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INTERACTIONS BETWEEN MONETARY AND FISCAL POLICY RULES*

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The Fiscal Stability Pact for EMU implies that constraints on fiscal policy facilitate inflation control. In this paper we identify two stable policy regimes. When monetary policy seeks to raise real interest rates in response to excess inflation, a self-stabilising fiscal policy is required to ensure model stability. A fiscal policy which does not, by itself, ensure fiscal solvency constrains monetary policy to be relatively 'passive'. However, in simulations we conclude that the central bank does not need to seek, on this account, the degree of debt stabilisation that appears to be implied by the fiscal stability pact.

There has been a considerable amount of analysis recently of the performance of alternative monetary policy rules, prompted in part by the adoption of explicit inflation targets and the granting of independence to central banks in a number of countries. Nearly all of this analysis ignores the behaviour of fiscal policy. However, the controversy aroused by the fiscal stability pact, agreed as part of the preparation for the EMU's independent central bank, suggests that the linkages between monetary and fiscal policy in influencing inflation are not fully understood.

Recent work that does allow for the impact of fiscal policy on inflation is the 'fiscal theory of the price level'. This literature initially sought to identify (Woodford (1995)), and subsequently assumed (see, for example, Canzoneri *et al.* (1998), Cochrane (1998) and Schmitt-Grohe and Uribe (1997)), the conditions under which either fiscal policy or monetary policy alone determines the price level. In order to obtain the result that monetary policy does not affect prices it is necessary that real government spending and taxation are exogenous. In addition to the restrictions on fiscal policy, it is also necessary to assume that the conditions for Ricardian Equivalence hold. These and further assumptions ensure that the real interest rate is determined by the availability of real resources and is unaffected by monetary policy. Provided prices are flexible and the majority of government debt is denominated in nominal terms, these assumptions imply that the current price level is fully determined by the needs of fiscal solvency.

The analysis in this paper is related to this work. In particular Woodford (1996), extends the theory to allow for nominal inertia, but retains the assumptions of Ricardian Equivalence and the perfect substitutability of private and public consumption. Our paper, however, drops many of the assumptions required to ensure that either fiscal or monetary policy alone determine prices: the model used here allows for deviations from Ricardian Equivalence,

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nominal inertia in price setting, the possibility that government debt is denominated in real terms and feedback from debt disequilibrium to government spending. The analysis also focuses on an environment in which monetary and fiscal policy are set according to simple rules. These extensions imply that there are clear interactions between monetary and fiscal policy. Cases where fiscal action constrains monetary action (the regime usually analysed under the 'fiscal theory of the price level') are considered, along with regimes where fiscal policy does not constrain monetary policy, but where it can still influence prices.

1. The Model

In this section we outline a multi-good version of the Blanchard-Yaari (see Blanchard (1985)) perpetual youth model, which also allows for the existence of money. For simplicity, we exclude capital from the analysis. At each point in time a new cohort of individuals is born, each of whom faces a constant probability of death (k). The impact of this probability is to raise the individual's subjective discount rate (σ) by k. The individual consumes goods from a continuum of consumption goods, $c(i)$ defined over the range $[0, 1]$.[1] An individual born into a cohort at time s, seeks to maximise her discounted expected lifetime utility by choosing an optimum pattern of consumption and holdings of real money balances (m).[2] The individual's objective function is defined as,

$$\int_t^\infty \{\nu \ln[c(s, z)] + (1-\nu)\ln[m(s, z)]\}\exp[-(k+\sigma)(z-t)]\, dz \tag{1}$$

where the basket of consumption goods is given by,

$$c(s, z) = \left[\int_0^1 c_z^s(i)^{(\theta-1)/\theta}\, di\right]^{\theta/(\theta-1)}.$$

In our model the individual can hold her non-human wealth, $w(s, z)$, in the form of non-interest bearing money or government bonds, which are assumed to be perfect substitutes. Government bonds earn a real return $r(z)$, while the value of the individual's real money balances deteriorates at the rate of inflation, $\pi(z)$. Due to the uncertainty caused by the probability of death, competitive insurance companies contract to pay the individual a premium $kw(s, z)$ at each point in time in return for her financial wealth when she dies.

