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Monetary policy rules, the Fiscal Theory of the Price Level
and (almost) all that jazz: In quest of simplicity

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I am deeply indebted to Carlos A. Vegh for many insightful comments and, more importantly, for his interest in my work and our invigorating exchanges for many years.

Guillermo Calvo's work has invariably been distinguished not only by deep relevance, but by elegant simpleness. Since imitation (successful or not) is the sincerest form of admiration, it seems fitting for this paper to be an attempt to reexamine a group of closely related questions in the same spirit of a quest for simplicity. Readers of Calvo's work will also recognize the connection between some of the points touched upon in this paper and some of his contributions --most notably, the relevance of the government budget constraint (Calvo [1985]), the concern with levels *versus* rates of change [Calvo [1981]) and the study of interest rate pegging policies (Calvo and Vegh [1990]).

The central question I address is the so-called "fiscal theory of the price level" (*FTPL*), and some closely related topics, such as the pegging of the nominal interest rate and the existence not only of an equilibrium, but of mechanisms which under different assumptions will or will not allow the attainment of such equilibrium.

The relevant literature during the last fifteen years or so has been both vast and diverse, with the "eye of the storm" being the proposition, first advanced in its most stark form by Woodford [1995], that under certain conditions, and for a given level of nominal "government debt" (bonds *cum* fiat money) the path of the price level is determined exclusively by fiscal policy (i.e., the anticipated path of the government primary surplus and of government debt). Indispensable references in this discussion are, among others, Sims [1994, 1999], Cochrane [2001, 2002], Kocherlakota and Phelan [1999], McCallum [1997, 2001], Christiano and Fitzgerald [2000], Buiter ([2002], [2005]), Leeper [1991], Bassetto, [2002], Niepelt, [2004], Dupor [2000] and Daniel [2001] for the case of the open economy and, of course, Woodford, especially [1994, 1995, 1998] Although the natural benchmark for the beginning of the discussion is Woodford [1995], there are previous pieces anticipating some of the same propositions [Begg and Haque [1984], Auernheimer and Contreras [1990, 1995]). As it is usually the case, there are also classical works touching on some of the very basic concepts --Metzler [1951] being, of course, the primary reference, as well as Tobin [1974] and, more recently, the already "classic" Sargent and Wallace's "unpleasant

monetarist arithmetic" [1981].

This paper is certainly not a survey, but the re-visitation of the question along the lines of a very simple framework first presented in Auernheimer and Contreras [1990], and the evaluation of some of the propositions for and against the basic *FTPL* claims. Even a casual reader will notice that the literature is extensive, in some instances a bit unfocused and at times "full of sound and fury".¹ Rather than addressing the various propositions and counter-propositions, we will proceed with the analysis of the simple model, derive some results and indicate, in each case, the extent to which these results are or not in agreement with those advanced by the various contenders.

We consider an extremely simple model (and will not hesitate to use graphical representations when helpful), which is rather standard in the literature and, in fact, basically coincides with models used in most of the discussion. At variance with most if not all the literature on the subject, we use continuous time, for two related reasons.² First, the analysis is simpler and less cluttered. Second, ambiguities and potential confusion among dates and "beginning or end of the period" questions are removed, and the distinction between levels and rates of change is sharpened --this last consideration being particularly important in this case.³

¹ Witness some of the statements in the discussion: "*The thesis of this paper is that the 'fiscal theory of the price level' is fatally flawed*". Buiter [2002], p. 459 and, in the abstract of the same paper, "*This paper argues that the 'fiscal theory of the price level' has feet of clay*". Niepelt, [2004], Paper title: "*The Fiscal Myth of the Price Level*".

² For a notable exception, see Daniel [2001].

³ It is of course true that a correctly constructed discrete time model should have, as a limit when the interval between dates approaches zero, an equivalent continuous time version, and *vice versa*, but this is not always easy to secure. See, for example, Carlstrom and Fuerst [2001], where, in the context of a different question, it is shown how "seemingly minor modifications" (whether beginning of the period or end of the period real money balances should enter the utility function) can have the consequence of "dramatic differences" in the conclusions. The authors interpret their results as suggesting that "as monetary theorists we must be more careful in writing down the basics of our models" and that "there are concerns with continuous-time analyses that simply sweep this fundamental timing issues under the rug". We certainly agree with the first of these conclusions, but much less so with the second.

There is still another, more compelling reason for our choice of continuous time analysis, that will become clear as we proceed. In the class of problems we discuss, the fundamental questions are about initial conditions at time $t = 0$: in the absence of anticipated future changes in policy or in behavioral parameters, the whole path of all variables, including of course the price level, is determined at that initial time. More often than not, and depending on the "pre-initial" conditions at time $t = 0^-$, those initial conditions require discrete changes in some variables --the most important one in our case, although not the only one, being the price level. There is quite a bit of economic analysis and market mechanisms that can be discussed concerning the realization of those changes, and in continuous time there is a very sharp distinction between the mechanics of those discrete changes happening "at once" (as if time could be "stopped" at $t = 0^-$) and the ensuing evolution of the variables once time is "reinitiated" at $t = 0^+$. In Section 1 we present the bare-bones simple model, and elaborates on some basic points to be addressed. Section 2 considers the case of a "monetary rule", in which government sets the path of the money supply, and Section 3 compares the model's conclusions to some of the propositions in the literature. Section 4 discusses the case of a central bank pegging the nominal interest rate, and Section 5 concludes.

1.-- The Model

Individuals are identical, infinitely-lived, and at each point in time maximize the present value of their lifetime utility, which depends on their consumption and the services of their real money stock. We assume the utility function to be separable in the two arguments. Time is continuous, there is perfect foresight and prices are perfectly flexible. Then, at each initial point $t = 0$, the typical individual maximizes

$$[1] \quad \int_0^{\infty} U(c(t), m(t)) e^{-\rho t} dt$$

where ρ is the positive, constant rate of time preference, and c , m , are the flow of consumption and the stock of real balances, respectively.

Individuals receive a constant flow endowment of an instantaneously perishable single commodity, which we call "real income" and hold two assets: fiat money, which yields no interest, and government bonds. The exact characterization of these government bonds is crucial for some of the questions at hand, and requires some elaboration.⁴ Here, we define them as "call bonds", paying the prevailing nominal interest rate but with instantaneous maturity, i.e., very much as sight deposits. As deposits, they are denominated in terms of the monetary unit (say, one dollar), and changes in the nominal interest rate carry no capital gains or losses. This is, in its discrete-time equivalent form of "one period bonds", the assumption used in much of the literature.⁵

The stock of nominal money is denoted by M ; with P being the money price of the single good (the price level), so $m \equiv M/P$ is the real money stock.

The typical individual's flow budget constraint expressed in nominal terms, an identity at each point time t , is then

$$yP(t) + B(t)i(t) \equiv c(t)P(t) + v(t)P(t) + dB(t)/dt + dM(t)/dt$$

where y is the constant level of real income, B the level of government bonds, i the nominal interest rate, and v the flow of a real head tax (subsidy, if negative). Defining $b \equiv B/P$ as the real stock of government bonds and π as the rate of inflation, the constraint can be expressed in real terms, as

$$[2] \quad y + b(t)r = c(t) + v(t) + db(t)/dt + dm(t)/dt + m(t)\pi(t),$$

Notice that in writing [2] we have used the assumption that the equilibrium "Fisher condition"

$$[3] \quad i(t) = r + \pi(t),$$

⁴ See, for example, Cochrane [2001] for a discussion of the importance of debt maturity in the context of the questions at hand.

⁵ See Buiter [2002], McCallum [2001], Kocherlakota and Phelan [1999] and Woodford [1995] among others.

where r is the (constant) real interest rate, holds at all times. Because [3] is an equilibrium condition, then [2] is no longer a strict identity, but an equality that will hold at all times.

