The fiscal theory of the price level puzzle: A non Ricardian view

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The Fiscal Theory of the Price Level Puzzle: a non Ricardian View

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Abstract

The fiscal theory of the price level says that the price level can be made determinate if the government uses fiscal policies such that government liabilities explode unless the price in the first period is at the "right" level. The policy implications are disturbing, as they call for rather adventurous fiscal policies. We show that these disturbing policy implications are specific to the "Ricardian" models that have been used to develop the theory. By moving to non Ricardian models we see that price determinacy is consistent with reasonable fiscal policies.

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1 Introduction

In the recent years an intriguing theory of price determinacy in monetary economies has developed, the fiscal theory of the price level[1](FTPL). In a monetary economy, depending on fiscal and monetary policies, dynamic trajectories may have determinate prices, indeterminate prices, or no equilibrium. A wellknown result by Sargent and Wallace (1975) says that if the nominal interest rate is pegged, there is nominal indeterminacy[2]. Now considering more general interest rate rules reacting to inflation, there will be indeterminacy if the rule does not satisfy the wellknown "Taylor principle"[3].

What the FTPL says is that, even in such circumstances, adequate fiscal policies can restore determinacy. The fiscal policies that achieve determinacy are such that the government's intertemporal budget constraint is not balanced in all circumstances. In fact the intuition behind the result is that under such policies the government's real liabilities will evolve explosively in time unless one starts from a particular price level. This makes this initial price level the only feasible one. The problem with the FTPL is that the corresponding fiscal policies are rather risky, since the government does not plan to balance its budget in all situations, and this could lead in most circumstances to explosive real liabilities. These controversial policy implications have led to numerous contributions making explicitations or criticisms[4].

What we want to show in this article is that the controversial policy implications are actually due to the particular "Ricardian" framework whithin which the results were derived, and we will show that moving to a "non-Ricardian" framework yields much less controversial results. By non-Ricardian models we mean models where, as in OLG models, new agents enter in time, so that in particular Ricardian equivalence fails (Barro, 1974). We shall see that in such a framework price determinacy is consistent with much more reasonable fiscal policies.

Before going to the analytics, we may give a brief intuition as to why one may dispense with the explosive FTPL policies in a non Ricardian economy. It was shown by Weil (1991) that, unlike in a Ricardian economy, financial assets represent real wealth to alive agents in a non Ricardian economy[5]. As a

[1]See notably Leeper (1991), Sims (1994), Woodford (1994, 1995).

[2]This means that, if a price sequence is an equilibrium one, any price sequence multiple of this one is also an equilibrium sequence.

[3]The "Taylor principle" says that the nominal interest rate should respond to inflation with an elasticity greater than one. As a consequence the real interest rate will respond positively to inflation (Taylor, 1993, 1998).

[4]See, for example, Buiter (2002), Kocherlakota and Phelan (1999), McCallum (2001). An empirical evaluation of the theory can be found in Sala (2004).

[5]In a nutshell, the eonomic intuition is the following: if there is a single infinitely lived

result dynamic equations (see for example equation 16 below) will include not only prices (which are non predetermined), but also financial assets (which are predetermined), and this link will help to make prices determined.

2 The model

We want to have a non Ricardian model that "nests" the traditional infinitely lived agent model, so we shall use a model due to Weil (1987, 1991), and assume that new "generations" of households are born each period, but nobody dies. Denote as N_t the number of households alive at time t. So $N_t - N_{t-1} \geq 0$ households are born in period t. We will mainly work below with a constant rate of growth of the population $n \geq 0$, so that $N_t = (1+n)^t$. The Ricardian case is obtained by taking the limit case $n = 0$.

Consider a household born in period j. We denote by c_{jt}, y_{jt} and m_{jt} his consumption, endowment and money holdings at time $t \geq j$. This household maximizes the following utility function:

$$U_{jt} = \sum_{s=t}^{\infty} \beta^{s-t} Log\, c_{js} \tag{1}$$

and is submitted in period t to a "cash in advance" constraint:

$$P_t c_{jt} \leq m_{jt} \tag{2}$$

Household j begins period t with a financial wealth ω_{jt}. First the bond market opens, and the household lends an amount b_{jt} at the nominal interest rate i_t. The rest is kept under the form of money m_{jt}, so that:

$$\omega_{jt} = m_{jt} + b_{jt} \tag{3}$$

Then the goods market opens, and the household sells his endowment y_{jt}, pays taxes τ_{jt} in real terms and consumes c_{jt}, subject to the cash constraint (2). Consequently, the budget constraint for household j is:

$$\omega_{jt+1} = (1+i_t)\,\omega_{jt} - i_t m_{jt} + P_t y_{jt} - P_t \tau_{jt} - P_t c_{jt} \tag{4}$$

consumer, because of the government's intertemporal budget constraint, every dollar of financial assets is cancelled by future discounted taxes, so that these assets represent no net wealth. In the contrary in a non Ricardian economy agents not yet alive today will pay part of these taxes in the future, so that a fraction of financial assets is real wealth for currently alive agents.