The individual also earns labour income and a share of the profits from all the imperfectly competitive firms in the economy. Since all individuals are assumed to supply an identical unit of labour inelastically and receive the same

[1] We need more than one good to motivate our use of Calvo contracts in price setting.

[2] For simplicity a Cobb-Douglas specification for the money-in-utility function is adopted. Alternative specifications could allow for a richer relationship between seignorage revenues and interest rates, although all the results we present below are not dependent upon the existence of seignorage revenues – they occur even in a cashless economy.

proportion of aggregate firm profits then the sum of the individual's profit and labour income is given by $y(s, z)$ (i.e. *per capita* GDP) before payment of lump-sum taxation of $t(s, z)$. Although the staggering of price setting introduced later will imply profit margins that differ across firms, assuming that individuals receive a proportion of aggregate profits effectively pools the risk due to uncertainty over the timing of price changes. The individual's dynamic budget constraint can be represented in real terms as,

$$dw(s, z) = [r(z) + k]w(s, z) + y(s, z) - t(s, z) - c(s, z) - [r(z) + \pi(z)]m(s, z) \tag{2}$$

where dx is the time derivative for variable x i.e. $dx(z)/(dz)$.

The individual also faces the familiar no-Ponzi Game condition for her holdings of non-human wealth, $w(s, z)$,

$$\lim_{z\to\infty} \exp\left\{-\int_t^z [r(\omega) + k]\, d\omega\right\} w(s, z) = 0. \tag{3}$$

The individual then maximises utility subject to the budget constraint (2) and the no-Ponzi Game condition (3). After normalising total population size to one, it is possible to aggregate the typical individual's first-order conditions across cohorts. Therefore the aggregate consumption function can be shown to be,

$$C(t) = \nu(k + \sigma)[H(t) + W(t)] \tag{4}$$

and real money demand,

$$M(t) = \left(\frac{1 - \nu}{\nu}\right)\left[\frac{C(t)}{r(t) + \pi(t)}\right]. \tag{5}$$

The dynamics of aggregate discounted profit and labour income are simply,

$$dH(t) = [r(t) + k]H(t) - [Y(t) - T(t)], \tag{6}$$

along with the no-Ponzi Game condition,

$$\lim_{z\to\infty} \exp\left\{-\int_t^z [r(\omega) + k]\, d\omega\right\} H(z) = 0. \tag{7}$$

Since there is no capital in the model, financial wealth is made up of government bonds and non-interest bearing money, both of which constitute the liabilities of the government. Accordingly, the government's dynamic budget constraint, in real terms, is given by,

$$dW(t) = r(t)W(t) + G(t) - T(t) - [r(t) + \pi(t)]M(t), \tag{8}$$

and there also exists a no-Ponzi Game condition for these liabilities. Government debt, $B(t)$ is defined as $W(t) - M(t)$.

Fiscal policy can react to the level of government debt either through changes in government spending or through changes in taxes. Feedback to government spending would have an impact on real variables even if Ricardian Equivalence held, which is not the case with feedback to taxation. We therefore begin with feedback on taxation, which allows us to assess the importance of Ricardian Equivalence. However, we also report results for the case where fiscal policy focuses on government spending, and the qualitative results are the same. The case of feedback to government spending is also analysed in Section 2.

For simplicity, autonomous government spending is assumed to be allocated amongst individual consumption goods in the same manner as individuals' consumption. This implies that the demand for a particular product is,

$$y_i(t) = Y(t)\left[\frac{p_i(t)}{P(t)}\right]^{-\theta}, \tag{9}$$

where aggregate demand is, $Y(t) = C(t) + G(t)$, and the aggregate price level is defined by the following CES index,

$$P(t) = \int_0^1 [p_i(t)^{1-\theta}\, di]^{1/(1-\theta)} \tag{10}$$

Following Calvo (1983), firms set prices with a probability q at any point in time. As would be expected from the firm's demand curve, when setting prices the firm takes account of the expected aggregate price level and the level of aggregate demand relative to the steady-state,

$$X(t) = q\int_t^{\infty}\left\{P(s)\left[\frac{Y(s)}{\overline{Y}}\right]^b\right\}\exp[-q(s-t)]\, ds \tag{11}$$

where $X(t)$ is the price set by all firms which were able to change prices at time t and the parameter b is expected to be inversely related to θ. The aggregate price level is then a weighted average of prices set in the past,

$$P(t) = \left\{\int_{-\infty}^{t} q\exp[-q(t-s)]\, X(s)^{1-\theta}\, ds\right\}^{1/(1-\theta)}. \tag{12}$$

After differentiation, manipulation and linearisation of (11) and (12) this yields the following forward-looking Phillips curve,

$$d\pi'(t) = -\alpha Y'(t) \tag{13}$$

where, $\alpha = q^2 b$ and a primed variable denotes deviation from steady-state. The more traditional backward-looking Phillips curve is simply the same expression with $\alpha < 0$.