Government (the fiscal authority *cum* the central bank) prints fiat money at zero cost, borrows or lends via the sale or purchase of bonds, imposes neutral head taxes (transfer, if negative), and spends on goods which are "thrown into the ocean" --a real flow denoted by g . The flow government budget constraint in nominal terms, again an identity, is then

$$dB/dt \equiv B(t) i + g(t) P(t) - v(t) P(t) - dM/dt$$

Using [3] once more, the constraint can be written in real terms as

$$\begin{aligned} [4] \quad db/dt &= b(t) r + g(t) - v(t) - (dm/dt) - m(t) \pi(t) \\ &= b(t) r - s(t) - (dm/dt) - m(t) \pi(t) \end{aligned}$$

where $s(t) = v(t) - g(t)$ is the government primary surplus (deficit when negative). This is again an equality that will hold at all times, as in the case of [2].

Addition of the two budget constraints yields the "resource constraint"

$$[5] \quad y = c(t) + g(t).$$

In what follows we assume that government expenditures remain constant, so that any changes in the primary surplus s take place via a change in the tax (subsidy). What this means is that the level of consumption will also remain constant.

Maximization of [1] by the typical individual, subject to its budget constraint [2], yields the familiar Euler necessary conditions for optimality:

$$[6.1] \quad dc/dt = (U_c/U_{cc}) (\rho - r)$$

$$[6.2] \quad dc/dt = (U_c/U_{cc}) (\rho + \pi) - (U_m/U_{cc})$$

Expressions [6.1] and [6.2] imply

$$[6.3] \quad (U_m / [r + \pi]) = U_c.$$

and the condition $r = \rho$, in turn, implies that

$$[6.4] \quad dc/dt = 0,$$

i.e., consumption is piecewise constant.⁶ Note, again, that given the assumption of constant levels of government expenditures and real income, then consumption becomes a constant parameter that, being piecewise constant, can change a finite number of times, as any parameter can --in this case, for example, as a result of exogenous changes in the endowment.

In addition, optimal plans are to satisfy the transversality conditions⁷

$$\lim b(t) e^{-rt} = 0 \text{ as } t \rightarrow \infty$$

$$\lim m(t) e^{-rt} = 0 \text{ as } t \rightarrow \infty$$

We are *not* constraining government debt to be non-negative --i.e., we are allowing $b < 0$, so that

⁶ The equality $r = \rho$ is *not* an arbitrary assumption. If behind the assumption of a "fixed, instantaneously perishable flow endowment" there is a fixed, non-depreciable, non-reproducible aggregate capital stock --the most sensible economic assumption--, capital can be exchanged in the market, and will have a price in terms of its output. Given the fixed rate of time preference, and a fixed marginal product of capital, the price of capital will adjust so that the interest rate (the ratio of the marginal product of capital and its price in terms of output) turns out to be equal to the rate of time preference so as to assure the optimality of the constant level of consumption, dictated by the overall resource constraint.

⁷ See McCallum [2001], p. 21.

government can lend to the public and hold positive net assets.⁸ We are also ruling out $m(t) < 0$.

Notice, next, that expression [6.3] is the demand for money. Since in all what follows we will specify a constant level of real income and of government expenditures (with whatever changes taking place in the primary surplus assumed to be via a change in head taxes), then consumption will be constant. For a real interest rate that is then also constant, for convenience we can write expression [6.3] as

$$[6.3'] \quad m = \mathcal{L}(i) = \mathcal{L}(r + \pi) \quad \mathcal{L}' < 0.$$

Next, and most importantly, "helicopter drops" (or "annihilations" *à la* Hume) of fiat money *as part of a deliberate policy rule* are precluded.⁹ In particular, we assume that any discrete change in the stock of nominal money takes place via an equal change in the stock of nominal bonds, with the opposite sign, i.e., at any point in time t

$$[7] \quad \Delta M|_t \equiv - \Delta B|_t$$

This is, of course, an assumption which is at the heart of both the fiscal theory and the correct specification of a constant nominal interest rate pegging. Assumption [7] is the equivalent of specifying that all changes in the nominal money stock need to be "accounted for" in the government budget constraint's other asset --the stock of bonds.

Still another assumption will be that the system operates in a range at which

$$[7'] \quad |(\partial \mathcal{L}(\cdot) / \partial \pi) (\pi / \mathcal{L}(\cdot))| < 1,$$

⁸ The usual assumption in this literature is $b \geq 0$, and this has consequences for the set of admissible adjustment paths. We see no reason for this limitation, which is at variance with much of the literature on the open macro economy, for example, in which government can hold positive net assets. Kocherlakota and Phelan [1999] also allow for negative government debt.

⁹ This will not necessarily preclude discrete changes in either the nominal money supply or nominal bonds as "conceptual experiments".

i.e., an increase in the inflation rate will increase the inflation tax --an assumption that not only conforms to empirical estimates (except for some very dramatic, short-lived hyperinflationary episodes) but that is necessary to make sense of the analysis.

Omitting the time arguments in order to avoid clutter and defining $\pi = \mathcal{Q}^{-1}(m) - r = \ell(m)$, where \mathcal{Q}^{-1} is the inverse of function [6.3], the simple model can be summarized in the two expressions

$$[8] \quad db/dt = b r - s - m \mu$$

or its equivalent

$$[8] \quad db/dt = b r - s - dm/dt - m \pi,$$

and

$$[9] \quad dm/dt = m (\mu - \ell(m))$$

where $\mu \equiv (dM/dt)(1/M)$ is the rate of nominal money growth.

Notice that, in this construction, [6.3] holds at all times at which the system is engaged in the optimal paths implied by the first order conditions.¹⁰

We will now consider the first of two cases, in the context of the model, of a well defined policy rule --a "monetary rule", the second being an interest rate rule, to be considered later. In every case we will ask the following three questions: (1) Is there a *unique* path of the price level satisfying the transversality conditions? (2) If there is a unique such path, is it "accessible" for any initial conditions? and (3) If the answer to the two previous questions is in the affirmative, is there a market mechanism so that agents are induced to reach such a unique path? This third question is directly related to the general point raised by Lucas [1978] in a different context, but very relevant here nonetheless:

"One would feel more comfortable ... with rational expectations equilibria if these equilibria

¹⁰ See below, though, for a subtle qualification to this statement.

were accompanied by some form of 'stability theory' which illuminated the forces which move an economy toward equilibrium". Lucas [1978, p. 1429]

We will refer to this as the existence, or lack of existence, of a "market induced stability mechanism", and our answers to the question will be more on the side of conjectures than on the side of proofs. Finally, notice that in this model, for an exogenous level of the government surplus and for the control of nominal aggregates, a unique path of the price level is sufficient for determining a unique path of the level of real government debt and of the real money stock.

2.- A Monetary Rule

In the system [8]-[9], assume that government fixes a pre-announced path of the money supply. For simplicity, we assume that such path implies a constant rate of monetary growth, i.e.,

$$[9] \quad M(t) = M_0 \exp(\mu t) \quad t \geq 0$$

In addition, we also assume that the anticipated and effective fiscal policy is to keep constant the level of the primary budget surplus, s . This is, of course, a typical "non-Ricardian" policy, as is being defined in the literature on the *FTPL*.¹¹

¹¹ More specifically (Kocherlakota and Phelan [1999]), a "Ricardian" policy is one in which government sets a fiscal and monetary policy compatible with any possible path of prices. A "non-Ricardian" policy is one in which government's setting of the monetary and fiscal variables is compatible with only one path of prices. A typical example of the latter is the current specification of a monetary rule; a typical example of the former would be, in the current case, the setting of the rate of money growth to which ever value is necessary for the long-run equilibrium to obtain, for any possible level of the fiscal surplus and current government debt. For this last case proponents of the *FTPL* concede the relevance of the traditional monetary analysis.

The system in expressions [8] and [9], can then be represented in the phase diagram in Figure 1, where

$$[10] \quad b = (s + m \mu) / r$$

$$[11] \quad \ell(m) = \mu$$

are the values of b and m satisfying $db/dt = 0$ and $dm/dt = 0$, respectively, with b^* and m^* being the long run steady values satisfying both [10] and [11]. Notice that, of course, [11] is *not* the equilibrium "money supply equal to money demand" (which is given by [6.3] and is implied in [11]), but the condition for the rates of inflation and monetary growth to be equal.