Aggregate quantities are obtained by summing the various individual variables. There are $N_j - N_{j-1}$ agents in generation j, so for example aggregate assets Ω_t and taxes T_t are equal to:

$$\Omega_t = \sum_{j \leq t} (N_j - N_{j-1}) \, \omega_{jt} \qquad T_t = \sum_{j \leq t} (N_j - N_{j-1}) \, \tau_{jt} \tag{5}$$

Similar formulas apply to output Y_t, consumption C_t, money M_t and bonds B_t. We now must describe how endowments and taxes are distributed among households. We assume that all households have the same income and taxes, so:

$$y_{jt} = y_t = Y_t / N_t \qquad \tau_{jt} = \tau_t = T_t / N_t \tag{6}$$

and that real income per head grows at the rate ζ:

$$y_{t+1} / y_t = \zeta \qquad Y_{t+1} / Y_t = (1 + n) \, \zeta \tag{7}$$

Let us now consider government. Households' aggregate financial wealth Ω_t has as a counterpart an identical amount Ω_t of financial liabilities of the government. These are decomposed into money and bonds:

$$\Omega_t = M_t + B_t \tag{8}$$

The evolution of these liabilities is described by the government's budget constraint:

$$\Omega_{t+1} = (1 + i_t) \, \Omega_t - i_t M_t - P_t T_t \tag{9}$$

Note that, to simplify the exposition and to concentrate on tax policy, we have assumed that governement spending is zero. If not, the results would be essentially the same, but the formulas would be more clumsy.

2.1 Monetary policy

In what follows we shall study two types of monetary policies. First, and since we want to concentrate on the effects of fiscal policy, we shall study in sections 4 and 5 a particularly simple monetary policy, interest rate pegging. To simplify the exposition, we shall assume that the pegged interest rate is constant in time, so that $i_t = i_0$. As we indicated above this rule is of particular interest because, in the usual Ricardian framework, it leads to nominal indeterminacy.

We shall then also study in section 6 more general policies where the nominal interest rate responds to inflation, i.e. denoting $\Pi_t = P_t / P_{t-1}$:

$$1 + i_t = \Phi(\Pi_t) \qquad \Phi(\Pi_t) \geq 1 \qquad \Phi'(\Pi_t) \geq 0 \tag{10}$$

2.2 Fiscal policy

If the budget was balanced, taxes would be equal to interest payments on bonds $i_t B_t$, so that one would have $P_t T_t = i_t B_t$. We shall actually assume that the government can run a deficit or a surplus, so taxes have the form:

$$P_t T_t = i_t B_t - D(\Omega_t, P_t Y_t) \tag{11}$$

where the function $D(\Omega_t, P_t Y_t)$, which represents the fiscal deficit in nominal terms, is homogeneous of degree 1 in its two arguments[6].

3 Dynamics

Let us start with the dynamic equation for Ω_t. Putting together equations (8), (9) and (11), we find:

$$\Omega_{t+1} = \Omega_t + D(\Omega_t, P_t Y_t) \tag{12}$$

In view of the homogeneity property of the function D, it will be convenient to take as a working variable:

$$Z_t = \Omega_t / P_t Y_t \tag{13}$$

Then equation (12) can be rewritten:

$$\Omega_{t+1}/\Omega_t = F(Z_t) \tag{14}$$

where:

$$F(Z_t) = \frac{\Omega_t + D(\Omega_t, P_t Y_t)}{\Omega_t} \tag{15}$$

Turning now to nominal income $P_t Y_t$, it is shown in the appendix that, assuming $N_{t+1}/N_t = 1 + n$, its dynamics is given by:

$$P_{t+1} Y_{t+1} = \beta(1+n)(1+i_t) P_t Y_t - (1-\beta) n \Omega_{t+1} \tag{16}$$

[6]Note that we express taxes as a function of $P_t Y_t$ and Ω_t. Some authors use instead as arguments $P_t Y_t$ and B_t. Since $\Omega_t = M_t + B_t = P_t Y_t + B_t$, it is easy to go from one formulation to the other, and all subsequent formulas can be rewritten with B_t as an argument, but the results are sometimes more clumsy.

Equations (14) and (16) are the basic dynamic equations of our model.

We should note that whereas in the traditional "Ricardian" case ($n = 0$) equation (16) is homogeneous in prices only, if $n > 0$ the equation is homogeneous in prices *and* financial wealth. Since financial wealth is predetermined, this gives a "nominal anchor" that will contribute, together with further conditions that we will see below, to make prices determined.

Now, in order to contrast the results with what will follow, we shall examine some determinacy conditions in the traditional Ricardian case.