We adopt a very simple monetary policy that involves raising the real rate of interest above the steady-state level generated by the model, $\overline{r}$, if inflation deviates from some target level π^*:

$$r(t) = \overline{r} + \mu[\pi(t) - \pi^*] \tag{14}$$

Here the parameter μ indicates the 'strength' of monetary policy: we define an 'active' monetary policy as being one where real interest rates rise in response to an increase in inflation i.e. $\mu > 0$. 'Passive' monetary policy is when nominal interest rates do not rise in the face of an increase in inflation, by enough to maintain real interest rates. Here $\mu = -1$ would imply a policy of fixing the nominal interest rate. For simplicity we adopt an inflation target of zero.

In order to assess the stability of the model we linearise the remainder of the model, under different assumptions about the form of fiscal stabilisation, around its steady state. This allows the model to be represented in matrix algebra form as,

$$\begin{bmatrix} dW'(t) \\ dH'(t) \\ d\pi'(t) \end{bmatrix} = A \begin{bmatrix} W'(t) \\ H'(t) \\ \pi'(t) \end{bmatrix}, \tag{15}$$

Details of the linearsied model and its matrix representation are given in Appendix 1.

1.1. *Stability*

A formal analysis of the stability of the model highlights some of the concerns about the interaction between fiscal and monetary policy that may lie behind the fiscal stability pact associated with EMU. In particular it shows that 'passive' fiscal stabilisation is incompatible with any attempt by the monetary authorities to implement 'active' monetary policy rules.

In our first analysis of stability we assume that the government has a target level for government spending, G^*, which actual government spending is set equal to. The government then adjusts lump-sum taxation to gradually meet the steady-state level of debt,

$$T(t) = \overline{T} + f[B(t) - \overline{B}] \tag{16}$$

where f is a parameter reflecting the degree of fiscal feedback. Rules of this kind have been widely used in both the theoretical and empirical literature.[3]

Consider the situation where inflation is forward looking i.e. $\alpha > 0$.[4] In this case both discounted labour/profit income (H) and inflation can be considered as jump variables, while financial wealth (W) is a predetermined variable. Thus a necessary, but not sufficient, condition for saddlepath stability is that the determinant of the transition matrix, A, be negative. Substituting for the steady-state values of variables and solving the determinant inequality condition for the fiscal feedback parameter, f, it can be shown that the determinant is indeed negative whenever,

$$f > \Omega, \quad \text{for } \mu > 0, \text{ or } \mu < 0 \text{ and } \overline{r}^2\mu > -(1-\nu)(1+\mu)k(k+\sigma) \tag{17}$$

$$f < \Omega, \quad \text{for } \mu < 0 \text{ and, } \overline{r}^2\mu < -(1-\nu)(1+\mu)k(k+\sigma). \tag{18}$$

[3] It is difficult to motivate tax smoothing in our model as taxes are lump sum. In any case, tax smoothing would be close to being an optimal discretionary policy compared to the simple rules we choose to consider in this paper. We do not wish to take sides in the rules versus discretion debate.

[4] Since α enters the final row of the transition matrix as a common factor, the necessary conditions for stability are the same whether or not inflation is forward or backward looking.

where,

$$\Omega = \frac{\mu \overline{r}^2 (2\overline{r} - \sigma)}{(1-\nu)(1+\mu)k(k+\sigma) + \overline{r}^2\mu}.$$

These conditions indicate that an 'active' monetary policy regime ($\mu > 0$) must be accompanied by an 'active' fiscal policy regime for the model to be stable. The reason for this is that, in the face of an inflationary shock, an active monetary policy will raise real interest rates and raise real debt service costs. Fiscal policy must adjust tax revenues or spending to offset the debt interest spiral that would otherwise be initiated by the 'active' monetary policy. This is also why, as the degree of monetary policy activism increases (i.e. as μ increases), the restrictions on fiscal policy also become tighter.