Since at any point in time the stocks of both nominal bonds (B) and nominal money (M) are given; a discrete increase (decrease) in the price level will decrease (increase) the levels of *both* real debt and real money balances by the same proportion.¹² In terms of the graph in Figure 1, this can be represented by movements along the ray passing through the initial pair b, m . Note, though, that since the price level is not a state variable, an initial point is strictly defined as a pair $B(0), M(0)$, i.e. the nominal stock of bonds and money, so that in this graphical representation an initial position is characterized as any point along a ray with a slope $B(0)/M(0)$. Notice also that the graph in Figure 1 is drawn for the more general case of a positive rate of monetary expansion, i.e., $\mu > 0$. The special but theoretically important case in which the nominal money stock is constant, i.e., $\mu = 0$, is depicted in the graph of Figure 3.

Consider, first, the case $\mu > 0$. The answer to our first question (Is there a *unique* path of the price level satisfying the transversality conditions?) is in the affirmative. This is the path $m(t)=m^*$ and $b(t)=b^*$, and the path of prices implied by [9]. The answer to the second question (If there is a unique such path, is it "accessible" for *any* initial conditions?) is in the negative. An initial ratio $B(0)/M(0) = b^*/m^*$ is a necessary condition for reaching the unique equilibrium m^*, b^* , via a discrete change in the price level.

¹² This would not be so, of course, in the case of "indexed" government debt (i.e., debt denominated in real terms), a case to which we will make reference later.

For any other initial nominal levels of debt and money there is no path of the price level satisfying the transversality and the non-negative money conditions. Notice, nevertheless, that such general conclusion would not hold if a non-negative restriction is imposed on nominal debt (i.e., if government is not allowed to lend and hold positive assets). In this case, any initial ratio of nominal debt and nominal money could result in paths of the price level for which both real debt and real money would approach zero.

The third, and most interesting question is whether there is a market mechanism through which, if the necessary initial condition $B(0)/M(0) = b^*/m^*$ is satisfied, will generate a price level P^* such that $B(0)/P^* = b^*$ and $M(0)/P^* = m^*$. The answer to this question is given here as the sketch of a conjecture. Consider a "pre-initial" case at which the price level is P^* , and given the initial levels of nominal money and bonds the system rests at its steady state equilibrium b^*, m^* , and with the inflation rate being equal to the rate of monetary growth, $\pi = \mu$. Perform now the usual experiment of assuming that all of the sudden, for no other reason than a mysterious uniform marking-up of prices, the price level increases to $P_1 > P^*$. The usual story for how an instantaneous equilibrium is restored is the following, implicitly assuming that chronological time is stopped. The rise in prices has decreased real cash balances, with the result that now, at the same inflation rate, agents have "too little money", i.e., $m_1 < \mathcal{L}^{\text{R}} + \mu$ -with the stock of real bonds having also fallen to $b_1 < b^*$.¹³ They will then decrease their spending, but since aggregate output is fixed, successive rounds of "instantaneous" price adjustments (decreases), the price level will end up at the original value P^* , i.e., with the economy back at the initial equilibrium. This "story" is the usual one in models where money is the only asset. What about our case, in which agents also hold government bonds? Wouldn't individuals, in this instantaneous process, also seek to perform a portfolio adjustment, exchanging bonds for money? There are two problems with this variation of the story. First, it is true that individuals will be able to withdraw their "call bonds" (i.e., not to continue part or all their roll over), but it is also true that if government is committed to the pre-announced path of the

¹³ The possibility of this instantaneously temporary difference between the demand and the supply of money is the "subtle qualification" alluded to in footnote 10 above.

nominal money supply, it will immediately restore its previous level --it would take only an infinitely small increase in the nominal interest rate to persuade depositors to keep the initial level of those "call bonds". The second problem is that an exchange of bonds for money will not restore the previous equilibrium. In this conjecture, it seems that the "monetary story" of intended changes in expenditures is rather persuasive.¹⁴

The alternative to the "instantaneous" adjustment process outlined above is, of course, that at the point b_1, m_1 the inflation rate would increase to a level $\pi_1 > \mu$ for which $m_1 = \mathcal{L}^{\text{R}} + \pi_1$, and for which the system would "engage" in the dynamics of a path violating the transversality conditions --a path not only formally inadmissible but one which makes little economic sense.

For initial values outside the ray $B(0)/M(0) = b^*/m^*$ there is no price level that would allow to attain the unique steady state equilibrium. A particular instance of this proposition is the Sargent-Wallace case of an "unpleasant monetarist arithmetic" (Sargent and Wallace [1981]) in which, starting from an initial equilibrium m_0, b_0 , government lowers the rate of monetary expansion keeping the same level of the government primary surplus¹⁵. It is easy to show that, under assumption [7], a fall in the rate of monetary growth will result in an equilibrium at $m^* > m_0, b^* < b_0$, and to show (and to verify by mere inspection from the graph in Figure 2, in which A is the initial equilibrium, and point A' the new steady state after the change in policy) that from the original equilibrium at m_0, b_0 , there is no possible change in the price level that would generate an immediate adjustment to the new unique equilibrium. Two things can then happen: there is no anticipated further change in either fiscal policy (the primary surplus) or monetary policy (the rate of monetary expansion), or there is the generalized anticipation that at a

¹⁴ The idea of an adjustment process taking place at a single point in chronological time can be interpreted, of course, as describing an adjustment during a very short interval, in a manner that all agents understand as taking place separately from the laws of motion implied by the overall equations --in our case, equations [8]-[9].

¹⁵ Sargent and Wallace [1981] analyze the case of "indexed" government debt, i.e., denominated in real terms, but their results are relevant also in the case of nominal debt.

future time some of those changes will occur so that a new long run equilibrium is achieved. In the first case a long run *feasible* equilibrium will simply not exist. In the second case, a future "corrective" policy change is anticipated --the possibility envisioned by Sargent and Wallace [1981] being an increase in the rate of money growth. Either this correction or an appropriate rise in the fiscal surplus would generate a unique and feasible adjustment ultimately leading to a unique steady state equilibrium.

Another possibility is, of course, a temporary violation of the monetary rule, with a once-and-for-all increase in the nominal money stock, leading to a corresponding once-and-for-all increase in the price level, i.e., a temporary, short-lived hyperinflation. It is easy to show (even in simple graphical terms in the context of Figure 2), that this can be accomplished either via a "rain of money" (a temporary violation of assumption [7]), or a purchase of bonds. These possibilities are depicted in Figure 2, where a one-time gift or drop of a "rain of money" results in a movement from point A to point D, and a purchase of bonds, in a movement from A to C, with a one time increase in prices then allowing to access the new long-run equilibrium at point A'. Notice, parenthetically, that there are two distinct effects of the increase in the money stock, not always clearly distinguished in the literature. One is the obvious "inflating away" part of real debt via a fall in the real value of bonds; the other, the purchase of interest bearing bonds in exchange for non-interest bearing money. That is why a "rain of money" requires a higher increase in the nominal money stock, and a higher one-time increase in prices, than the purchase of bonds --in the first case, only the first of these effects is at work. If debt is denominated in real terms, as in Sargent and Wallace's analysis, then the required increase in the money stock via purchase of bonds can also do the trick, with the highest necessary increase in money and the highest increase in prices (point B in Figure 2); here, a rise in prices will not decrease real debt, so that the entire adjustment needs to take place via the second effect, and a "rain of money" will not work at all. This temporary hyperinflation "solution" is, indeed the manner in which some governments have at times tried to deal with the "unpleasant arithmetic" problem.¹⁶

¹⁶ Although initially triggered via a 150 per cent devaluation, *followed* by the increase in the money
(continued...)