4 The Ricardian case and the fiscal theory of the price level

We shall begin our investigation with the traditional Ricardian version of the model[7]. For that it is enough to take $n = 0$. We shall also assume a simple interest rate peg $i_t = i_0$, as this is a case where the fiscal theory of the price level is particularly relevant. Equation (16) is then rewritten as:

$$P_{t+1}Y_{t+1} = \beta\left(1 + i_0\right)P_tY_t \tag{17}$$

Combining (13), (14) and (17) we find the dynamics of Z_t:

$$Z_{t+1} = \frac{Z_tF\left(Z_t\right)}{\beta\left(1 + i_0\right)} \tag{18}$$

We shall denote as ξ the potential steady states (in Z_t) of this system. In view of (18), potential values of ξ are characterized by:

$$\xi = \xi F\left(\xi\right)/\beta\left(1 + i_0\right) \tag{19}$$

4.1 Determinacy and the FTPL

We are mostly interested in equilibria with nonzero financial assets. We shall assume that (19) admits at least one positive solution, and loglinearize (18) around it. Omitting constants we find[8]:

$$z_{t+1} = \left(1 + f\right)z_t \tag{20}$$

where f is the elasticity of the "fiscal" function F:

[7] Determinacy conditions in the Ricardian case were notably developed by Leeper (1991).

[8] Lowercase letters correspond to the logarithms of the corresponding uppercase letters.

$$f = f(Z_t) = \partial Log\left[F(Z_t)\right]/\partial Log Z_t \tag{21}$$

Using the Blanchard Kahn (1980) criterion, the condition for local determinacy is thus[9]:

$$f > 0 \tag{22}$$

This means that, if the ratio Z_t of government liabilities to nominal income is already high, the government must increase the rate of growth of these liabilities. Such a strategy will lead to an explosive behavior of financial liabilities, which is actually the basis of the fiscal theory of the price level. It is also a rather adventurous fiscal policy, which contributed making the FTPL controversial.

4.2 An example

Let us consider the following tax function:

$$P_t T_t = i_t B_t + (1-\gamma)\,\Omega_t + \delta P_t Y_t \qquad \gamma \geq 0 \qquad \delta \geq 0 \tag{23}$$

The term $\delta P_t Y_t$ says that the government taxes a constant fraction δ of nominal income $P_t Y_t$. The term $(1-\gamma)\,\Omega_t$ says that the government may want to withdraw a fraction $1-\gamma$ of its outstanding financial liabilities. If γ is greater than 1, this actually corresponds to an expansion of government liabilities.

Combining (13), (17) and (23), we obtain the dynamics of Z_t:

$$Z_{t+1} = \frac{\gamma Z_t - \delta}{\beta\,(1+i_0)} \tag{24}$$

There will exist a determinate equilibrium only if:

$$\gamma > \beta\,(1+i_0) \tag{25}$$

We see that the government should engineer a minimal rate of expansion of its financial liabilities. Actually, if γ satisfies (25), then from (24) the ratio of financial liabilities to income will be explosive. This is obviously a very risky fiscal policy.

We may note that conditions (22) and (25) actually say the same thing. Computing indeed the elasticity f at the equilibrium we find:

[9] The reader can actually check that this condition does not only hold for an interest rate peg, but with a general interest rate rule $\Phi(\Pi_t)$ as well, as long as it does not satisfy the Taylor principle.

$$f=\frac{\gamma-\beta\left(1+i_0\right)}{\beta\left(1+i_0\right)} \tag{26}$$

so that $f>0$ (equation 22) yields $\gamma>\beta\left(1+i_0\right)$ (equation 25).

5 Fiscal policy and determinacy in the non-Ricardian case

We want to show now that, as soon as one moves to a non-Ricardian framework, adventurous fiscal policies like (22) or (25) are not necessary anymore for determinacy. We shall begin in this section with local determinacy, leaving global determinacy to the next section.

5.1 The dynamic equations

We shall now study the dynamics of the system in the non Ricardian case, i.e. $n>0$. To compare it with the results of section 4 we continue to assume interest rate pegging $i_t=i_0$, so equation (14) still holds and (16) is written:

$$P_{t+1}Y_{t+1}=\theta P_tY_t-\kappa\Omega_{t+1} \tag{27}$$

with:

$$\theta=\beta\left(1+n\right)\left(1+i_0\right) \qquad \kappa=\left(1-\beta\right)n \tag{28}$$

Dividing (14) by (27) we obtain the dynamics of Z_t:

$$Z_{t+1}=\frac{Z_tF\left(Z_t\right)}{\theta-\kappa Z_tF\left(Z_t\right)} \tag{29}$$

From now on we shall assume that government liabilities can become neither negative nor infinite, so that: $0\leq F\left(Z_t\right)\leq F_{\max}<\infty$. The potential steady states ξ are given by: $\xi=\xi F\left(\xi\right)/\left[\theta-\kappa\xi F\left(\xi\right)\right]$. There are two types of solutions, ξ_1 and ξ_2, given by (when they exist):

$$F\left(\xi_1\right)=\frac{\theta}{1+\kappa\xi_1} \qquad \xi_2=0 \tag{30}$$

5.2 Determinacy

Now loglinearizing equation (29) around the positive solution ξ_1 we find:

$$z_{t+1} = \frac{\theta}{F(\xi_1)}(1+f)\, z_t \tag{31}$$

and the condition for local determinacy is:

$$\theta(1+f) > F(\xi_1) \tag{32}$$

We see that $f > 0$ (equation 22) is not necessary anymore for determinacy.