Stability under a 'passive' fiscal policy regime must also necessarily imply a 'passive' monetary policy.[5] This is not to say, however, that the fiscal authorities can automatically 'force' an independent monetary authority, such as the new ECB, to operate a 'passive' monetary policy. Arguably, it may be difficult for any government to credibly adopt a fiscal policy that never (now or in the future) operated to ensure fiscal solvency over an infinite horizon (see also McCallum (1998)). Our result simply means that a 'passive' fiscal policy is incompatible with an 'active' monetary policy – some change in policy is required.

When Ricardian Equivalence holds (i.e. when $k = 0$) *or* when there is no money in the economy then these conditions reduce to,

$$f > 2\overline{r} - \sigma, \text{ when } \mu > 0, \text{ and} \tag{19}$$

$$f < 2\overline{r} - \sigma, \text{ when } \mu < 0, \tag{20}$$

and there is a clear dichotomy between 'active' and 'passive' policy regimes.

These simpler conditions also reveal that the exclusion of money from the economy increases the degree of active fiscal stabilisation required to ensure stability when monetary policy is actively targeting inflation. The reason for this is that the exclusion of money no longer allows the government to finance part of its deficit by issuing non-interest bearing assets. As a result, any movement in interest rates as part of an active inflation targeting monetary policy has a greater impact on the government's finances than when part of government liabilities are issued in the form of money, *ceteris paribus.* It is also interesting to note that in either of these special cases it is only the sign and not the size of μ, the monetary policy feedback parameter, that is relevant in defining the restrictions on fiscal policy necessary to ensure stability.

The analysis above considered the case where taxation reacted to deviations of government debt from its steady-state value. An alternative model of fiscal stabilisation is where the level of government spending varies in response to

[5] To the extent that government debt is held abroad, there is a limit to the ability output of domestic monetary policy to stabilise debt.

deviations of debt from equilibrium, and where taxation is applied at a constant rate. Therefore, we replace $G(t)$ and (16) with,

$$G(t) = G^* + f[B(t) - \overline{B}], \text{ and} \tag{21}$$

$$T(t) = \tau Y(t). \tag{22}$$

The conditions for stability in this case are given by,

$$f > \Psi \text{ if the denominator of } \Psi > 0, \text{ and} \tag{23}$$

$$f < \Psi \text{ if the denominator of } \Psi < 0, \tag{24}$$

where,

$$\Psi = \frac{\nu \overline{r}^2 \mu k(2\overline{r} - \sigma)(k+\sigma)}{\{(1-\nu)[k^2(1+\mu)(k+\sigma)^2 - k(k+\sigma)\mu\overline{r}(3\overline{r} - 2\sigma) + \overline{r}(\overline{r} - \sigma)] + \overline{r}^2\mu[k(k+\sigma) + (\overline{r} - \sigma)^2]\}}.$$

Although, the sign of the denominator of this expression is ambiguous, for plausible values of ν it will be the case that fiscal feedback will be greater than a positive constant given by the expression above when $\mu > 0$, and less than a positive constant when $\mu < 0$. To see this more clearly, consider the case of a cashless economy ($\nu = 1$), where the stability condition can be re-written as,

$$f > \frac{(2\overline{r} - \sigma)k(k+\sigma)}{k(k+\sigma) + (\overline{r} - \sigma)^2}, \text{ when } \mu > 0, \text{ and} \tag{25}$$

$$f < \frac{(2\overline{r} - \sigma)k(k+\sigma)}{k(k+\sigma) + (\overline{r} - \sigma)^2}, \text{ when } \mu < 0. \tag{26}$$

Since $\overline{r} > \sigma$ to ensure that government debt is held in equilibrium, these conditions indicate that an 'active' ('passive') monetary policy regime must be accompanied by an 'active' ('passive') fiscal policy regime for the model to be stable. When Ricardian Equivalence holds (i.e. when $k = 0$) then these conditions simply state that government spending should fall (rise) when government debt exceeds its target and monetary policy is 'active' ('passive').

These determinant conditions are, in general, necessary, but not sufficient conditions for stability. However, in the simulations we consider below, the numerical evaluation of the eigenvalues indicates that both models are saddlepath stable.