Another, less "spectacular" possibility, is for government to implementing a "soft" monetary rule, in which the rate of growth of the money supply is fixed, but in which discrete, discretionary changes in the nominal money are part of the policy. With the existence of call bonds, it is even possible, if there is a "market induced stability mechanism", for the public to take the initiative via changes in those deposits, with government passively allowing for those endogenous changes. We do not pursue this topic here (although we will refer to it again in the concluding Section 5), except to note, first, that such a scenario would be quite similar (in fact, observationally equivalent) to a nominal interest rate pegging or targeting. This is not surprising: as we will indicate later, a nominal interest rate pegging determines, at each point in time, the rate of change (but not the level) of prices, and the possibility alluded to in this paragraph determines at each point in time the rate of change of nominal money, but not its level.

Consider now the particular case $\mu = 0$, i.e., a constant nominal money stock, which is the one considered in much of the literature on the *FTPL*. Now the two system equations [10]-[11] become

$$[10] \quad b = s/r$$

$$[11] \quad \ell(m) = \mu,$$

which are shown in the graph of Figure 3. This is a case that, as hinted before, is of especial theoretical interest, and has been analyzed first by Obstfeld and Rogoff [1983] in the pure monetary context, and in the context of the fiscal theory of the price level, among others, by Carlstrom and Fuerst [2000], Christiano and Fitzgerald [2000], Kocherlakota and Phelan [1999] and McCallum [2001]. Notice that in this case the link between equations [8] and [9] *would seem* to be broken, since changes in the real money

¹⁶(...continued)
supply (rather than an increase in money followed by a rise in all prices, including the exchange rate, as in our analysis), readers familiar with the Latin American experience will probably recognize the analogy of the analysis to the "Rodrigazo" episode in Argentina in June of 1975 --the name referring to Celestino Rodrigo, the economics minister at the time.

stock brought about by changes in the price level do not affect the seigniorage component of the government budget constraint, simply because there is no inflationary finance. But the link still exists for nominal debt, with discrete changes in the price level affecting real debt, and hence the government's fiscal position.

In this case, the answer to our first question (Is there a *unique* path of the price level satisfying the transversality conditions?) is in the negative: there is a well defined pair of values m^*, b^* such that $b(t)=b^*$ and $m(t)=m^*$ for all t , but there is also a set of infinite possible paths of the price level (and the inflation rate) which originate for any initial pair of values $b(0) = b^*, m(0) < m^*$, along which the transversality conditions are met and the real value of money converges to zero. The result is the same as in the *FTPL* literature cited above, but with a *caveat*. Note that, starting from the initial steady state equilibrium b^*, m^* , since we have nominal debt, such a point $b(0) = b^*, m(0) < m^*$ cannot be generated by the usual "inflationary bad dream" story, which would result in an immediate increase in the price level and therefore in a point $b(0) < b^*, m(0) < m^*$ for which the transversality conditions would not hold. The condition for hyperinflation, with $b(0) = b^*, m(0) < m^*$, would result, even in the case of the dream, if debt is in real terms or, for either nominal or real debt, if a sudden "annihilation" of money would take place.

3.- The Fiscal Theory of the Price Level in the Case of a Monetary Rule

We proceed now to compare our results for the case of a monetary rule with some of the tenets of the *FTPL* and some of the propositions of its critics. As indicated above, we have performed our analysis in what can be considered a "non-Ricardian" policy *par excellence*, with a fixed constant primary budget surplus and a fixed path of the money supply --a non-Ricardian policy being, of course, the case where, according to the *FTPL*, the theory becomes relevant as an alternative to the monetary explanation.

Before proceeding, some general comments are in order: First, that in terms of our simple model, the basic proposition of the *FTPL* is that the price *level* is determined by equation [8], or, more specifically,

by equation [10], i.e., equation [8] when real debt is not changing, and independently of any monetary considerations. In turn, expression [6.3'], the demand for money, is considered to be more useful when viewed, for an exogenous monetary policy, as determining the interest rate --i.e., the rate of inflation (Woodford [1995, p.12, and again in p. 18]).

Second, that a considerable part of the discussion on the *FTPL* has focused on whether expression [8], or, more specifically, its equilibrium version [10], is a budget constraint or an equilibrium condition. In our view, much of this discussion has been less than illuminating, and has quickly reached the stage of decreasing (or maybe even negative) returns.¹⁷ A reference to the theological discussion on how many angels can dance on the head of a pin seems irresistible. We take the view that [8] is a flow budget constraint (and, more specifically, resulting from an identity), while [10] is one of the necessary equilibrium conditions, together with [11].

Finally, we should note that a consistent feature of the *FTPL* is the treatment of nominal money and nominal bonds as an aggregate ("total nominal debt"), and although there is a careful specification of bonds being interest-bearing debt and money being in general non-interest bearing debt, we find the practice slightly misleading. In fact, the neatest result of the *FTPL* is under the assumption that money effectively becomes an interest-bearing obligation, via a policy of returning to the private sector the revenues from money creation --a policy that we analyze below. Closely related to this point is the definition of an "adjusted fiscal surplus" as the usual pure primary surplus plus the revenues from money. Let us consider now some of our conclusions and their correspondence with some of the propositions in the literature.

(i) Discuss first, because it is the most straightforward, the case of the hyperinflation solution discussed by Carlstrom and Fuerst [2000], Christiano and Fitzgerald [2000], Kocherlakota and Phelan [1999] and McCallum [2001], resulting from an "annihilation", or a one-time confiscation of part of the nominal money stock. For the more general case in which $\mu > 0$, as we have shown above, such hyperinflationary

¹⁷ To have an idea of the "slipperiness" of the issue, see, for example, the "change of heart" in the case of one of the proponents of the *FTPL* in different versions of the same paper (Cochrane [2002]).

solution does not satisfy the transversality conditions if we assume the possibility of negative government debt, as Kocherlakota and Phelan [1999] do. As shown by Obstfeld and Rogoff [1983], such solution is indeed an equilibrium in a world without nominal government debt, as it would be in our model, with indexed government debt --i. e., specified in real terms. It is rather curious, then, the criticism of the *FTPL* as implying such hyperinflationary alternative solution, when in fact it is the presence of the fiscal element, with nominal government debt, that allows to rule out hyperinflation as an equilibrium when $\mu > 0$. In the case in which $\mu = 0$, considered in most of the literature, hyperinflation is indeed an equilibrium, but we note that the "monetarist" alternative will not yield a unique non-hyperinflationary equilibrium either in the presence of a non-Ricardian policy of an exogenous money stock and a fixed surplus.¹⁸ For the "monetarist" adjustment to work, of course, what is needed is an annihilation of all nominal assets (money and bonds) by the same proportion. Whether the adjustment back to the steady state equilibrium takes place along the lines sketched by Woodford [1995, p. 12], in which the adjustment is motivated by an increase in "total government debt" or via a discrepancy between the demand for money and the actual money stock (as described in the previous section, or as in Kocherlakota and Phelan [1999]) is almost immaterial.

(ii) A tenet of the *FTPL* is that the price level adjusts to assure $db/dt = 0$, or $br = s + \mu m$, i.e., the price level is "determined" by expression [10] --or by [10'], with $\mu = 0$, in which case the above equation reduces to $br = s$. Interpreted in this form, it would seem clear from the analysis that this would not be the case --i.e., such an adjustment, if it takes place, will in general result in paths of the price level which will not satisfy the transversality conditions. The only exception is, of course, the case in which, in terms of our graphical interpretation, the initial ratio of nominal bonds to nominal money happens to be such that $B(0)/M(0) = b^*/m^*$.

¹⁸ Notice that Kocherlakota and Phelan [1999], in arguing for the plausibility of the "monetarist solution" (i.e., a one-time fall in the price level, by the same proportion as the nominal money annihilation), assume a departure from the non-Ricardian policy, with government changing the fiscal surplus to adjust for the increase in real debt as a result of the price fall.

