ISSN 1469-4328

CeFiMS

The Centre for Financial & Management Studies

CeFiMS Discussion Papers

Fiscal Policy and Price Stability

Barbara Annicchiarico and Giancarlo Marini

CeFiMS DP 33

2003

SOAS
University of London

CeFiMS

CeFiMS Discussion Papers

Published by
Centre for Financial and Management Studies
at SOAS, the University of London.

Please address comments to:

The Editor
CeFiMS Discussion Papers
Centre for Financial and Management Studies
SOAS
Thornaugh Street
London WC1H 0XG
United Kingdom

Telephone: 44 207 898 4050

Fax: 44 207 898 4089

E-mail: cefims@soas.ac.uk

Or e-mail the correspondent author directly:

barbara.annicchiarico@uniroma2.it

Fiscal Policy and Price Stability

Barbara Annicchiarico*and Giancarlo Marini†

March, 2003

Abstract

This paper studies the issue of price stability in a continuous time optimising general equilibrium model with overlapping generations. It is shown that fiscal policy has effects on nominal variables. Fiscal expansions are inflationary even when the government intertemporal budget constraint is respected and there is no recourse to money financing. Our results shed new light on the interaction between fiscal policy and nominal prices.

JEL Classification: E31, E63.

Keywords: Fiscal Policy, Price Stability.

*Department of Economics, University of Rome Tor Vergata, Via Columbia 2, 00133 Roma, Italy. *e-mail:* barbara.annicchiarico@uniroma2.it.

†Department of Economics, University of Rome Tor Vergata, Via Columbia 2, 00133 Roma, Italy. *e-mail:* marini@uniroma2.it.

1 Introduction

Standard monetarist theory predicts that nominal prices are determined by monetary policy. Inflation is a monetary phenomenon, exclusively depending on the rate of change of the money stock. An independent central bank, credibly committed to price stability, can thus determine the dynamics of nominal prices. However, it is well known, at least since the contribution of Sargent and Wallace (1981), that lax fiscal policy might affect the credibility of monetary policy. When government deficits cannot be financed exclusively by new bond issues, the monetary authorities may be forced to create money and inflation. The main consequence, as noted by Aiyagari and Gertler (1985), is that the price level is higher in a fiscal regime in which the public debt is expected to be backed by future money creation.

The current macroeconomic policy debate emphasizes the possible interrelation between monetary policy and fiscal discipline. Concern for the negative consequences of high government debt and deficits has repeatedly been expressed by central bankers and international economic institutions.

In the European Monetary Union (EMU) with a single currency, where the money supply is independently controlled by the European Central Bank (ECB), individual countries can no longer control monetary policy and governments are requested to keep sound budget positions. In particular, in the presence of a monetary authority committed to maintaining price stability, governments must give up hopes of debt monetization and accept the fact that current high deficits can only be financed by higher taxes and/or lower public expenditures in the future. Acceptance of monetary discipline and the impossibility of debt monetization are two basic pillars of the EMU[1].

As clearly stated by Willem Duisenberg on several occasions, the success of price stability-oriented monetary policy crucially depends also on sensible

[1] See European Commission (1990).

fiscal policy. For example, in a speech held in 1999, the President of the ECB stresses the importance of the Stability and Growth Pact in promoting sound public finances and price stability: "From the perspective of a central banker, a prime reason for the establishment of the Pact was that a lack of fiscal discipline would negatively affect the ability of the Eurosystem to achieve its primary objective to maintain price stability"[2]. More recently, the President explicitly calls for fiscal policy discipline to support the monetary strategy of the ECB: "Our monetary policy strategy is complicated, but very clear and we explain it day after day. In the two-pillar strategy, under the second pillar, we certainly come to a judgement about fiscal developments as we see them - it is one of the indicators we look at in determining our policy stance"[3]. In a recent statement on the Stability and Growth Pact the Governing Council of the ECB clearly explains that budgetary discipline is essential for price stability in the EMU[4]. Also the European Commission periodically reminds euro-area Member States to "orient and implement their budgetary positions so as to achieve or maintain budgetary positions of close to balance or in surplus over the economic cycle"[5], stating that "continued fiscal discipline will also facilitate the ECBs task of achieving price stability"[6].

The recommendations of the ECB and of the European Commission, however, are not backed by a theoretical framework showing the importance of fiscal discipline for price stability in the presence of an independent monetary authority. Some authors have recently questioned the validity of the monetarist approach. In particular, the so-called fiscal theory of the price

[2]Speech by Willem F. Duisenberg at the Global Economy Conference organized by the Economic Strategy Institute, Washington D.C, 27 April 1999.