Our results give us one reason why an independent central bank (such as the new European Central Bank) might be concerned about the behaviour of fiscal policy. If fiscal policy does not react sufficiently actively to disequilibrium in government debt, then this lax fiscal control may compromise the ability of the Bank to respond actively in tackling inflation. In essence, lax fiscal control means that real interest rates must be used to stabilise debt, so monetary policy cannot increase real interest rates to combat an inflationary shock. However to avoid this possibility Central Banks simply need to ensure some degree of fiscal feedback.

2. Fiscal Policy and Inflation

In the previous section we established two potentially stable policy regimes: a regime where monetary and fiscal policy were both ‘passive’, and a regime where both were ‘active’. In this section we explore issues of monetary and fiscal policy interaction further for both regimes, focusing on the extent to which inflationary shocks are stabilised.

We begin by examining whether the choice of instrument of fiscal feedback (government spending or taxation) affects the results. We then examine how the two regimes compare. It might be presumed that it was undesirable to force monetary policy to be passive because it would increase inflation disequilibrium following a demand shock. We show that this is not necessarily the case. We then focus on the passive regime, and vary the degree of passivity in monetary policy. Finally we turn to the active regime, and ask whether it is always better from a stabilisation point of view to make fiscal feedback as active as possible, as appears to be presumed under the fiscal stability pact?

Throughout we consider models which are stable in the sense of the previous section. However, since analytical solutions of the model in the face of shocks are intractable, we utilise a discrete time analogue of the continuous time model considered above and adopt a parameter set in order to examine the detail of the dynamic paths of model variables following shocks. (We also consider the sensitivity of key results to parameter choices.) Our central parameter set is given in Table 1. The data period is annual.

Output is normalised at unity, and steady state government spending is 34% of GDP. This implies long run government debt is about 40% of GDP, and generates an equilibrium real interest rate of 3% p.a. Together with the ‘mark up’ k and the tax rate, this determines the size of discounted profit and labour income, H. A value of 0.1 for α implies that a one year, 1% increase in output will ceteris paribus lead to a 0.1% increase in inflation in the same year. We also looked at a much stronger inflationary response, where $\alpha = 1.0$, but this did not, qualitatively, change our results.

Before considering the interactions of monetary and fiscal policy, a prior question is whether discretionary changes in fiscal policy have a noticeable impact on the economy. If discretionary changes in fiscal policy are unimpor-

Table 1
Parameters and Steady-State Values of Variables

Parameters		Base values	
		r	0.03
α	0.1	Y	1
k	0.06	G	0.340
σ	0.02	W	0.404
τ	0.35	M	0.066
ν	0.997	H	7.872

tant, we are almost bound to find that changes in the fiscal feedback rule have little effect on the conduct of monetary policy. Here we find a crucial difference between changes in taxes and government spending. Although the mark-up on interest rates in our central parameter set, at 0.06, is large (larger than any realistic figure for the probability of death, for example), the impact of tax changes on consumption is still substantially smoothed. As a result, a 1% fall in taxation for one year leads to only a 0.03% increase in output. In contrast, a 1% increase in government spending for one year feeds directly into demand and, in the presence of nominal inertia, raises output by 0.35%.

This result shows that, if fiscal feedback takes place on government spending rather than taxes, then the strength of any fiscal feedback rule could *in principle* influence inflation and the design of an optimal monetary policy. For this reason we focus on this form of fiscal feedback in the remainder of this section.[6] Specifically, our active fiscal rule ($f = 0.08$) reduces annual government spending by about 1% in a year if debt is 10% above target. This is a useful reference case, because it mirrors exactly the response of the private sector ($f = k + \sigma$), neutralising the impact of wealth on demand when inflation is forward looking. We examine more aggressive fiscal stabilisation below.[7] Our active monetary policy rule ($\mu = 0.5$) raises nominal interest rates by 1.5 points for each one point rise in inflation. (This number is widely used in the context of Taylor rules – see, for example, Taylor (1993).)[8] Our passive fiscal policy simply holds real government spending (and the tax rate) constant, which given the stability conditions derived in the previous section is incompatible with an active monetary policy. Here we consider the most active of passive monetary policies: nominal interest rates rise by 0.9 points for every 1 point rise in inflation.