The *FTPL* is often cast in an apparently slightly, but fundamentally different form. *For the case in which* $\pi = \mu$, expression [10], the government's flow budget constraint that needs to hold for $db/dt=0$, can be written as

$$b = (s + m \pi)/r,$$

so that

$$B/P = (s + (M/P)(i - r))/r = (s + (M/P)(i) - (M/P)r)/r$$

and

$$[12] \quad (B + M)/P = (s + m i)/r$$

where $(s + m i)$ is the "adjusted fiscal surplus", with the term $m i$ rather than the usual "inflation tax" term $m \pi$, to account for the "interest savings on the government's monetary liabilities" (Woodford [1995, p. 10]). In expression [12] it is clear that the price level is uniquely determined by the total of "government liabilities", $(B + M)$ and the "adjusted fiscal surplus", as posited by the *FTPL*. But notice that equation [12] is nothing else than the final reduced form of our overall system [8]-[9], since it assumes not only $db/dt=0$ but also $\pi = \mu$, i.e., $dm/dt=0$. It is then not surprising for the price level to depend on these fiscal magnitudes. It is trivial that in a system in which there is more than one nominal asset, a correspondence needs to exist between the total of those nominal assets, or an arbitrary subset of them, and the price level for the economy to exhibit neutrality in the presence of perfect price flexibility. Another problem, of course, is with the definition of the fiscal surplus as being "adjusted" for the revenues from money creation; as it is clear from expression [12], for a given unadjusted primary fiscal deficit s , the nominal interest rate (and hence the inflation rate) will depend on the exogenous rate of money growth. As it will be mentioned later, an interest rate pegging policy, by fixing the term $m i$, eliminates this objection, and goes a long way to explain why the *FTPL* appears as "especially useful" in such a regime. (Woodford [1995], p.4).

(iii) Finally, consider the following argument by one of the main proponents of the *FTPL*, which in our view is more substantial and goes to the core of the theory:

"Furthermore, it is even arguable that the expected path of the money supply does *not* matter for price-level determination, *except through its consequences for the government's budget*" (Woodford [1995, p. 15; his emphasis]).

One argument against this proposition could be the following. Consider an economy without government finances, in which the only role of government is to print fiat money, which is distributed via head subsidies, and increases over time at a fixed proportional rate (which of course could be zero). Will a one time change (expected or unexpected) in either the stock or its rate of change have consequences for the price level? The answer is of course in the affirmative. But such an argument would of course be misplaced, amounting to throw away the baby with the tub water --proponents of the *FTPL* would immediately reply that in such an economy all possible policies are Ricardian, and their point would be well taken. What is then that makes money to appear as becoming so "unimportant" once nominal government debt is introduced?

In our view, more than a question of whether an expression such as equation [10] "determines" the price level, the answer rests on the fact that in the presence of nominal government debt, *all monetary actions have a fiscal component and a fiscal effect*, via the effects of changes in prices on real debt, unless those effects are neutralized via changes in the purely fiscal magnitudes, such as the debt or the primary fiscal surplus --what would, of course, amount to a "Ricardian policy" for which the monetarist adjustment becomes relevant. This point can be still better understood if we consider Woodford's discussion of a regime which would "neutralize the fiscal effects of a change in the money supply" (Woodford [1995, p. 15]). Consider, In terms of the notation of our model, a regime in which the "revenues from money creation", defined in Woodford's as m_i , were returned to the public --of course, on a per head basis, unrelated to money holdings. In this case monetary changes have no fiscal effects, and the relevant equations for the government's flow budget constraint can be written as

$$db/dt = b r + m i - s - dm/dt - m \pi$$

$$db/dt + dm/dt = b r + m r - s$$

and, calling $v = b+m$, "total government debt", then

$$dv/dt = v r - s.$$

In this case it is obvious that all what matters for the determination of the price level (and for the overall global adjustment, for that matter) is the nominal aggregate $V \equiv B+M$. This is probably the "purest" exhibit of the *FTPL*, a case in which exchanges of money for bonds and *vice versa* are of no consequence. But notice, first, that it is derived, as it were, by a policy which in fact converts money into bonds, and second, that since there is a well-defined demand for money, equation [11] is still relevant and needs to be satisfied. In fact, the system becomes identical to the case analyzed in the previous section for the case $\mu=0$, even with the same geometrical interpretation in Figure 3, with the term v instead of b .

4.- A Nominal Interest Rule

A policy of pegging the nominal interest rate to a predetermined path or single value has a long history of controversy in the profession, and for quite a time had a consistently "bad reputation". In the seventies and early eighties, in the era of monetarism with adaptive expectations, the argument was that such policy results in explosive behavior. After the advent of rational expectations, the argument was, and still is in many quarters, that it would result in price level indeterminacy: if the monetary authority pegs the nominal interest rate, then the nominal money stock needs to react passively in response to changes in the price level so as to keep constant the real money corresponding to the demand for money, pinned down by the exogenous value of the rate --i.e., the central bank would need to "validate" any price level.

Explicit consideration of the government budget constraint, and the absence of "rains of money" (i.e., changes in the money stock unmatched by corresponding changes of opposite sign on government assets,

such as government debt) allows to eliminate indeterminacy --though this is not an opinion shared by most critics of the *FTPL*.

There are reasons why the question of the validity of an interest rate pegging is usually discussed within the context of the *FTPL*, mainly because in both cases the determinacy or indeterminacy of the price level is at stake, and in both cases the government budget constraint, and in particular the connection among its components is at the center of the analysis . Yet, this need not be necessarily the case.¹⁹

In this Section we use the elementary framework of Section 1 to analyze the implications of what we can in general call "an interest rate rule". We will first present the "mechanics" involved, perform some experiments and then discuss some of the features and implications of a nominal interest rate pegging. We will argue that not only prices are uniquely determined, but that the policy yields some attractive features and plausible results, both in the current context and in the context of an open economy.

At the outset, we need to stress a distinction that, although often made explicit in some of the literature, sometimes is not kept in mind. The distinction is between a nominal interest rate "pegging" (or "fixing"), and a policy of interest rate "targeting". The two yield in general the same results, and are therefore observationally equivalent. But, even at the theoretical level (and perhaps still more so) they imply very different types of policies. We characterize a "pegging" policy as one in which the central bank is willing to lend and borrow, irrespectively of quantities, at a fixed nominal interest rate. The central bank is then completely passive, and the actual purchase or sales of bonds (in our case, call bonds) are entirely left to the initiative of the private sector, with government simply supplying (or demanding) whatever quantities the public demands (or supplies). The analogy with the "pegging" or fixing of the exchange rate is immediate. A policy of "targeting" a fixed, pre-announced level of the interest rate, even when (as in our very simple model) the targeting is always perfect, is characterized by an active policy, on the part of the

¹⁹ In fact, our early work (Auernheimer and Contreras [1990, 1995], which together with Begg and Haque's [1984], has been credited by a generous colleague as being "the original exponents of the *FTPL*" (Buiter [2002])), was exclusively motivated by the analysis of an interest rate policy pegging, without explicit references to a general theory of price determination.

central bank, of open market operations so as to keep the rate at the targeted level. The reason why these observationally equivalent policies are quite different is that there may not exist a "market induced stability mechanism" inducing individuals, despite the fixed level of the interest rate, to "take the initiative" in engage in exchanges between money and bonds that would lead to a unique rational expectations equilibrium. In what follows we will simply refer to an "interest rate rule" as encompassing both of these observationally equivalent cases.

Consider then the model presented and analyzed in the previous sections, which results in the reduced form equations [8'] and [9], which we reproduce here for convenience:

$$[8'] \quad db/dt = b r - s - dm/dt - m \pi$$

$$[9] \quad dm/dt = m (\mu - \ell(m))$$

where, as before, government debt is in nominal terms --more specifically, as call bonds.

Suppose now that the central bank stands prepared to borrow and lend at a fixed nominal interest rate i^* , and that such commitment is believed by the public and effectively implemented. Since the nominal interest rate is fixed, so is the real money stock, say, at a level

$$[13] \quad m^* = \mathcal{L}(i^*)$$

and, with the Fischer equation holding at all times, arbitrage will assure that

$$[13'] \quad \pi^* = i^* - r.$$

Using these values in [8'] and [9] yields then the extremely simple formulation

$$[14] \quad db/dt = b r - s - m^* (i^* - r).$$

and [13].