[3]Speech by Willem F. Duisenberg: Testimony before the Committee on Economic and Monetary Affairs of the European Parliament, Brussels, 23 January 2002.

[4]See ECB (2002), p. 7.

[5]European Commission (2002a), p. 18.

[6]European Commission (2002b), p. 13.

level proposed by Woodford (1994, 1995) and Sims (1994) argues that the government's choice of the public deficit financing mode is crucial in the determination of the time path of the inflation rate[7]. Following Woodford, fiscal policy can affect price stability only in the case of a "non-Ricardian" regime, where the intertemporal budget constraint of the government does not need to be satisfied for all sequences of the price level. In the case of price level indeterminacy, the fiscal theory of the price level provides sufficient conditions to select a unique equilibrium path towards the steady state.

The influence of fiscal policy on the price level crucially rests on the assumption that the government is expected not to respect the intertemporal budget constraint. The theoretical validity of this approach has been seriously questioned by Buiter (2002) who argues that the public sector solvency constraint should always be satisfied and not only in equilibrium.

The main aim of the present paper is to demonstrate that fiscal variables do affect nominal prices within a general equilibrium optimising framework, where both private agents and the government must always respect their intertemporal budget constraint for any price level. Hence, we analyze a framework where "non-Ricardian" policies of the type described by the fiscal theory of the price level are not permitted. The channel of transmission of fiscal to nominal variables is derived in a continuous-time optimising overlapping generations model. It is shown that high debt and deficits are inflationary. Inflation is not just a monetary phenomenon, but also depends on fiscal variables. A fiscal expansion financed by bond issues and future taxes makes the nominal interest rate increase in the long run. The nominal price level has to rise to restore equilibrium in the money market. The price increase occurs even when the money stock is fixed. The main policy conclusion is that price stability requires not only an appropriate monetary rule, but also an appropriate fiscal policy. Our approach thus appears to provide

[7]This line of research has its roots in a earlier work by Leeper (1991).

strong theoretical support for the arguments put forward by central bankers invoking fiscal discipline as a prerequisite to achieve the objective of price stability.

The scheme of the paper is as follows. Section 2 presents the optimising continuous time overlapping generations model. The effects of a fiscal expansion on the price level are examined in Section 3. Section 4 summarizes the main results.

2 The Optimising Overlapping Generations Model

We consider a simple monetary perfect foresight model of a closed economy in which the production side is given by a standard endowment economy. The demand side of the model is described by an extended version of the Yaari (1965)-Blanchard (1985) model in which money directly enters the utility function in order to account for the services provided by real money holdings[8].

2.1 The Individual's Consumption Behavior

The economy is assumed to be populated by forward looking agents facing the same, constant instantaneous probability of death, β. Consumers have identical preferences and face the same sequence of future labour income and lump-sum taxes. Birth and death rates are assumed to be identical, so that there is no population growth. For simplicity, total population is normalized to one and there is no operative intergenerational bequest motive.

[8]Money provides transaction services yielding direct utility to the consumers. A monetary version of Blanchard-Yaari overlapping generations model can be found in Marini and van der Ploeg (1988).

The supply of labour at each instant t of an individual born at time $s \leq t$, $l(s,t)$, is inelastic and normalized to one. Each agent of cohort s chooses the time path of real consumption $c(s,t)$ and of real money balances $\varphi(s,t)$, in order to maximize the expected discounted value of the following lifetime utility function

$$\max_{\{c(s,t),\varphi(s,t)\}} E_t \int_t^\infty \log[c(s,v)^\eta \varphi(s,v)^{1-\eta}] e^{-\rho(v-t)} dv \tag{1}$$

where ρ is the constant rate of time preference and $0 < \eta < 1$. The probability at time t of being alive at time $v \geq t$ is given by $e^{-\beta(v-t)}$.

Equation (1) can be rewritten as

$$\max_{\{c(s,t),\varphi(s,t)\}} \int_t^\infty \log[c(s,v)^\eta \varphi(s,t)^{1-\eta}] e^{-(\rho+\beta)(v-t)} dv \tag{2}$$

The consumer's instantaneous budget constraint is given by

$$\frac{d}{dt} a(s,t) = [r(t)+\beta] a(s,t) + y(s,t) - \tau(s,t) - c(s,t) - i(t) m(s,t) Q(t) \tag{3}$$

subject to the transversality's condition

$$\lim_{v\to\infty} a(s,v) e^{-\int_t^v [r(u)+\beta] du} = 0 \tag{4}$$

where $a(s,t)$, $y(s,t)$, $m(s,t)$ and $\tau(s,t)$ denote real financial wealth, real wage income, nominal money stock and lump-sum taxation at time t of an agent born at time s, respectively; $r(t)$ is the real interest rate, $i(t)$ is the nominal interest rate and $Q(t)$ is defined as the inverse of the price level, $Q(t) = 1/P(t)$, where $P(t)$ is the price level. The inverse of the price level $Q(t)$ denotes the purchasing power of one unit of nominal money. In this way the model can conveniently be solved in terms of real variables. Consumers hold their financial wealth, $a(s,t)$, in the form of real money balances and real government bonds, $b(s,t)$. Agents are assumed to receive an instantaneous premium payment of $\beta a(s,t)$ from a competitive insurance company in exchange for their financial wealth at the time of death. The utility function is unit-elastic over time, so that money is essential in this model, unless $\eta = 1$.

