are indeterminate unless the economy is deterministic or the set of marketed assets sufficiently small. The portfolio allocation between* $q$ *and* $Q$ *is indeterminate, unless the set of marketed assets is sufficiently small.*

Proof. The inflation rates and the portfolio allocation are only constrained (from (8) and (10), and (4)) by

$$\begin{aligned} (1 + i_{t-1})^{-1} &= \int_{\epsilon^t|\epsilon^{t-1}} m_{t-1} \frac{p_{t-1}}{p_t} \, d\epsilon^t, \\ \omega_t &= q_{t-1}(\epsilon^t|\epsilon^{t-1}) + \frac{Q_{t-1}(\epsilon^t|\epsilon^{t-1})}{p_t} + \frac{M_{t-1}}{p_{t-1}} \frac{p_{t-1}}{p_t}, \ \forall \epsilon^t|\epsilon^{t-1}. \end{aligned}$$

[11] Assumptions $h'(v_t) < 0, h''(v_t) < 0$ and $u_{12}(\cdot) > 0$ imply $\tilde{u}_{12}(\cdot) > 0$.

$i_{t-1}$, $m_{t-1}$, $M_{t-1}/p_{t-1}$, and $\omega_t$ are uniquely determined (cf. Lemma 2). It is evident that with uncertainty and without restrictions on $(q_{t-1}, Q_{t-1})$, the distribution of inflation across states is indeterminate. Even conditional on some state-contingent inflation rates that satisfy the first equation, only the state-contingent real value of total government debt, $q_{t-1} + Q_{t-1}/p_t$, is fixed. Its composition generally remains indeterminate. ■

Several remarks on Lemma 3 are in order. First, in a perfect foresight setting, the initial price level completely determines the equilibrium price level sequence. This is not the case under uncertainty, since the interest rate peg only fixes a weighted average of the inflation rates. Second, even conditional on some state-contingent equilibrium price level sequence and the associated money supply sequence, the portfolio allocation between $q$ and $Q$ remains indeterminate (cf. Sargent, 1987, Proposition 5.2).[12] Third, suppose that the government only issues dollar denominated, "riskless" claims: $q_{t-1} \equiv 0$, $Q_{t-1}(\epsilon^t|\epsilon^{t-1}) \equiv \bar{Q}_{t-1}\ \forall \epsilon^t|\epsilon^{t-1}$. Inflation rates and nominal claims must then satisfy

$$\begin{aligned} 1 &= \int_{\epsilon^t|\epsilon^{t-1}} m_{t-1}/p_t \, d\epsilon^t \, (1+i_{t-1})p_{t-1}, \\ \omega_t &= \frac{\bar{Q}_{t-1} + M_{t-1}}{p_t}. \end{aligned}$$

If $\omega_t$ differs across states so must prices: the existence of an equilibrium is inconsistent with truly riskless nominal claims (i.e., claims that pay a safe real return) and a stochastic fiscal policy necessarily implies price level instability.[13 14] In such an economy with nominal, "riskless", one-period bonds, the price level is recursively pinned down by

$$p_t = \left( \omega_{t-1} + g_{t-1} - \tau_{t-1} - \frac{M_{t-1}}{p_{t-1}} \frac{i_{t-1}}{1+i_{t-1}} \right) \frac{(1+i_{t-1})p_{t-1}}{\omega_t}$$

once an initial price level is fixed.[15] Cochrane (2001) shows that the inflation rate sequence remains uniquely determined under general maturities, although its stochastic properties are strongly affected by the specific choice of maturity structure.[16]

With these preliminary findings, we can now characterize equilibrium under the different policy regimes. Consider first the case of a Ricardian policy. Under such a regime, the government is committed to levying taxes such that (12) is identically satisfied. Therefore, the intertemporal budget constraint imposes no restrictions on the endogenous variables; it only constrains fiscal policy.