A graphical representation, provided in Figure 4, is immediate and almost embarrassingly simple.. Note that although the real money stock will at all chronological times be constant at the level m^* , since "during" the instantaneous adjustment process taking place at a point in time at which we "stop" chronological time in order to follow the logical steps of the same *tatonnement* process we considered in Section 1, we find it useful, then, for using the plane m, b to follow such process, rather than in the real line $m=m^*$. From [14], there is then only one level of the real government debt at which $db/dt=0$, and this is

$$[14'] \quad b^* = \frac{s + m^* (i^* - r)}{r}.$$

with values of the real debt above this level resulting in rising levels of debt, and *vice versa*.

It is of course obvious, from [14], that in the absence of anticipated future changes in parameters, in order to satisfy the transversality conditions, the adjustment needs to be instantaneous. This is reflected in the arrows showing the laws of motion in Figure 4.

The answer to our first question (Is there a unique equilibrium satisfying the transversality conditions?) is in the affirmative. In the context of Figure 4, for example, this is point A, at b^*, m^* . Notice that, for any given *level* of the nominal aggregate ($B+M$) (government total liabilities, as consistently called by proponents of the *FTPL*), there is a unique "mix" of the two components in the aggregate (i.e., a unique ratio B/M) and, given such ratio, a unique level of prices, for which the unique steady state equilibrium is realized. The "right" B/M ratio and the "right" price level are, each of them, necessary conditions, and, when holding jointly, they become sufficient. This simple reasoning sheds light on the reason why the nominal interest rule, when the government budget constraint is taken seriously (i.e., considering the

aggregate ($B+M$) as given at any point in time), does not lead to price indeterminacy. At the same time, notice that, as a formal matter, *the sole specification of the aggregate ($B+M$) is not sufficient, per se, for determining the equilibrium price level*, despite claims by the *FTPL*. This is the same problem that we mentioned while considering the case of the monetary rule, i.e., that the condition $dm/dt=0$ is consistently neglected by expositors of the *FTPL*. In the case of the interest rate rule, it is clear that any aggregate ($B+M$) will determine a unique level of prices for which $db/dt=0$ (i.e., for which equation [14'] will hold), but in general this will not be the price level for which also $dm/dt=0$ will be satisfied.²⁰ What is necessary for both conditions to hold is for the ratio of debt to money be the "right" one, and an interest rate rule will generate such ratio via open market operations. This is so, of course, for the fundamental reason that money is a non-interest bearing government "liability".

Our second question is, as in other cases, whether it is feasible an adjustment leading to that unique equilibrium? Consider, in the same Figure 4, a "pre-initial" point anywhere in the b, m plane --say, point B. Given the pegged nominal interest rate policy, the unique equilibrium can be reached via an open market operation (a sale of bonds to government in exchange for money), leading to point D, and from there on a fall in the price level, which will translate in an increase in the real value of both bonds and money leading to the equilibrium point A. Another alternative amounting to the same is, of course, a fall in prices leading to point C, and from there on a transformation of bonds into money via exchanges with the central bank, leading again to the equilibrium A. There are, obviously, infinite possible sequences of falls in the price level and open market operations leading, in this instantaneous adjustment process, to the unique, rational steady state. equilibrium.

Our third question (Is there a "market induced stability mechanism" such that agents would motivate the required exchanges of money for bonds and *vice versa*, as well as the required changes in prices?) is more complex, and our answer will be tentative. If the mechanism exists, then the passive pegging on the part of the central bank will be sufficient. Individuals hold both money and bonds, so that at each point in

²⁰ Woodford [1995] recognizes this problem, but dismisses as irrelevant for the proposition that the aggregate ($B+M$) is sufficient to determine the path of prices.

time they decide on both the composition of their portfolio and their consumption expenditures, so that we have here two possible adjustment mechanisms, one which changes the (B/M) ratio and another that changes prices. It seems reasonable to assume that agents increase their consumption expenditures (leading to a rise in prices, since aggregate consumption is constant) when they hold "too much money" ($m > m^*$) and "too many bonds" ($b > b^*$), and that they exchange money for bonds, or *vice versa* in order to achieve a ratio of their nominal assets equal to $(B/M) = (b^*/m^*)$. If this is the case, then there are reasons to believe, at the intuitive level, that a market induced stability mechanism exists, and we take this to be the case. If this mechanism falters, then the central bank can always engage in active open market operations in order to complement it --marking of course a transition from a pegging to targeting. We perform now three "experiments", which should be sufficient for providing both a sense of the mechanism involved in an interest rate rule as well as some arguments in favor of a rather positive evaluation of the rule in terms of plausible results and policy consequences.

Consider, first, an unexpected permanent increase in the level of the pegged nominal interest rate, a case that is described in the graph of Figure 5 (of course, the same discussion can be performed in analytical terms). Suppose, in order to avoid clutter, that the initial position was at point A, and that the interest rate increase results in a new equilibrium at point C. The adjustment, in this case, requires an exchange of money for bonds, i.e., an open market sale of bonds, that moves the system from point A to point B, and from there, a fall in the level of prices resulting in a movement from point B to point C. Notice that in this case the result is consistent with the usual initial "contractionary" effect of a rise in the interest rate --which in this model, since aggregate output and consumption are constant, translates in a fall of the price level. And this is so despite the fact that, given the constant real interest rate, the inflation rate will immediately increase to a permanently higher level (expression [13'] above).²¹

²¹ It is easy to show that, given assumption [7'] (i.e., the economy is in the range of the demand for money for which higher inflation translates into higher revenue from money creation), then the new equilibrium point C will always be above the line connecting points A and B, i.e., so that a fall in prices will be required.

Next, take the case in which an increase in the level of the pegged interest rate is announced, at time t_0 , to take place at a future time t_1 , the announcement being both believed and later implemented. This is depicted in Figure 6, where point A shows the initial equilibrium b^* , m^* at the time of the announcement. With efficient markets, a requirement in the adjustment is that at the time of the effective increase of the interest rate no discrete changes in the price level are to take place (the usual "asset price continuity principle") --i.e., any changes at time t_1 will be limited to open market operations. The qualitative features of the analysis are then easy to characterize: An initial fall in the price level, together with a purchase of bonds by the public, at the time of the announcement (immediately positioning the economy at a point such as C), followed by a gradual increase in the level of real government debt during the interim period (from C to D) and, at time t_1 at which the increase in the interest rate is consummated, an additional purchase of government bonds by the public. The effects are, of course, qualitatively similar to the previous case of a contemporaneous, unanticipated change, but with a smaller initial increase in the level of prices.

Finally, consider the case of a one-time, unanticipated fall in the level of the fiscal primary surplus, s . This is an interesting experiment, because it is the kind of policy change of the "unpleasant monetarist arithmetic" type: a rise in the primary deficit, with no change in the rate of inflation. This case is depicted in Figure 7, where point A corresponds to the initial equilibrium b^* , m^* . A fall in the primary surplus determines a lower long run level of the real government debt, say, at $b^{**} < b^*$, with a new equilibrium at point A' --notice that the arrows indicating the law of motion are drawn for this new lower level b^{**} . The instantaneous adjustment involves both a discrete increase in the price level (from A to B) and an open market operation (a sale of government debt by the public) resulting in a movement from point B to point A'.

Some comments on the results of these conceptual experiments are in order. First, as indicated above, notice that the results of an unanticipated increase in the nominal interest rate give a rather clear account of the contractionary effects of an increase in the interest rate and, as a corollary, an explanation for the short *versus* long run consequences of such an increase: an initial "deflationary" effect, followed by a

permanently higher rate of inflation. This is not a result that is easy to generate in models with microeconomic foundations.

Second, the adjustment following a fall in the primary surplus, implies an automatic response to an occurrence particularly common in developing economies. In those economies, it is frequent to encounter situations in which the primary deficit is incompatible with the inflation rate implied by either the rate of money growth or, in the case of an open economy, an exogenous path of the nominal exchange rate with "too low" a rate of devaluation and inflation. In all those episodes the eventual unavoidable accommodation (usually on the central bank' rather than in the fiscal authority's behavior) is a source of loss of credibility for the monetary authority. With a nominal interest rate rule, which requires no change in the pre-announced monetary policy, the credibility question is placed at the doors of the fiscal authority, where it belongs.