Preferences are intertemporally separable and the utility function is homothetic. The consumer's problem can be easily solved by using a two-stage budgeting procedure.

Total consumption at time t of an agent born at time s, $\kappa(s,t)$, is defined as the sum of consumption plus the interest foregone on money holdings

$$\kappa(s,t) \equiv c(s,t) + [r(t) + \pi(t)]\varphi(s,t) \tag{5}$$

In the first stage, the consumer chooses the optimal mix of consumption and real money holdings in order to maximize the instantaneous utility function, $\log[c(s,t)^{\eta}\varphi(s,t)^{1-\eta}]$, conditional upon a given level of total consumption, $\kappa(s,t)$. The maximization problem yields the following first order condition: the marginal rate of substitution between consumption and real money balances must be equal to the nominal interest rate

$$\frac{1-\eta}{\eta}\frac{c(s,t)}{\varphi(s,t)} = r(t) + \pi(t) \tag{6}$$

where $\pi(t) = \frac{\dot{P}(t)}{P(t)} = -\frac{\dot{Q}(t)}{Q(t)}$ is the inflation rate.

Substituting condition (6) into (5) yields consumption and real money balances in terms of total consumption

$$c(s,t) = \eta\kappa(s,t) \tag{7}$$

$$[r(t) + \pi(t)]\varphi(s,t) = (1-\eta)\kappa(s,t) \tag{8}$$

In the second stage, consumers derive the optimal time path of total consumption. Substituting equations (7) and (8) into the lifetime utility function (2) yields

$$\max_{\{\kappa(s,t)\}} \int_t^\infty \{\log \kappa(s,t) - \log \chi(t)\} e^{-(\rho+\beta)(v-t)} dv \tag{9}$$

where $\chi(t) \equiv \left(\frac{1}{\eta}\right)^\eta \left[\frac{r(t)+\pi(t)}{1-\eta}\right]^{1-\eta}$ is the ideal cost-of-living index of the basket of physical goods and real money balances at time t. Agents maximize (9) given the budget constraint (3) and the solvency condition (4). The solution to the individual's optimization problem yields total consumption as a linear function of total wealth

$$\kappa(s,t) = (\beta + \rho)\left[a(s,t) + h(s,t)\right] \tag{10}$$

where $h(s,t)$ is human wealth defined as the present discounted value of after-tax labour income

$$h(s,t) = \int_t^\infty \left[y(s,v) - \tau(s,v)\right] e^{-\int_t^v [r(u)+\beta]du} \tag{11}$$

Combining (10) with (7) yields an expression for the optimal level of individual consumption

$$c(s,t) = \frac{\beta+\rho}{1+\xi}\left[a(s,t) + h(s,t)\right] \tag{12}$$

where, $\xi \equiv \frac{1-\eta}{\eta}$. Equalizing the marginal rate of substitution between consumption and real money balances to the nominal interest rate, the portfolio equilibrium condition can be re-written as

$$m(s,t)Q(t) = \xi \frac{c(s,t)}{r(t)+\pi(t)} \tag{13}$$

2.2 Aggregation

With population normalized to one the constant instantaneous death rate β is also the size of the cohort which dies at each instant. The size of the surviving cohort s at time $t \geq s$ is $\beta e^{-\beta(t-s)}$. Aggregate values of an economic variable, $x(s,t)$, can thus be obtained by integrating over all the generations

$$X(t) = \int_{-\infty}^{t} x(s,t)\beta e^{\beta(s-t)} ds \tag{14}$$

where the upper case letter denotes the aggregate value of the variable itself.