**Proposition 1** *Suppose policy is Ricardian. Then an REE exists. The state-contingent equilibrium sequences* $\{i_t, c_t, M_t/p_t, \mu_t p_t, \lambda_t, m_t, r_t, \omega_t\}$ *are uniquely determined. The initial price level is indeterminate. The state-contingent inflation rates are indeterminate unless the economy is deterministic or the set of marketed assets sufficiently small.*

[12] Similarly, a Ricardian equivalence result applies: A change in the time and state profile of lump sum taxes with an (under the equilibrium prices) unchanged market value of lump sum tax collections does not affect any of the equilibrium sequences except $\{\omega_t, q_t, Q_t\}$.

[13] Christiano and Fitzgerald (2000) label this result "Woodford's really unpleasant arithmetic."

[14] State contingent government debt, explicit or due to state-contingent inflation, need not be detrimental from a welfare point of view. Cf. Lucas and Stokey (1983) for an analysis under the assumption of distortionary taxation.

[15] This follows from the equation in Footnote 10.

[16] Cochrane's model involves no monetary frictions and has $M_{t-1} \equiv 0$.

Proof. Lemmas 1 and 2 incorporate all restrictions imposed by an REE under a given policy specification, except (4) and (12). Under a Ricardian policy, (12) is satisfied by assumption. Moreover, $(q_t, Q_t)$ can be freely chosen to satisfy (4) and an REE therefore exists. The (in)determinacy results follow from Lemmas 2 and 3 as well as the fact that no condition restricts the initial price level. ■

Under a Ricardian policy rule, the price level sequence remains indeterminate because the equilibrium restrictions are homogeneous of degree zero in $(M_t, p_t, \mu_t^{-1})$. This is the standard price level indeterminacy result under a nominal interest rate peg. Moreover, as discussed in Lemma 3, there exists a multiplicity of equilibrium assignments of stochastic inflation rates (cf. also Woodford, 1994).

Consider next the case of a non-Ricardian policy. Under such a regime, the government is not committed to identically satisfying (12) and the intertemporal budget constraint imposes an additional restriction on the endogenous variables.

**Proposition 2** *Suppose policy is non-Ricardian and the level of initial nominal government liabilities differs from zero. Then an REE exists. The state-contingent equilibrium sequences* $\{i_t, c_t, M_t/p_t, \mu_t p_t, \lambda_t, m_t, r_t, \omega_t\}$ *and the initial price level are uniquely determined. The state-contingent inflation rates are indeterminate unless the economy is deterministic or the set of marketed assets is sufficiently small.*

Proof. Lemmas 1 and 2 incorporate all restrictions imposed by an REE under a given policy specification, except (4) and (12). Under a non-Ricardian policy, the initial price level adjusts to the unique level that solves (12). Moreover, $(q_t, Q_t)$ can be freely chosen to satisfy (4) and an REE therefore exists. The (in)determinacy results follow from Lemmas 2 and 3. ■

Under a non-Ricardian policy and non-zero initial nominal government liabilities, the initial price level is determinate. It equalizes the present discounted value of future net revenues (which are determined in a non-Ricardian fashion) with the market value of outstanding government liabilities.[17] [18] The intuition for this FTPL link between non-Ricardian policy and the price level is straightforward: The interest rate peg and the non-Ricardian policy render the dynamics of government liabilities inherently unstable. Condition (12), on the other hand, requires that a transversality condition be satisfied in equilibrium. The existence of equilibrium therefore hinges on the initial condition of the system. The FTPL link allows to manipulate this initial condition by letting the price level appropriately revalue outstanding government liabilities.[19]

**Proposition 3** *Suppose policy is non-Ricardian and the level of initial nominal government liabilities equals zero. Then, an REE only exists if the initial real government debt* happens *to satisfy (12), subject to the equilibrium values* $\{M_t/p_t, m_t\}$ *implied by Lemmas 1 and 2. In that case, the implications of Proposition 1 apply.*

Proof. Without initial nominal government liabilities, all variables in (12) are either predetermined or fixed by other equilibrium conditions (cf. Lemma 2). An REE exists only if (12)

[17] As mentioned earlier, an REE under a non-Ricardian policy rule might result in a negative price level. Note also that the existence of an REE hinges on whether the equilibrium conditions without (12) leave the price level indeterminate. Whenever this is not the case (for example in a standard CIA constraint setting with a money supply rule and positive nominal interest rates), the equilibrium price level under a non-Ricardian policy is over determined.