5.3 An example

Assume that the government engineers through fiscal policy a constant rate of growth γ of its liabilities, so that $F(Z_t) = \gamma$ and $f = 0$. Then the determinacy condition (32) becomes:

$$\gamma < \theta = \beta(1+n)(1+i_0) \tag{33}$$

We see that the policy prescription is practically the inverse of that in condition (25)! Here a more rigorous fiscal policy (i.e. a low γ) is conducive to price determinacy, unlike in the FTPL where a very unrigorous fiscal policy (a high γ) was the key to determinacy (condition 25).

To interpret further (33), let us rewrite it as:

$$\frac{\zeta(1+n)(1+i_0)}{\gamma} > \frac{\zeta}{\beta} \tag{34}$$

Since inflation is equal to $\gamma/\zeta(1+n)$, this says that the real rate of return of the financial assets (left hand side) is greater than the rate of return in the Ricardian model ζ/β. Such a condition was shown in Wallace (1980) and Bénassy (2002) to be a condition for the viability of a monetary equilibrium.

5.4 A global view

Let us continue with the example above, and consider now the issue of global determinacy. With $F(Z_t) = \gamma$, the dynamic equation (29) becomes:

$$Z_{t+1} = \frac{\gamma Z_t}{\theta - \kappa\gamma Z_t} \tag{35}$$

This is represented in figure 1. We see that the equilibrium ξ_1 is indeed locally determinate. But there is a second equilibrium $\xi_2 = 0$ which is indeterminate, and all trajectories initiating between ξ_1 and ξ_2 converge towards it. So it is important to move to the study of global determinacy, and we shall now show how adequate combinations of monetary and fiscal policies allow to obtain global determinacy.

Figure 1: Local determinacy, global indeterminacy

6 Global determinacy

We shall now introduce interest rate rules that respond to inflation like (10) and show that we can achieve global determinacy under reasonable fiscal policies.

Let us recall that in the Ricardian framework there are two alternative conditions for price determinacy, corresponding to the Taylor principle and the FTPL, and expressed respectively as $\phi(\Pi_t) > 1$ and $f(Z_t) > 0$. What we want to show is that in a non-Ricardian world it is possible to obtain global determinacy eventhough none of these two conditions is satisfied, i.e. if we have both:

$$\phi(\Pi_t) < 1 \qquad \text{and} \qquad f(Z_t) \leq 0 \tag{36}$$

Policies like (36) would lead to indeterminacy in the Ricardian framework[10]. Combining (10), (14) and (16), the dynamic equation for nominal income is written:

$$P_{t+1}Y_{t+1} = \beta(1+n)\Phi(\Pi_t)P_tY_t - \kappa\Omega_{t+1} \tag{37}$$

The dynamic system consists of equations (14) and (37). Because of the more general interest rate rule $\Phi(\Pi_t)$, it will not be possible to summarize the dynamics with one single variable as in (29), so we shall use two working variables[11], inflation Π_t and the (predetermined) variable $X_t = \Omega_t / P_{t-1}Y_{t-1}$. Then, calling $\nu = \kappa/(1+n) = n(1-\beta)/(1+n)$, the dynamic system (14), (37) is rewritten:

$$X_{t+1} = \frac{X_t}{\zeta(1+n)\Pi_t} F\left[\frac{X_t}{\zeta(1+n)\Pi_t}\right] \tag{38}$$

$$\zeta\Pi_{t+1} = \beta\Phi(\Pi_t) - \nu X_{t+1} \tag{39}$$

[10] Conditions for global determinacy in traditional Ricardian economies have been notably studied in Benhabib, Schmitt-Grohe and Uribe (2001, 2002).

[11] This representation is borrowed from Guillard (2004).