Perhaps an additional comment, related to the point made in the previous paragraph, is also in order, concerning the implications of a nominal interest rate rule for the case of an open economy. It is easy to show that the conclusions in this paper can be extended, with the same qualitative results, to the case of a small open economy, and in particular for the nominal interest rate rule. Consider the case of such a small open economy, with perfect capital mobility. In that case, the nominal exchange rate becomes the price level, and the rate of devaluation the inflation rate. Suppose then that the nominal interest rate is pegged at a level i^* . Now, expression [3] becomes the uncovered interest rate parity condition

$$i(t) = r + \hat{e}(t),$$

with r being the rest of the world's interest rate in terms of foreign currency and \hat{e} the rate of devaluation (for e being the nominal exchange rate). Then, in the same way as in the close economy pegging the nominal interest indirectly pegs the inflation rate but not the price level, in this case it yields control over *the rate of devaluation, but not on the level* of the exchange rate. Notice the important difference between this system and the case of an exchange rate rule, in which *both* the level and the rate of change of the

nominal exchange rate are exogenously controlled. Suppose now, for example, that there is an unexpected increase in the primary fiscal deficit (i.e., a fall in the fiscal surplus). The adjustment implies, then, a devaluation, but which takes place automatically, as part of the normal mechanism of the rule, rather than decreed by the central bank in the case in which an exchange rate rule is followed. An additional comment for the case of the open economy is that an increase in the fixed level of the nominal interest rate results in an initial *fall* of the nominal exchange rate, i.e., in an appreciation of the currency. This is, of course, the equivalent to the initial fall in the price level for the case of the close economy. It is a widely accepted result among both economists and policy makers, but which is, again, not easy to generate in models with microeconomic foundations.²²

5.- Concluding Remarks

We have presented a very simple continuous time model, with microeconomic foundations, and used it to analyze some of the questions related to the fiscal theory of the price level and to a policy of pegging the nominal interest rate. The result of comparing our conclusions with some propositions in the literature, and our reaction to some of the issues can be summarized as follows.

- We have shown that the "hyperinflationary solution" as an alternative rational expectations path does not exist, in the context of an exogenous monetary rule, for the quite general case of a positive rate of monetary expansion. Indeed, we see no reason for the usual statement that such a path is the *FTPL* alternative to the monetary explanation resulting in a steady state, non-inflationary path of prices and real variables. In fact, the hyperinflationary possibility has been shown to exist long before the formulation of the *FTPL*, and it is the presence of nominal government debt (fiscal theory or not), what allows the elimination of such path when the rate of money growth is positive.

²² Calvo and Vegh [1990] also generate this result, through a very different mechanism.

- The strict formulation of the *FTPL* ignores the requirement that in the steady state, in a stationary economy, the rate of inflation needs to be the same as the rate of monetary growth --in terms of our expressions for the case of a monetary rule, not only expression [10] needs to hold in the steady state, but so does [11].. The problem is eliminated under a scheme in which interest on money is transferred to the private sector as a lump-sum transfer, in which case, in the steady state, the price level depends exclusively on the aggregate $(B+M)$, but this is done only at the cost of essentially transforming money into bonds.

- In an economy with one or more nominal assets, in which a rational expectations unique equilibrium is characterized by a unique set of real values of those assets, it will be true that for each of those assets, or arbitrary group of those assets, their real value will be their nominal value divided by the price level. One can then write such an expression, but to assert that from such an equation it follows that the price level is "determined" by the level of that nominal asset or any combination (sum) of those assets would be fallacious and highly misleading. Of course, nowhere any proponent of the *FTPL* asserts that, but the use of a single equation (the long run equilibrium government budget constraint) conveys the impression that at times some elements or variations of the fallacy may be present in the argument.

- We find that an interest rate pegging rule not only delivers a unique, hence well determined price level, but that some simple experiments generate results which are compatible with, and provide a theoretical explanation of empirical observations. We have also argued that such rule seems to have some attractive features as a policy.

- We have explored a couple of other issues, not strictly pertaining to the main purpose of the paper, but closely related. In particular, for the case of a monetary rule, we have characterized the short run temporary hyperinflationary "solution" that has been the response in some countries at various times. Here, we have distinguished clearly --with even the graphical representation contributing to that clarity--

the two effects that a one-time increase in the nominal money has on government debt: the "inflating debt away", when in nominal terms, and the "purchase of real debt", that is always possible for a positive price of money, including the case of indexed debt. The latter is an effect that is often neglected, in particular when considering the government's incentives to orchestrate a surprise hyperinflation.

- Finally, a short comment is in order regarding "levels" and "rates of change" considerations involved in various policy rules. It is clear that the usual strict "monetary rule" implies an exogenous path of nominal money involving both its level and its rate of change. In the case of an open economy, an analogue is the standard "exchange rate rule", again fixing both the level and the rate of change (i.e., the rate of devaluation) of the nominal exchange rate.²³ In contrast, a nominal interest rate rule, indirectly and via the Fisher equation, fixes the rate of change, but not the level, of prices. In Section 2, when considering the case of the usual monetary rule (which sets the path of both the level and the rate of change of the nominal money stock), we made reference to the possibility of a modified monetary rule, fixing only the rate of change of the nominal money stock. In this case, in the context of our model, at each point in time the level of the both the money supply and government debt could be decided by the public, and in principle such a rule could yield results very similar to the nominal interest rate rule, provided either that there would be a market incentive mechanism for individuals to engage in open market operations, or that the central bank would take the initiative. What seems to be interesting about this characterization is that both an interest rate rule and the "modified" monetary rule, as fixing exogenous rates of change or either prices or money leave a degree of freedom for the market to achieve a steady-state rational expectations unique equilibrium that may not, and in some cases will definitely not, be feasible with policies which exogenously fixed both levels and rates of change.

²³ Notice that this is equivalent, for the close economy, to government fixing the price level, and its rate of change, by committing to buy or sell a representative bundle of goods at a pre-announced fixed price.

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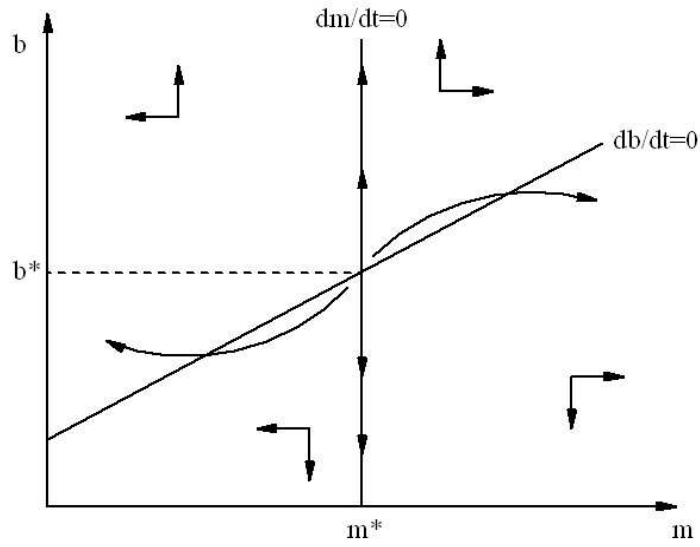