[18] The same result holds under more general assumptions about the nominal interest rate rule; for example, $i_t$ might depend on lagged price levels.

[19] Cf. Leeper's (1991) discussion of "active" and "passive" policies and their implications for stability.

happens to be satisfied at those values. In that case, the non-Ricardian policy exactly replicates a Ricardian policy. ∎

Propositions 1–3 show that the specification of the policy rule and the initial level of nominal government liabilities crucially determine whether an REE exists and whether the price level is determinate: (i) Under a Ricardian policy, the auctioneer is free to pick the initial equilibrium price level; (ii) under a non-Ricardian policy with non-zero initial nominal liabilities, the auctioneer is restricted in this choice: only the specific price level that equilibrates the government's intertemporal budget constraint results in an REE; finally (iii) under a non-Ricardian policy with zero initial nominal liabilities, the auctioneer has no influence on the existence of an REE: everything hinges on whether the policy happens to replicate a Ricardian rule in which case an REE exists.

Proposition 2 replicates the argument of the FTPL supporters who exclusively focus on (ii) when arguing that the price level is fiscally determined. But even if (ii) were the relevant case to consider, this interpretation would only be valid with respect to the initial price level, since the equilibrium inflation rates remain indeterminate even under a non-Ricardian policy (cf. Lemma 3). The reason for this inflation indeterminacy is that once the FTPL link has pinned down the initial price level, there is neither a need nor scope for it to operate again: No need, because the real value of outstanding government liabilities is then fixed at a level guaranteeing that (12) is satisfied in the current and all future periods.[20] The equilibrium conditions are therefore identical to those under a Ricardian policy, where the initial price level has been fixed by the auctioneer. No scope, because the FTPL link in the initial period operates like a *surprise*, i.e. a state of nature whose likelihood has not been correctly anticipated. Since such surprises are inconsistent with rational expectations, the FTPL link cannot operate in any other period than the initial one. It is exactly this feature that calls into question whether the FTPL link is still consistent with a rational expectations equilibrium, once the *issuance* of government debt is properly taken into account.

Modeling the issuance of government debt is also advisable for another reason. Supporters of the FTPL rationalize their assumption of a non-Ricardian policy by stressing that (12) should be interpreted as a "government valuation equation", and not as a budget constraint. Cochrane (2000), for example, compares the FTPL link in (12) to the pricing of privately issued equity: "First, the issuer decides how many shares ... he will sell, pledging to divide the state-contingent profit stream ... among the shareholders. ... The equilibrium price ... of securities is then determined [by an expression parallel to (12)]" (pp. 16). An inspection of this comparison exposes a flaw: Whereas the stock analogy describes the pricing of an asset to be issued, the interpretation of (12) as a government valuation equation implicitly introduces the *re*valuation of an asset issued in an earlier period. But under rational expectations, asset prices evolve along their state-contingent equilibrium paths, without such unforeseen revaluations. An "initial" revaluation via the FTPL link is therefore inconsistent with a rational expectations equilibrium in a slightly extended model stretching one period further into the past. Put differently, if the FTPL link operates in some "initial" period, then the model cannot explain how (as much) nominal government debt could had been issued before that period. Only the Ricardian policy assumption allows a meaningful discussion of the issuance of all government debt.

I now formalize this intuition.

**Definition 3** *A* rational expectations equilibrium with issued assets (REEI) *under* $\{g_t, i_t\}$ *is a REE with no nominal asset holdings at the beginning of the initial period.*

[20] This follows from the equation in Footnote 10.

To check whether non-Ricardian policies and the FTPL link are consistent with an REEI, we simply need to return further in time than for our previous discussion, up to a period $k < 0$ say, where $W_k$ equals zero such that all nominal assets are issued in or after period $k$. Since an REEI as of period $k$ is the same as an REE with $W_k = 0$, it directly follows that the existence of an REEI is consistent with a Ricardian policy, but in general not with a non-Ricardian policy.