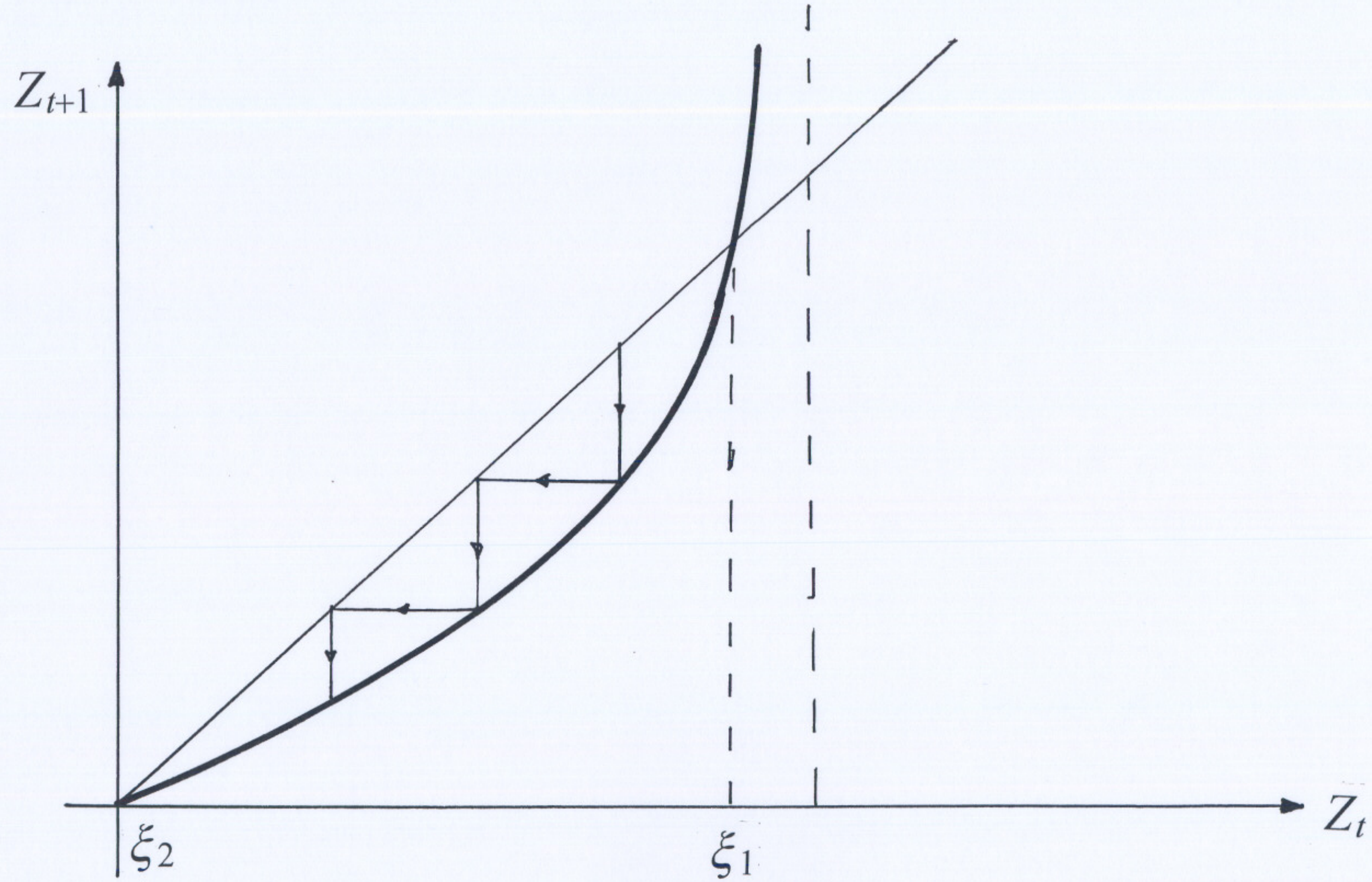

Figure 1

6.1 A general interest rate rule

We shall first study here the case with a general interest rate rule $\Phi(\Pi_t)$, but, in order to make the exposition more transparent, continue with the fiscal example of section 5.3, i.e. $F(Z_t) = \gamma$, so that (38) is rewritten as:

$$X_{t+1} = \frac{\gamma X_t}{\zeta(1+n)\Pi_t} \tag{40}$$

6.1.1 Uniqueness of equilibrium

As a first step we shall look for conditions that yield a unique equilibrium. From (39) and (40) the potential steady states (X^*, Π^*) are characterized by the two equations:

$$X^* = \gamma X^* / \zeta(1+n)\Pi^* \tag{41}$$

$$\zeta\Pi^* = \beta\Phi(\Pi^*) - \nu X^* \tag{42}$$

This yields two types of potential steady states:

$$\Pi^* = \frac{\gamma}{\zeta(1+n)} \qquad X^* = \frac{\beta\Phi(\Pi^*) - \zeta\Pi^*}{\nu} \tag{43}$$

$$X^* = 0 \qquad \zeta\Pi^* = \beta\Phi(\Pi^*) \tag{44}$$

The first solution, described by (43), always exists. So the only way to have a unique equilibrium is to suppress the solutions described by (44). It is easy to see that a sufficient condition for that is:

$$\beta\Phi(\Pi_t) - \zeta\Pi_t > 0 \qquad \forall\Pi_t \tag{45}$$

We may note that (45) can be rewritten as:

$$\Phi(\Pi_t)/\Pi_t > \zeta/\beta \tag{46}$$

In words, the interest rate rule should generate a real rate of interest that is higher than the real rate that would prevail in the corresponding Ricardian economy. We should note the conceptual similarity of (46) with equation (34), as both express that the real return on financial assets is sufficiently high to induce agents to hold them in long run equilibrium.