Under the assumptions that net labour income is independent of age and that non-human wealth for newly born individuals is zero, $a(t,t) = 0$, upon aggregation over all the population, one obtains

$$C(t) = \frac{\beta+\rho}{1+\xi}[A(t) + H(t)] \tag{15}$$

$$M(t)Q(t) = \xi \frac{C(t)}{r(t) + \pi(t)} \tag{16}$$

$$H(t) = \int_{t}^{\infty} [Y(t) - T(v)] e^{-\int_t^v [r(u)+\beta] du} dv \tag{17}$$

$$A(t) = B(t) + M(t)Q(t) \tag{18}$$

The dynamic equations for aggregate consumption, human wealth and real financial wealth are given by

$$\dot{C}(t) = [r(t) - \rho]\, C(t) - \beta \frac{\beta+\rho}{1+\xi} A(t) \tag{19}$$

$$\dot{H}(t) = [r(t) + \beta]\, H(t) - Y(t) + T(t) \tag{20}$$

$$\dot{A}(t) = r(t)A(t) + Y(t) - C(t) - i(t)M(t)Q(t) - T(t) \tag{21}$$

2.3 The Public Sector, Money and Market Equilibrium

The government is assumed to finance public expenditures and interest payments on public debt by seignorage revenue, lump-sum taxation and issuance of new bonds. The government flow budget constraint in real terms is given by

$$\dot{B}(t) = r(t)B(t) - T(t) - \mu(t)M(t)Q(t) + G(t) \tag{22}$$

where G is government spending and μ is the rate of nominal money growth. The government must respect the terminal boundary condition, precluding Ponzi games

$$\lim_{v \to \infty} B(v)e^{-\int_t^v r(u)du} = 0 \tag{23}$$

Integrating equation (22) forward gives the intertemporal budget constraint of the government

$$B(t) = \int_t^{\infty} \left[T(v) - G(v) + \mu(v)M(v)Q(v)\right] e^{-\int_t^v r(u)du} dv \tag{24}$$

Equilibrium in the goods market requires that

$$Y(t) = C(t) + G(t) \tag{25}$$

We can assume for simplicity that Y and G are constant over time. Consumption is $C = Y - G$. Since $\dot{C}(t) = 0$, we obtain from equation (13) the following expression for the real interest rate

$$r(t) = \rho + \frac{1}{C}\frac{\beta + \rho}{1 + \xi}\beta\left[B(t) + M(t)Q(t)\right] \tag{26}$$

The equilibrium in the money market is characterized by

$$\dot{[M(t)Q(t)]} = \left[\mu(t) - \pi(t)\right] M(t)Q(t) \tag{27}$$

Combining (27) with the optimal portfolio balance condition (16) yields

$$\frac{\dot{Q}(t)}{Q(t)} = r(t) - \frac{\xi C}{M(t)Q(t)} \tag{28}$$

3 Fiscal Policy, Public Solvency and Price Stability

In order to focus on the effects of a fiscal expansion on the price level, we assume no recourse to money financing, that is the rate of nominal money growth is set equal to zero, $\mu(t) = 0$ for $t \geq 0$. In particular, as debt accumulates the government is assumed to pursue fiscal solvency by adopting a rule for lump-sum taxation of the form

$$T(t) = Z - \theta \dot{B}(t) \tag{29}$$

with $\theta > 1$ and $Z > 0$ (see Buiter, 1988). The idea behind the above fiscal rule is that taxes are raised when there is a government deficit, in order to prevent the escalation of debt. In steady state taxes are given by Z. Note that equation (29) rules out any effect of fiscal policy on prices of the kind examined by the fiscal theory of the price level literature, since the intertemporal budget constraint of the government is always satisfied. It follows that the dynamic equation for real government debt (22) becomes

$$\dot{B}(t) = \frac{1}{\theta - 1}[Z - G - r(t)B(t)] \tag{30}$$

Combining equations (29) and (30) yields

$$T(t) = \frac{1}{\theta - 1}[\theta G + \theta r(t)B(t) - Z] \tag{31}$$

In the short run an increase in Z is expansionary, while in the long run implies an increase in the level of taxes. Government debt and taxation increase over time until the interest payments on bonds exactly match the long-run increase in taxation. The coefficient $\frac{1}{\theta-1}$ is to be interpreted as the speed of adjustment of the fiscal policy rule preventing an escalation of government debt. The steady state effects of a fiscal expansion are shown not to be affected by the level of θ.

Using equation (26), equations (30) and (28) can be rewritten as follows

$$\overset{\bullet}{B}(t) = \frac{1}{\theta-1}\left[Z - \rho B(t) - \frac{1}{C}\frac{\beta+\rho}{1+\xi}\beta B(t)Q(t) - \frac{1}{C}\frac{\beta+\rho}{1+\xi}\beta B^2(t)\right] \tag{32}$$

$$\overset{\bullet}{Q}(t) = \rho Q(t) + \frac{1}{C}\frac{\beta+\rho}{1+\xi}\beta B(t)Q(t) + \frac{1}{C}\frac{\beta+\rho}{1+\xi}\beta Q(t)^2 - \xi C \tag{33}$$

where $Q(0) = free$ and $B(0) = 0$.