**Proposition 4** *(i) Suppose policy is Ricardian. Then an REEI exists and the implications of Proposition 1 apply. (ii) Suppose policy is non-Ricardian. Then an REEI only exists if the initial real government debt* happens *to satisfy (12), subject to the equilibrium values $\{M_t/p_t, m_t\}$ implied by Lemmas 1 and 2. In that case, the implications of Proposition 1 apply.*

Proof. The proof follows directly from Propositions 1 and 3. ■

Proposition 4 makes it clear that the feasibility of non-Ricardian policies as well as the FTPL link between such policies and the price level is an artifact of an incompletely specified model: The FTPL relies on an asset revaluation occuring immediately at the beginning of the initial period; this revaluation only works in the presence of non-zero outstanding nominal liabilities; but the model cannot rationalize how these liabilities could had been issued (in that amount) in the first place. Non-Ricardian policies are not feasible because households cannot be cheated or forced to hold government debt if they must expect the latter to yield returns below the market clearing level.

### 3.1 Objections

At this point, several questions or objections might arise. I discuss them in turn.

i. *Government default.* Does the requirement that policy be Ricardian exclude the possibility of government default? No. It is perfectly possible for a government to default in an REEI. Default is just a special case of $W_t$ (or $w_t$), the dollar value (or real value) of debt at maturity, stochastically varying with $\epsilon^t$. Partial or full default in some state(s) of nature is consistent with an REEI, as long as the payoffs in other states are high enough to ex ante compensate investors for the potential losses.

ii. *State contingent policy regimes.* Consider an economy that started from zero initially outstanding nominal assets and assume that the policy regime is state contingent in the following sense: In period $t$, state $\hat{\epsilon}^t$, the real primary surplus sequence from then on is exogenously fixed while it is endogenous in all other states of nature at $t$. One might suspect that the prospect of a likely endogenous fiscal policy after period $t$ should allow the government to issue any desired amount of nominal debt before that date; and that whatever level of nominal debt is carried into period $t$, state $\hat{\epsilon}^t$, together with the exogenous surplus sequence from $\hat{\epsilon}^t$ on, constrains the equilibrium value of $p_t(\hat{\epsilon}^t)$ and thus fiscally determines the price level in this particular branch of the event tree. But this is not the case. To understand why, note that a policy regime cannot be Ricardian in some states of nature and non-Ricardian in others: As long as fiscal policy is endogenous in some periods or contingencies, the whole program remains Ricardian. What might appear to be a non-Ricardian "sub-regime" as of state $\hat{\epsilon}^t$ in the above supposition, is truly one contingency within a broader Ricardian scheme. In this broader scheme, the seemingly non-Ricardian regime of exogenous primary surpluses from $\hat{\epsilon}^t$ onwards is consistent with an REEI, as long as these surpluses are balanced ex ante by surpluses in the other periods and contingencies. At the same time, the price level in general and $p_t(\hat{\epsilon}^t)$ in particular are not (fiscally) determined, as shown earlier. Instead, they are chosen by the Walrasian auctioneer, subject to the conditions discussed in Lemma 3. It is not the amount of nominal debt, together with the surplus sequence, that determines the price level in $\hat{\epsilon}_t$; the price level sequence, together with the portfolio allocation and state contingent real government liabilities, rather determines the amount of nominal debt issued in period $t-1$ and carried into state $\hat{\epsilon}_t$.

iii. *What comes first: Nominal deficits or the price level?* Note that the REEI conditions fix the real deficit, $d_0$, in the initial period. The timing can then be either way:[21] (1) The fiscal authority can move before the auctioneer and issue nominal debt in the amount $A$ say. This determines the bond market clearing price level as $p_0 = A/d_0$. Note, that this is not the FTPL for policy is Ricardian. (2) The auctioneer can move first and fix $p_0$ (together with the successive price levels). The government then issues nominal debt to the point where $A = p_0 d_0$. It cannot issue more than that amount because households would not willingly hold more, knowing that only $d_0$ can be sustained in real terms.