6.1.2 Global determinacy

The equations of the curves $X_{t+1} = X_t$ and $\Pi_{t+1} = \Pi_t$ are respectively:

$$X_t = 0 \text{ and } \Pi_t = \gamma/\zeta\,(1+n) \tag{47}$$

$$X_t = \zeta\,(1+n)\,\Pi_t\,[\beta\Phi\,(\Pi_t) - \zeta\Pi_t]\,/\gamma\nu \tag{48}$$

We may further note that:

$$X_{t+1} > X_t \qquad \text{if} \quad \Pi_t < \gamma/\zeta\,(1+n) \tag{49}$$

$$\Pi_{t+1} > \Pi_t \qquad \text{if} \quad X_t < \zeta\,(1+n)\,\Pi_t\,[\beta\Phi\,(\Pi_t) - \zeta\Pi_t]\,/\gamma\nu \tag{50}$$

Figure 2 depicts the two curves $\Pi_{t+1} = \Pi_t$ and $X_{t+1} = X_t$, as well as the dynamics of the economy given by (49) and (50), in the case corresponding to condition (46). It appears clearly that the dynamics around the unique equilibrium is a saddle path, and there is global determinacy.

There remains now to check that there exist functions $\Phi\,(\Pi_t)$ such that the Taylor principle does not hold, and nevertheless condition (45) is satisfied.

Figure 2: $F\,(Z_t) = \gamma$ and a general interest rate rule $\Phi\,(\Pi_t)$

6.2 An example: linear interest rate rules

We shall consider here simple linear interest rate rules:

$$\Phi\,(\Pi_t) = A\Pi_t + B \qquad A > 0 \quad B > 1 \tag{51}$$

They have the property that their elasticity is always below 1 since:

$$\phi\,(\Pi_t) = \frac{\partial Log\Phi\,(\Pi_t)}{\partial Log\Pi_t} = \frac{\partial Log\,(A\Pi_t + B)}{\partial Log\Pi_t} = \frac{A\Pi_t}{A\Pi_t + B} < 1 \tag{52}$$

so they do not satisfy the Taylor principle. Now condition (45) will be satisfied if $A > \zeta/\beta$, and then global determinacy is ensured.