2.1. *A Comparison of Active and Passive Policies*

To compare our active and passive policy regimes, we consider a demand shock in the form of a 1% decrease in consumption (for given H and W), which dies away gradually and linearly over five years. (Using a shock with some persistence allows us to combine unanticipated and anticipated behaviour. The qualitative results in this section would be identical if we considered a one period shock, or replaced a demand shock with a supply shock). Fig. 1 shows the impact of the shock on output, financial wealth and inflation in the

[6] Simulations not shown here confirm the result that changes in fiscal feedback when feedback acts on taxes has virtually no effect on stabilising inflation or output. For much the same reason, using the model to compare a tax based fiscal feedback rule with a policy of tax smoothing would not produce very interesting effects on inflation or output.

[7] The central parameter value is well above the critical value derived in the previous section.

[8] In this model, a very large value of μ is optimal in the face of demand shocks (because the effects of the demand shock on output and inflation can be eliminated entirely with a suitable monetary contraction), but large μ is unlikely to be desirable for supply shocks (as the inflationary consequences of the shock can only be eliminated at the price of output disequilibrium) (see Leith and Wren-Lewis (1997)).

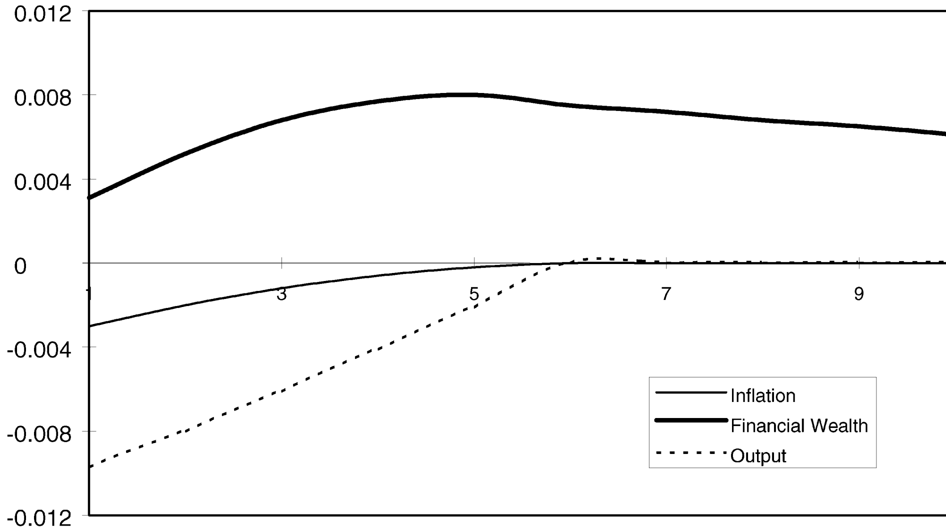

Fig. 1. *Deviations of Financial Wealth, Inflation and Output from Base*

forward-looking version of the model under an active policy regime. (All variables are measured as absolute deviations from base.) The shock lasts for 5 periods (years).

The negative shock to consumption raises saving and wealth, although this effect is mitigated by lower output and interest rates decreasing incomes. As the consumption shock dies away, so does the impact on output, inflation and wealth. Inflation is at its lowest in the first year because, when inflation is forward looking, it tends to 'front load' any changes to output (see Ireland and Wren-Lewis, 1998). After the shock is over, output and inflation return to base, because of the 'wealth neutrality' noted above.[9] Disequilibrium in wealth is much more long lasting, as fiscal feedback is only gradual. (We examine a more rapid debt feedback rule below.)

Fig. 2 focuses on inflation, and compares the trajectory above with the same shock under a passive policy regime. Inflation is *above* base in all periods under the passive regime, even though the direct effect of the consumption shock is deflationary. This apparently perverse result follows from the dynamic behaviour of government debt. The negative consumption shock raises saving, implying a higher stock of government debt. (Tax receipts are lower because output falls, and lower inflation under a passive monetary policy raises debt interest payments.) In the long run, real debt has to return to its original level. As there is no feedback from debt to government spending, the only way government debt can stabilise is for monetary policy to cut debt interest payments, increase seignorage and boost tax revenues through higher output.