It should be noted that the nominal value of the initial government liabilities, say $NB(0)$, is predetermined. It follows that the initial condition must satisfy $B(0) = NB(0)/P(0)$. The assumed absence of an initial outstanding debt also precludes the possibility of any effect of an unexpected jump in the price level on the real value of government bonds.

The non-linear differential equations (32) and (33) describe the dynamics of the economy where, for simplicity, we have normalized the exogenous stock of nominal money to one and set public expenditure equal to zero, $G = 0$. The steady state of the economy is obtained when $\overset{\bullet}{B}(t) = \overset{\bullet}{Q}(t) = 0$ and is described by the following equations

$$\rho\overline{B} + \frac{1}{C}\frac{\beta+\rho}{1+\xi}\beta\overline{BQ} + \frac{1}{C}\frac{\beta+\rho}{1+\xi}\beta\overline{B}^2 - Z = 0 \tag{34}$$

$$\rho\overline{Q} + \frac{1}{C}\frac{\beta+\rho}{1+\xi}\beta\overline{BQ} + \frac{1}{C}\frac{\beta+\rho}{1+\xi}\beta\overline{Q}^2 - \xi C = 0 \tag{35}$$

where $\overline{B}$ and $\overline{Q}$ are the steady state solutions for public debt and the inverse of the price level, respectively.

3.1 Long-Run Effects of a Fiscal Expansion and Transitional Dynamics

Suppose that the economy is initially in a steady state equilibrium and that there is an unexpected and permanent increase in Z financed by issuing bonds. The transitional dynamics of the economy after the fiscal shock is driven in part by the expectations of the new steady state, since the model is based on the assumption of forward looking agents. Hence, it is convenient to start the analysis with a discussion of the long-run effects of a fiscal expansion.

Differentiating the equilibrium system of equations (32)-(33), the long-run effects of a fiscal expansion are described by the following derivatives

$$\frac{d\overline{B}}{dZ} = \frac{\rho + \beta\frac{\Theta\overline{B}}{C} + \beta\frac{2\Theta\overline{Q}}{C}}{|\Delta|} > 0 \tag{36}$$

$$\frac{d\overline{Q}}{dZ} = -\frac{\beta\frac{\Theta\overline{Q}}{C}}{|\Delta|} < 0 \tag{37}$$

where

$|\Delta| = (\rho + \beta\frac{\Theta\overline{B}}{C} + \beta\frac{2\Theta\overline{Q}}{C})(\rho + \beta\frac{\Theta\overline{Q}}{C} + \beta\frac{2\Theta\overline{B}}{C}) - \left(\beta\frac{\Theta}{C}\right)^2\overline{QB} > 0$

and $\Theta \equiv \frac{\beta+\rho}{1+\xi}$.

In the long-run public debt and the price level are above their original level. This result can be explained by the adjustment dynamics followed by the system after the fiscal shock. As debt accumulates, the wealth effect alters the equilibrium in the money market, where the price level is determined. Fiscal policy affects the equilibrium of the monetary market through the wealth effect and the real interest rate. In the endowment economy considered, consumption does not change for a given level of public expenditure and the real interest rate is positively linked to the level of government bonds. It follows that a fiscal expansion financed by bond issues and future taxes makes the nominal interest rate increase in the long run and, consequently, the price level has to rise in order to restore equilibrium in the money market.

It should also be noted from equation (26) that in the special case of a zero death and birth rate, $\beta = 0$, the real interest rate does not depend on wealth and must be equal to the rate of time preference ρ. In that case the price level would be independent of the fiscal variables, $\frac{d\overline{Q}}{dZ} = 0$, since the model would collapse into the representative infinitely lived agent paradigm, no longer describing an economy with heterogeneity. In such a case, price stability and inflation are pure monetary phenomena and the public deficit influences the price level only when it is financed by money creation.

In order to analyze the dynamic properties and the equilibrium conditions of the model, we restrict our attention to the linear approximation of the system (32)-(33) around the steady state values $\overline{Q}$ and $\overline{B}$

$$\begin{pmatrix} \overset{\bullet}{B}(t) \\ \overset{\bullet}{Q}(t) \end{pmatrix} = A \begin{pmatrix} B(t) - \overline{B} \\ Q(t) - \overline{Q} \end{pmatrix} \tag{38}$$

where $A \equiv \begin{pmatrix} -\frac{a_{11}}{\theta-1} & -\frac{\beta}{\theta-1}\frac{\Theta\overline{B}}{C} \\ \beta\frac{\Theta\overline{Q}}{C} & a_{22} \end{pmatrix}$ with $a_{11} \equiv \rho + \beta\frac{\Theta\overline{Q}}{C} + \beta\frac{2\Theta\overline{B}}{C}$and

$a_{22} \equiv \rho+\beta\frac{\Theta\overline{B}}{C}+\beta\frac{2\Theta\overline{Q}}{C}$. The determinant of the Jacobian matrix is negative, $|A| < 0$, implying that the matrix A has one positive and one negative eigenvalue. Hence, there exists a unique equilibrium converging to the steady state.