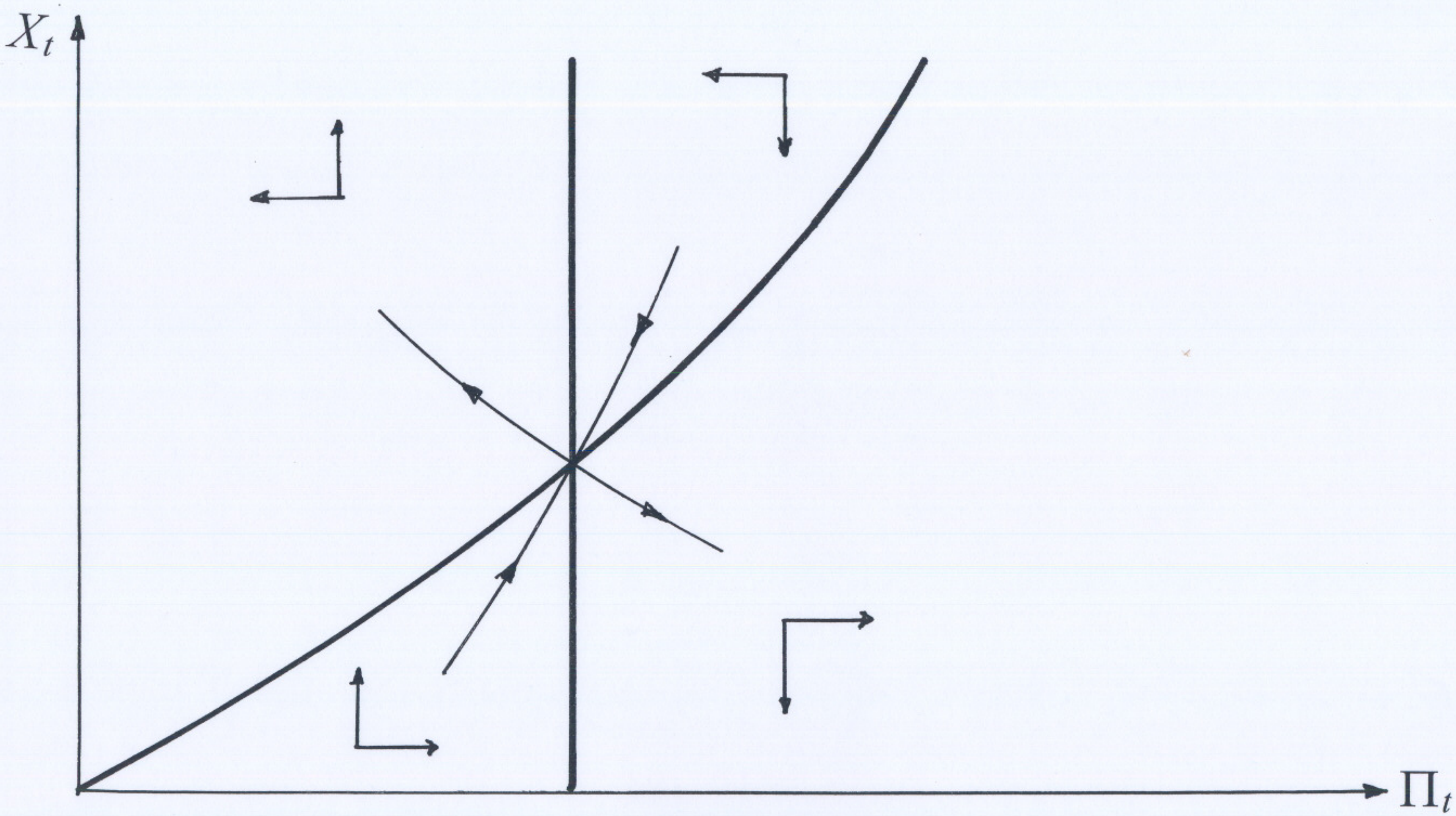

Figure 2

6.3 A general fiscal rule

The above global determinacy result has been obtained with the particular fiscal rule $F(Z_t) = \gamma$. We want to show now that global determinacy can actually be obtained with quite more general fiscal rules $F(Z_t)$. In order to keep calculations simple, we shall use for monetary policy the simple linear interest rate rule seen in the preceding section, i.e.:

$$\Phi(\Pi_t) = A\Pi_t + B \qquad A \geq \zeta/\beta \tag{53}$$

As we indicated at the beginning of section 6, we are interested in "reasonable", non explosive fiscal rules such that $f(Z_t) \leq 0$. We shall actually now prove that a *sufficient* condition for global determinacy is, together with (53):

$$-1 < f(Z_t) \leq 0 \tag{54}$$

Let us prove indeed that (53) and (54) are sufficient for global determinacy. The equations of the curves $X_{t+1} = X_t$ and $\Pi_{t+1} = \Pi_t$ are respectively:

$$\zeta(1+n)\Pi_t = F\left[\frac{X_t}{\zeta(1+n)\Pi_t}\right] \tag{55}$$

$$(\beta A - \zeta)\Pi_t + B = \frac{\nu X_t}{\zeta(1+n)\Pi_t} F\left[\frac{X_t}{\zeta(1+n)\Pi_t}\right] \tag{56}$$

Assumption (54) implies that, in the (Π_t, X_t) plane, the locus $X_{t+1} = X_t$ is downward sloping, whereas assumptions (53) and (54) imply that the locus $\Pi_{t+1} = \Pi_t$ is upward sloping. The dynamics is represented in figure 3, where it appears that we have saddle path dynamics and global determinacy.

Figure 3: $\Phi(\Pi_t) = A\Pi_t + B$ and a general fiscal rule $F(Z_t)$

7 Conclusion

We have seen that in the Ricardian case price determinacy is obtained if the fiscal authority expands government liabilities sufficiently for these liabilities to become explosive (see for example conditions 22 and 25), which is a central mechanism behind the fiscal theory of the price level.

This controversial prescription is not necessary anymore in a non-Ricardian framework. We found indeed that in such a case an explosive expansion of government liabilities is not required for local or global price determinacy,