[9] This neutrality occurs because wealth is the only predetermined state variable, and so represents the only disequilibrium once the shock has ended. As $f = k + \theta$, this disequilibrium has no consequences for other model variables.

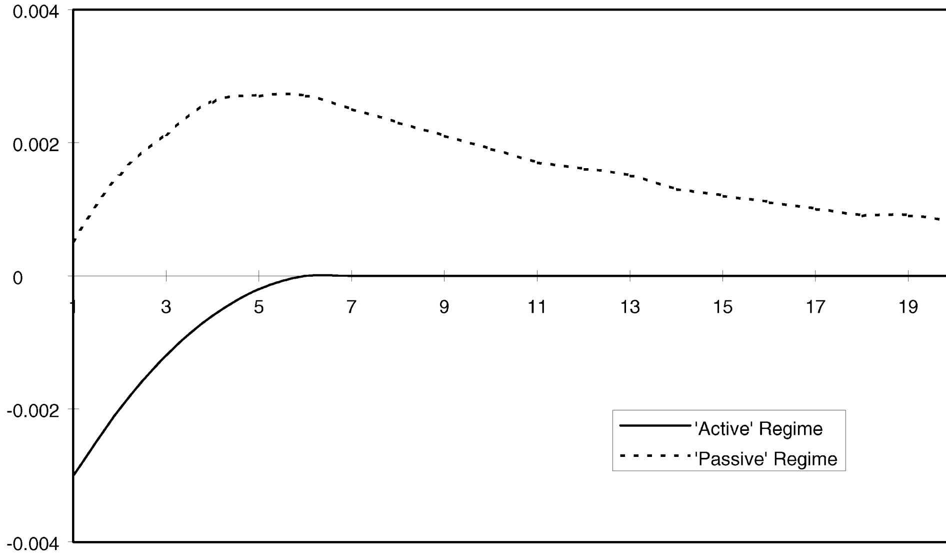

Fig. 2. *Inflation under the 'Active' and 'Passive' Regimes*

In order to achieve this interest rates have to be lower for a considerable period. Under a passive monetary policy this implies higher inflation.

While the passive policy mix is much better at reducing the initial inflation disequilibrium following the shock, it is much more destabilising than the active policy over the medium run. While output returns to base under active policies once the shock is over, output is 0.23% higher in year 6 in the passive policy regime, and remains over 0.1% above base until year 10. More fundamentally, the economy suffers the inflationary consequences of a price level that is higher in the long run in order to reduce the real stock of government debt.[10] The cost of having a passive monetary policy is therefore not that inflation disequilibrium will initially be greater following a demand or supply shock, but that stabilisation will be less efficient over the medium term.

2.2. *Monetary Policy in the Passive Regime*

In the passive regime there is little or no fiscal feedback from the debt stock. Although it would be possible to compare no feedback with a very small degree of feedback (e.g. $f = 0$ and $f = 0.01$), it is more interesting to examine changes in the monetary policy rule. Our central parameter set contained the most active of passive monetary policies ($\mu = -0.1$). Would a more passive policy produce a worse outcome?

Fig. 3 again considers the inflationary consequences of a negative consumption shock, but for two values of μ, -0.1 and -0.2. The two inflation paths are

[10] The absence of a nominal anchor (such as a fixed nominal debt stock) will mean that the price level has a hysteretic property.