Starting from a zero initial stock of debt, $B_0 = 0$, the time paths followed by public debt and the inverse of the price level are

$$B(t) = (1 - e^{-\lambda_1 t})\overline{B} \tag{39}$$

$$Q(t) - \overline{Q} = \frac{\beta\frac{\Theta\overline{Q}}{C}}{\lambda_1 - a_{22}}(B(t) - \overline{B}) \tag{40}$$

where λ_1 is the negative eigenvalue. Equation (40) describes the stable arm of the saddle path. It is negatively sloped, reflecting the fact that the price level increases with the stock of debt. The dynamics of public debt B and of the inverse of the price level Q can be described by the associated phase diagram in the $B-Q$ space. This is illustrated in Figure 1. Suppose that the economy is initially in a steady state equilibrium with the steady-state values denoted by Q_0 and $B_0 = 0$. As long as no future change in the fiscal variables is anticipated, the economy must lie on the stable arm. With the stock of government bonds being predetermined, after the unexpected fiscal expansion the inverse of the price level jumps from Q_0 to Q_0^+ onto the new stable locus XX, described by equation (40). Following the fiscal expansion public debt begins to accumulate and the price level continues to increase along the saddle path. The new steady state is at point E, with a higher equilibrium stock of debt and a higher price level. The fiscal expansion gives rise to an immediate increase in the price level, whilst on impact the price level undershoots its long run value.

The transitional dynamics can be described by considering the characteristic equation associated to the linearized system (38)

$$\Phi(\lambda, \alpha) = \lambda^2 - a_{11}\lambda - \alpha(\Omega - a_{22}\lambda) = 0 \tag{41}$$

where $\Omega \equiv a_{11}a_{22} - \left(\beta\frac{\Theta}{C}\right)^2 \overline{QB} > 0$ and $\alpha \equiv \frac{1}{\theta - 1}$. The relevant derivative evaluated at the negative root is

$$\frac{d\lambda}{d\alpha} = -\frac{\partial\Phi/\partial\alpha}{\partial\Phi/\partial\lambda} \tag{42}$$

The sign of $\frac{\partial\Phi}{\partial\alpha}$ is unambiguously negative. The sign of $\frac{\partial\Phi}{\partial\lambda}$ can be shown to be also negative as $\Phi(\cdot)$, given α, is a parabola and $\Phi(0, \alpha)$ is negative, so that $\Phi(\cdot)$ is decreasing in λ in the neighborhood of the unique negative eigenvalue. It follows that $\frac{d\lambda}{d\alpha} < 0$, that is when the speed of adjustment is high, the economy converges faster towards the new steady state equilibrium. Figure 2 shows that equation (41) has two solutions, $\lambda_1 < 0$ and $0 < \lambda_2 < a_{11}$, where $f(\lambda) \equiv \lambda^2 - a_{11}\lambda$, $g(\lambda, \alpha) \equiv \alpha(\Omega - a_{22}\lambda)$ and $\alpha' > \alpha$. The absolute value of the relevant eigenvalue λ_1 is increasing in α.

In conclusion, the transition paths of the price level and of public debt towards the new steady state crucially depend on the coefficient α characterizing the fiscal policy rule. In particular, the larger α, the greater in absolute value is the relevant root of the system λ_1 and the more quickly the system will reach the new steady state after the fiscal shock. Alternative time paths of fiscal rules ensuring public solvency thus exert different effects on price level dynamics.

4 Conclusions

The main result of our model is that a temporary reduction in taxation expected to be financed by bond issues and future taxes influences the steady state level of the price level for a given nominal stock of money.

Fiscal variables affect nominal variables. Budgetary policies need not be intertemporally unbalanced to explain the correlation between fiscal and nominal variables. In particular, a fiscal expansion affects prices even when the money stock is kept constant. Alternative time paths of fiscal adjustment, fully respecting the government intertemporal budget constraint, exert different consequences on price level dynamics. Our results, obtained in a standard optimising framework solve the apparent contradiction between central bankers' concern for fiscal discipline and standard general equilibrium modelling. In particular, the need for close to balanced budget government policy emerges in a fully maximizing framework. The view that price stability requires not only an appropriate monetary rule but also an appropriate conduct of fiscal policy has indeed strong theoretical foundations.