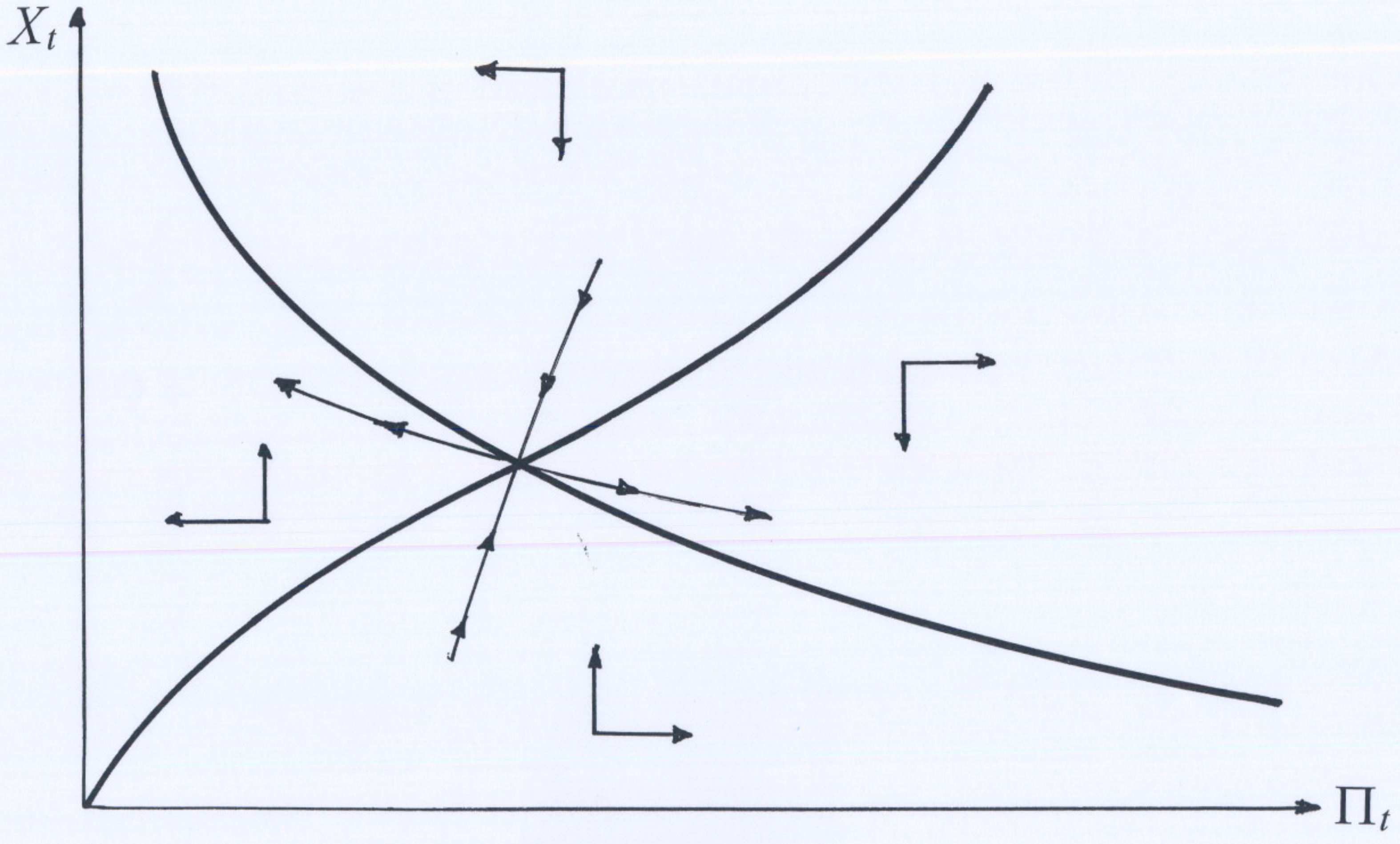

Figure 3

and that price determinacy can be associated to reasonable fiscal prescriptions (see for example condition 33). Finally we saw that global determinacy could be achieved with a combination of monetary and fiscal policies where monetary policy does not satisfy the "Taylor principle" and fiscal policies are nevertheless reasonable.

We saw the basic intuitions along the way and we can summarize them briefly: (1) The non Ricardian framework creates a wealth effect through which prices are linked to financial wealth, a predetermined variable (see notably equation 16). (2) In addition to $n > 0$, the determinacy conditions (equations 34 or 46) simply say that the combination of monetary and fiscal policies must make financial assets attractive enough (in rate of return) to be actually held by households. These conditions have nothing to do with the "explosive" FTPL policies like (22) or (25).

So it appears that the controversial policy prescriptions associated with the FTPL are linked with the Ricardian character of the economies in which they were derived. They disappear when one moves to a (more realistic) non-Ricardian framework.

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Appendix

In this appendix we shall derive the fundamental dynamic equation (16). Consider the household's budget equation (4), and assume that i_t is strictly positive. The household will thus satisfy the "cash in advance" equation exactly, so that $m_{jt} = P_t c_{jt}$ and the budget constraint is written:

$$\omega_{jt+1} = (1 + i_t)\,\omega_{jt} + P_t y_t - P_t \tau_t - (1 + i_t)\,P_t c_{jt} \tag{57}$$

Let us define the following discount factors:

$$R_t = \frac{1}{(1 + i_0)\ldots(1 + i_{t-1})} \qquad R_0 = 1 \tag{58}$$

Maximizing the utility function (1) subject to the sequence of budget constraints (57) from time t to infinity yields household j's consumption function:

$$R_t P_t c_{jt} = (1 - \beta)\left[R_t \omega_{jt} + \sum_{s=t}^{\infty} R_{s+1} P_s\,(y_s - \tau_s)\right] \tag{59}$$

Summing this across the N_t agents alive in period t, and using the equilibrium condition $C_t = Y_t$ we obtain the equilibrium equation:

$$R_t P_t Y_t = R_t P_t C_t = (1 - \beta)\left[R_t \Omega_t + N_t \sum_{s=t}^{\infty} R_{s+1} P_s\,(y_s - \tau_s)\right] \tag{60}$$

Let us divide both sides by N_t, subtract from it the corresponding equation for $t + 1$, and then divide by R_{t+1}. We obtain:

$$(1 + i_t)\,P_t y_t - P_{t+1} y_{t+1} = (1 - \beta)\left[\frac{(1 + i_t)\,\Omega_t}{N_t} - \frac{\Omega_{t+1}}{N_{t+1}} + P_t\,(y_t - \tau_t)\right] \tag{61}$$

Divide the government's budget equation (9) by N_t and insert it into (61). This yields:

$$P_{t+1} y_{t+1} = \beta\,(1 + i_t)\,P_t y_t - (1 - \beta)\left(\frac{1}{N_t} - \frac{1}{N_{t+1}}\right)\Omega_{t+1} \tag{62}$$

Now multiply (62) by N_{t+1}, and assume $N_{t+1}/N_t = 1 + n$. We obtain equation (16).