Both variants (1) and (2) are internally consistent. Their implications, e.g., for inflation, are identical. In both cases, policy is Ricardian.

iv. *Expectations of future policy.* The result that policy must be Ricardian relies on the assumption that households rationally anticipate the possible surplus sequences. While this assumption is strong, it is certainly standard, especially in the context of (i) asset pricing and (ii) the evaluation of different policy schemes (cf. Lucas, 1976). Note moreover that this paper does not impose the rational expectations assumption on the FTPL. Rather, the FTPL itself assumes rational expectations. This paper only argues that the rational expectations assumption must be *consistently* applied, and not only from some arbitrary period onwards. In effect, the crucial postulate is that expectation formation in any period be consistent with expectation formation in the preceding period, not that expectations be formed rationally in the sense that subjective and objective probabilities of policy regimes exactly coincide.

v. *A useful shortcut?* Can we accept the FTPL as a useful shortcut although it does not explain how nominal debt could have been issued in the first place? A useful shortcut abstracts from channels that are not first order, while the FTPL, in contrast, does abstract from a channel that is first order. The FTPL explains the price level, based on a relationship between the latter, predetermined nominal debt ($W_t$) and future surpluses. By treating nominal debt as predetermined, it neglects that $W_t$ is an endogenous state variable, chosen subject to the expected price level. The FTPL thus neglects the first-order effect of an asset's expected yield on the demand for that asset. It analyzes the impact of a state of nature that the market had perceived to be impossible—similar to a surprise in a perfect foresight world.

vi. *Implications for other models.* Many standard models of monetary or fiscal policy start from the assumption that some real or nominal debt is outstanding. Does the argument of this paper imply that the conclusions of these models have to be revisited? No. The problematic aspect of the FTPL is not that it assumes some positive stock of initially outstanding government liabilities. Instead, it is the implicit assumption that the government

[21] I disregard uncertainty here and assume no monetary frictions.

does not honor these liabilities. But this non-Ricardian policy assumption is not made in the previous literature.

## 4 An Alternative? Valuing Nominal Flows

Is it possible to construct a modified theory generating a link between non-Ricardian fiscal policy and the price level without suffering from the consistency problems of the FTPL? In principle, it is. To that end, the revaluation of nominal stocks needs to be replaced by the valuation of nominal flows. Consider a fiscal authority imposing real and nominal taxes and transfers—both in a non-Ricardian fashion. With nominal transfers $T_t$ and no outstanding government liabilities in the initial period $k$, the equilibrium conditions are unchanged except that (2) and (12) are replaced by

$$\omega_t + T_t/p_t + g_t - \tau_t - (M_t/p_t + \int_{\epsilon^{t+1}|\epsilon^t} Q_t n_t/p_t + q_t m_t \, d\epsilon^{t+1}) = 0, \tag{2'}$$

$$\omega_s = \sum_{t=s}^{\infty} \int_{\epsilon^t|\epsilon^s} \left( \tau_t - \frac{T_t}{p_t} + \frac{M_t}{p_t} \frac{i_t}{1+i_t} - g_t \right) \left( \prod_{j=s,\epsilon^s}^{t-1,\epsilon^{t-1}} m_j \right) d\epsilon^t, \quad \omega_k = 0. \tag{12'}$$

As before, $\{g_t, \tau_t, T_t, i_t, M_t/p_t, m_t\}$ are uniquely determined in equilibrium. Under a non-Ricardian policy, (12') and the equilibrium inflation rates therefore constrain the initial price level, $p_k$. Nominal transfers thereby play the same role as outstanding nominal government debt in the FTPL: They establish a lever allowing the initial price level to equilibrate the government's intertemporal budget constraint, despite the non-Ricardian policy specification. However, whereas this lever is associated with a surprise revaluation of previously issued assets in the FTPL, this is not the case here. The assumption of nominal flows therefore avoids the problems discussed in Section 3—coercive fiscal instruments work where market transactions fail.