References

[1] Aiyagari, R. S. and Gertler, M. (1985), "The Backing of Government Bonds and Monetarism", *Journal of Monetary Economics*, Vol. 16, pp.19-44.

[2] Blanchard, O. J. (1985), "Debt, Deficits, and Finite Horizons", *Journal of Political Economy*, Vol.93, pp. 223-247.

[3] Buiter, W. H. (1988), "Death, Birth, Productivity Growth and Debt Neutrality", *The Economic Journal*, Vol. 98, pp. 279-293.

[4] Buiter, W. H. (2002), "The Fiscal Theory of the Price Level: A Critique", *The Economic Journal*, Vol. 112, pp. 459-480.

[5] Duisenberg, W. F. (1999), Speech delivered at the *Global Economy Conference* organized by the Economic Strategy Institute, Washington D.C, 27 April 1999.

[6] Duisenberg, W. F. (2002), Testimony before the *Committee on Economic and Monetary Affairs* of the European Parliament, Brussels, 23 January 2002.

[7] ECB (2002), *Monthly Bulletin,* November.

[8] European Commission (1990), "One Market, One Money", *European Economy.*

[9] European Commission (2002a), "2002 Broad Economic Policy Guidelines", *European Economy.*

[10] European Commission (2002b), "The Euro Area in the World Economy - Developments in the first three Years", *Communication from the Commission no. 332*, Brussels.

[11] Leeper, E. M. (1991), "Equilibria under 'Active' and 'Passive' Monetary and Fiscal Policy", *Journal of Monetary Economics*, Vol. 27, pp.129-147.

[12] Marini, G. and van der Ploeg, F. (1988), "Monetary and Fiscal Policy in an Optimising Model with Capital Accumulation and Finite Lives", *The Economic Journal*, Vol. 98, pp. 772-786.

[13] Sargent, T. J. and Wallace, N. (1981), "Some Unpleasant Monetarist Arithmetic", *Quarterly Review of Minneapolis Federal Reserve Bank*, Fall, pp. 1-17.

[14] Sims, C. (1994), "A Simple Model for the Study of the Determination of the Price Level and the Interaction of Monetary and Fiscal Policy", *Economic Theory*, Vol. 4, pp. 381-399.

[15] Woodford, M. (1994), "Monetary Policy and Price Level Determinacy in a Cash-in-Advance Economy", *Economic Theory*, Vol. 4, pp. 345-380.

[16] Woodford, M. (1995), "Price Level Determinacy without Control of a Monetary Aggregate", *Carnegie Rochester Conference Series on Public Policy*, Vol. 43, pp. 1-46.

[17] Yaari, M. E. (1965), "Uncertain Lifetime, Life Insurance, and the Theory of the Consumer", *The Review of Economic Studies*, Vol. 32, pp. 137-150.