Figure 1

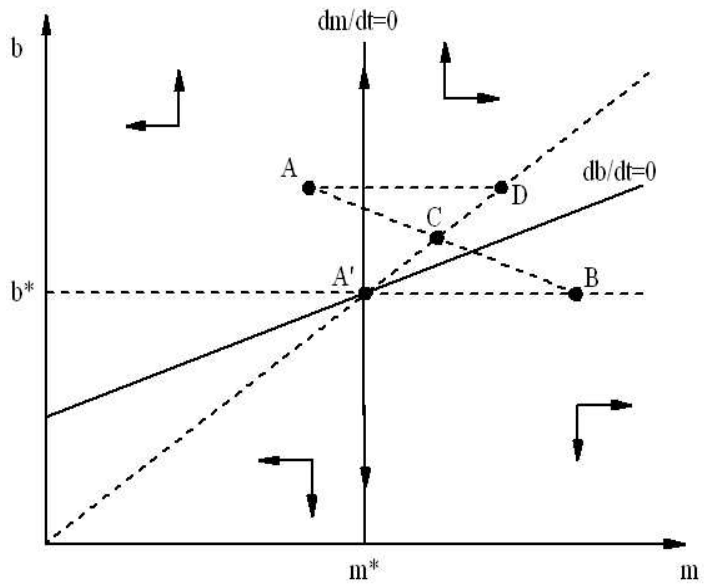


Figure 2

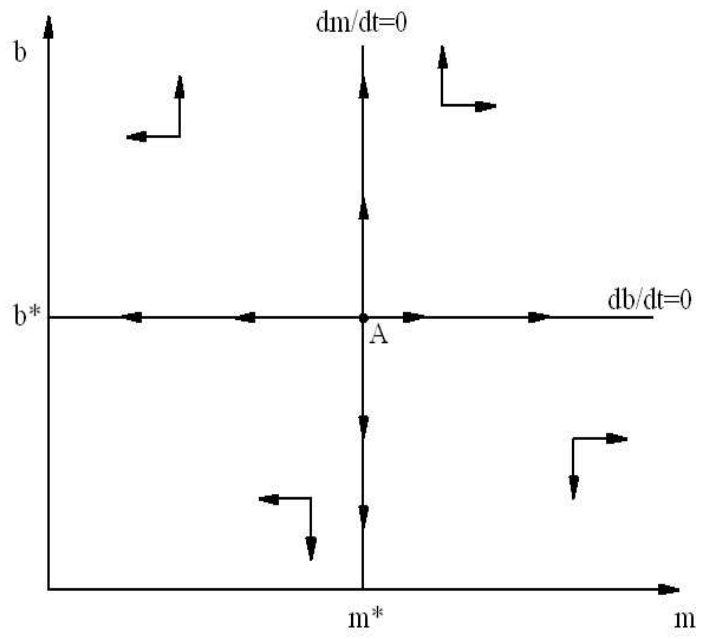


Figure 3

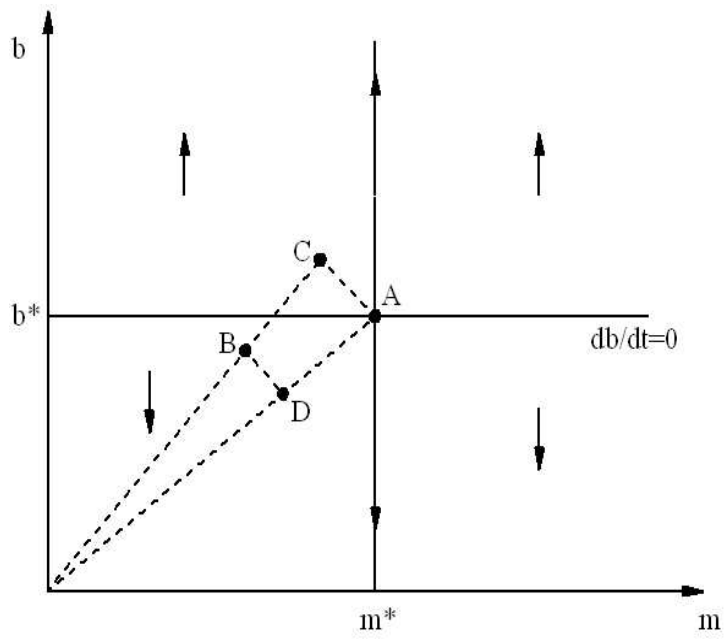


Figure 4

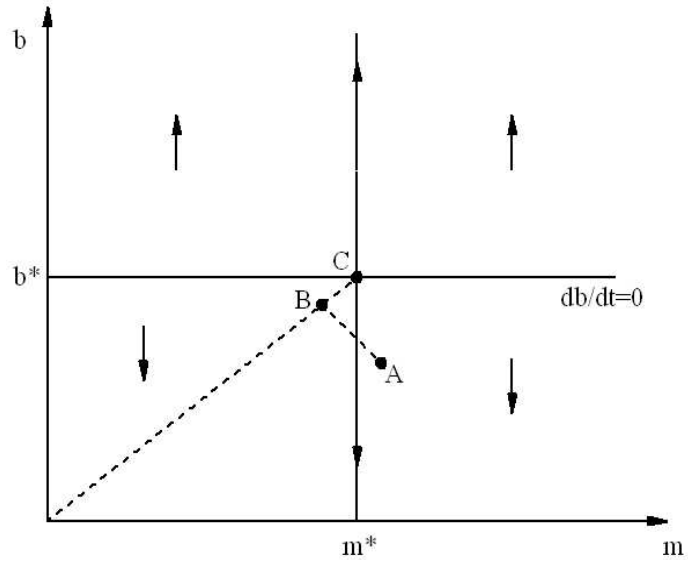


Figure 5

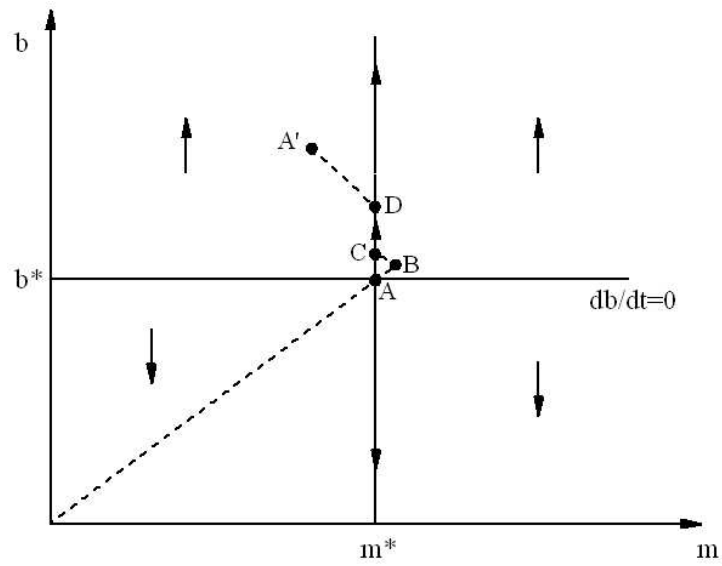


Figure 6

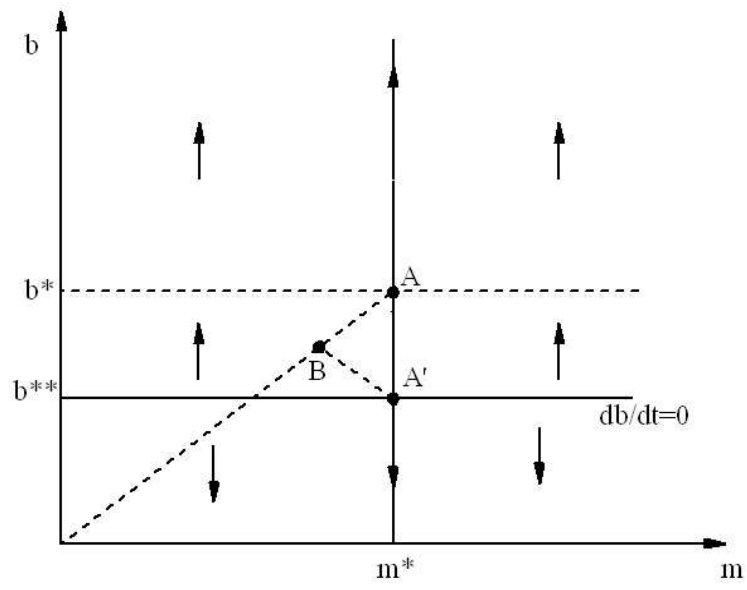


Figure 7