An alternative representation of (12') further highlights the parallels between the two setups. Define $\widetilde{W}_s$ as the time $s$ dollar value of the nominal transfer stream $\{T_t\}_{t=s}^{\infty}$, $\widetilde{W}_s \equiv \sum_{t=s}^{\infty} \int_{\epsilon^t|\epsilon^s} T_t \left( \prod_{j=s,\epsilon^s}^{t-1,\epsilon^{t-1}} n_j \right) d\epsilon^t$. As of time $k$, equation (12') can then be expressed as

$$\frac{\widetilde{W}_k}{p_k} = \sum_{t=k}^{\infty} \int_{\epsilon^t|\epsilon^k} \left( \tau_t + \frac{M_t}{p_t} \frac{i_t}{1+i_t} - g_t \right) \left( \prod_{j=k,\epsilon^k}^{t-1,\epsilon^{t-1}} m_j \right) d\epsilon^t. \tag{12''}$$

Any equilibrium assignment of inflation across states of nature fixes the nominal value of $\widetilde{W}_k$.[22] Since the real value of this "promise" of future transfer payments must satisfy (12") in equilibrium, non-Ricardian policy pins down the initial price level in exactly the same manner as in the FTPL setup.

Does this partial restoration of the FTPL link then imply that we need to update Sargent and Wallace's (1981) result on how monetary and fiscal policy interact in determining the equilibrium rate of inflation? No. The Ricardian or non-Ricardian character of the policy regime only determines how the *initial* price level is fixed: either by the auctioneer, or by the equilibrium condition (12"). It does not affect equilibrium *inflation* which is determined by equilibrium

[22] If the economy is deterministic or the transfer stream is not state dependent, then this nominal value is pinned down independent of the specific equilibrium allocation of inflation across states of nature.

conditions other than (12") that apply under any regime.[23] In particular, it is influenced by the surplus sequence, the maturity structure of government debt, and the portfolio allocation between real and nominal claims (cf. Lemma 3).

## 5 Conclusions

Along the lines of previous literature, the FTPL assumes that sometimes in the past, the government has been able to issue nominal liabilities. In addition, and in contrast to previous literature, it implicitly postulates that the return on these liabilities predictably differs from the market return. These two assumptions are not consistent with each other. Households that expected the government not to live up to the terms of its commitment would not have bought (as much) government debt in the first place.

While the FTPL thus leads to a contradiction, fiscal price level determination is nevertheless possible. It requires the government to simultaneously commit to real and nominal flows. The price level then plays the same role of a lever between real and nominal values as in the FTPL, but without having to induce an ex post revaluation. Although theoretically consistent, such a modified framework provides no new insights into the determination of equilibrium inflation.

Under the supposition of exogenous policy rules, Sargent and Wallace's (1981) analysis therefore remains exhaustive. The FTPL does not add to our understanding of the interaction between monetary and fiscal policy. Further progress in that respect should come from a better appreciation of the *choices* underlying fiscal and monetary policy. What is then needed is a specification of policy makers' preferences and the restrictions they face. As this paper has shown, the latter include the government's intertemporal budget constraint.

[23] This interpretation contrasts with the "tight money paradox" in the FTPL literature (cf. Christiano and Fitzgerald, 2000; Loyo, 1999; Woodford, 2001) according to which an aggressive Taylor rule (in the sense that the monetary authority elastically adjusts the nominal interest rate to an increase in inflation) paired with a non-Ricardian fiscal policy results in an inflationary or deflationary spiral. The argument is the following: Under a non-Ricardian policy, (12) determines the initial price level. Given the previous period's price level, this pins down the initial inflation rate. Due to the central bank's aggressive reaction function, inflation above (below) the desired stationary rate results in a high (low) nominal interest rate and therefore in even higher (lower) future inflation. Under a Ricardian policy, in contrast, (12) does not pin down the initial price level and the desired inflation rate can be attained. The problem with this argument is the assumption of a given price level in the "period before the initial period." It is unclear where this period comes from. If introduced, the assumption of a non-Ricardian regime is led *ad absurdum*, as discussed in Section 3.

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ISSN 0347-8769
Stockholm, 2002
Institute for International Economic Studies