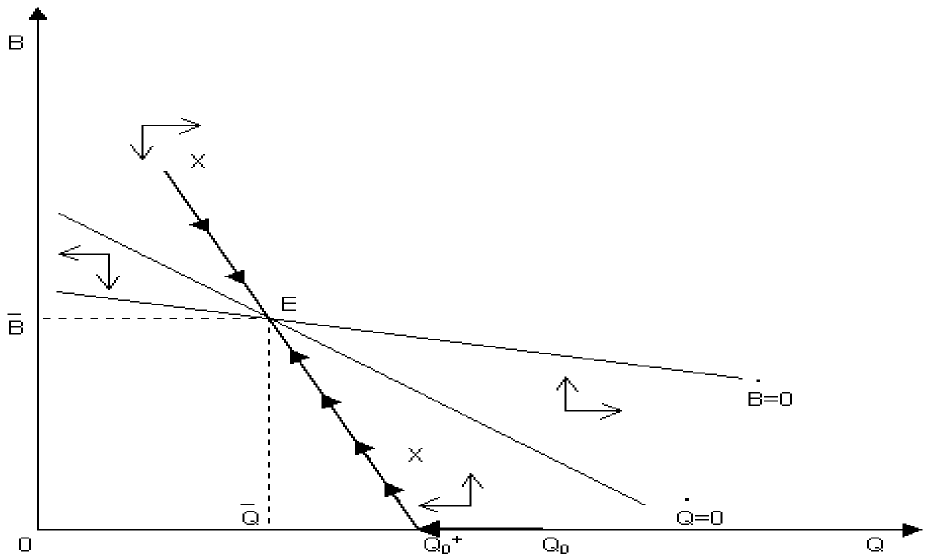

Figure 1

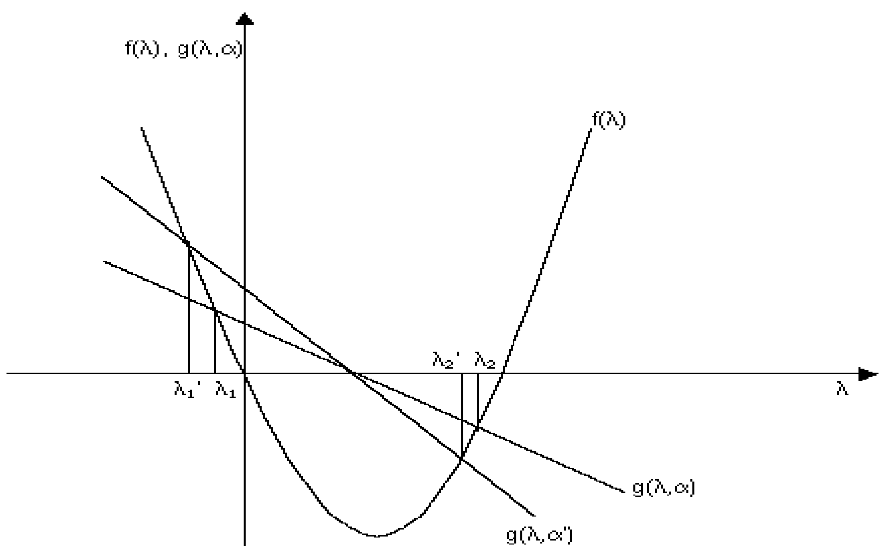

Figure 2

For copies of current and recent Discussion Papers, contact:

The Editor **CeFiMS Discussion Papers**
Centre for Financial and Management Studies
Thornhaugh Street
London WC1H 0XG
United Kingdom

2001

DP 09 Bassam Fattouh ***Determinants of Banks' Location in the World's Major Financial Centres***

DP 10 Panicos O. Demetriades, Bassam Fattouh ***Unproductive' Credit and the South Korean Crisis***

DP 11 Philip Arestis, Andrea Cipollini, Bassam Fattouh ***Threshold Effects in the US Budget Deficit***

DP 12 Panicos O. Demetriades, Bassam Fattouh, Kalvinder Shields ***Financial Liberalisation and the Evolution of Banking and Financial Risks: the Case of South Korea***

DP 13 Christopher Howe ***Development and International Economic Integration: Is China Ready? Some Ideological, Industrial and Regional Considerations***

DP 14 Konstantinos Loizos, John Thompson ***The Demand for Money in Greece: 1962 to 1998***

DP15 Luca G. Deidda ***Financial Institutions' Expertise and Growth Effects of Financial Liberalisation***

DP16 Luca G. Deidda, Bassam Fattouh ***Non linearity between Finance and Growth***

DP17 Luca G Deidda ***On the Growth Effects of Endogenous Financial Development***

DP18 Anja Nagel ***The Role of Financial Sector Dynamics in Thailand 's 1997 Currency Crisis***

DP19 Bassam Fattouh, Pasquale Scaramozzino, Laurence Harris ***Capital Structure in South Korea: A Quantile Regression Approach***

DP20 Giancarlo Marini, Giovanni Piersanti ***Fiscal Deficits and Currency Crises***

2002

DP21 Atsushi Tokuda ***The Origin of the Corporation in Meiji Japan***

DP22 Luca Deidda & Bassam Fattouh ***Concentration in the Banking Industry and Economic Growth***

DP23 Laixiang Sun ***Fading out of Local Government Ownership: Recent Ownership Reform in China's Township and Village Enterprises***

DP24 Giancarlo Marini, Pietro Senesi ***Technological Externalities and First-best Policy-rules***

DP25 Pietro Senesi ***Endogenous Fluctuations in a one Capital Good Model***

DP26 Fabio Cerina, Luca Deidda ***Do We Need More Time for Leisure?***

DP27 Federico Dini ***Concentration and Competition in the Credit Market***

DP28 Jun Ma ***Intergovernmental Fiscal Transfer: A Comparison of Nine Countries***

DP29 Alessandra Dal Colle Stievano ***Intermediation and Growth in Financially Open Economies***

DP30 Simone Valente ***Sustainable Development, Renewable Resources and Technological Progress***

DP31 Bassam Fattouh ***A Note on Multinational Corporate Structure: Evidence from UK***

2003

DP32 Leonardo Becchetti and Fabrizio Adriani ***Does the digital divide matter? The role of Information and Communication Technology in cross-country level and growth estimates***

DP33 Barbara Annicchiarico and Giancarlo Marini ***Fiscal Policy and Price Stability***

DP34 Barbara Annicchiarico and Giancarlo Marini ***Government Deficits, Consumption and the Price Level***