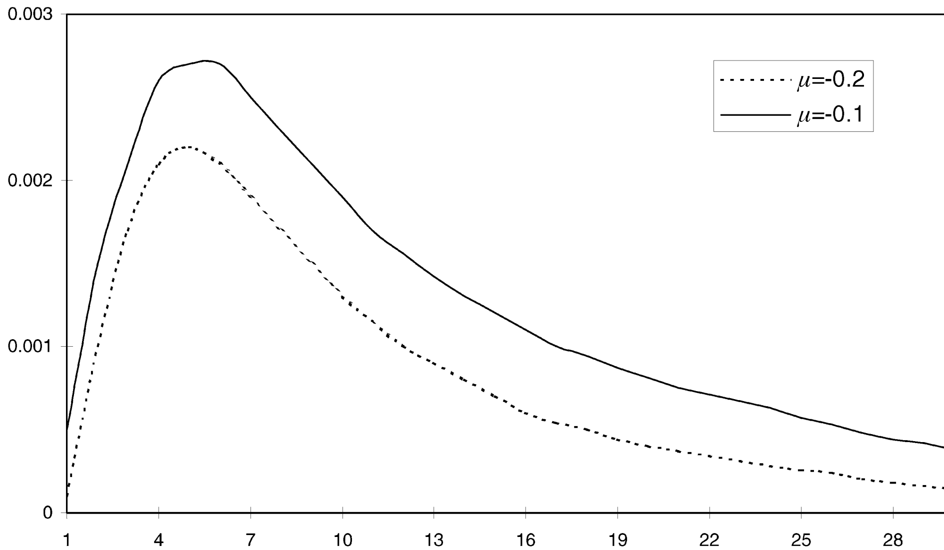

Fig. 3. *Inflation after Increasing the Passivity of Monetary Policy*

significantly different, with the more passive policy producing greater inflation stability. The reason is simply that the lower real interest rates required to reduce real debt can be achieved under the more passive policy at half the cost in terms of higher inflation. This shows that if monetary policy is passive, it is better for it to be more rather than less passive. With no fiscal feedback, the key job for monetary policy is to stabilise government debt, and this can be achieved more efficiently by reducing the sensitivity of nominal interest rates to inflation.

2.3. *Alternative Fiscal Rules When Policy is Active*

We now turn from considering alternative degrees of monetary policy passivity in the passive regime, to alternative degrees of fiscal policy activism in the active regime. We fix the degree of monetary policy activism at $\mu = 0.5$, which is the number widely used in the context of Taylor type rules. We assume that fiscal policy is active enough to ensure model stability, and ask whether further increases in fiscal activism would reduce disequilibrium following the same consumption shock considered above.[11]

Table 2 shows the impact of the consumption shock considered earlier for different degrees of fiscal feedback. ($f = 0.16$, for example, implies that G is reduced by 2% for every 10% of debt disequilibrium).

Probably the most important observation is that the paths for different values of the fiscal feedback parameter are not radically different. What

[11] Our central conclusion concerning the degree of fiscal policy activism continues to hold under different values of μ.

Table 2

Alternative Degrees of Fiscal Feedback: Central Parameter Set

Years	1	2	3	4	5	6
f			Output % deviation			
0.04	−1.01	−0.82	−0.63	−0.42	−0.21	−0.00
0.08	−0.97	−0.80	−0.61	−0.41	−0.21	−0.00
0.16	−0.92	−0.78	−0.61	−0.43	−0.23	−0.03
0.32	−0.90	−0.80	−0.66	−0.49	−0.30	−0.09
0.64	−0.90	−0.88	−0.77	−0.60	−0.38	−0.14
			Inflation % deviation			
0.04	−0.29	−0.19	−0.11	−0.05	−0.01	0.01
0.08	−0.30	−0.20	−0.12	−0.06	−0.02	−0.00
0.16	−0.32	−0.23	−0.15	−0.09	−0.04	−0.02
0.32	−0.35	−0.26	−0.18	−0.12	−0.07	−0.04
0.64	−0.38	−0.30	−0.21	−0.13	−0.07	−0.03

differences there are suggest that increasing fiscal feedback can in some circumstances generate greater disequilibrium. The reasons for this are not straightforward, however.

As we saw in Fig. 1, a negative consumption shock raises government debt, and this will reduce government spending to an extent governed by the degree of fiscal feedback. The greater the feedback, the more lower spending intensifies the deflationary impact of lower consumption. We might expect, therefore, that short term output would fall more when fiscal feedback was strong. In fact the opposite is the case, and monetary-fiscal interaction explains why.

Greater feedback does lead to lower output over the medium term, and this increases the initial fall in inflation, which itself reduces real interest rates. Lower interest rates *raise* the value of discounted labour/profit income, providing support to consumption. It is this consumption effect which dominates in the short term, such that greater fiscal feedback tends to *stabilise* short term output. However changes in real interest rates largely influence the pattern of consumption over time, so relatively high short term consumption will be offset by lower consumption in the medium term.

The net result on welfare is likely to depend on both the discount rate and the relative weight given to output and inflation disequilibria. Our sensitivity analysis also suggests that the 'optimal' value of fiscal feedback is also sensitive to model parameters, particularly α. In all cases, however, we found the impact of changes in fiscal feedback to be relatively small, suggesting that there is not a strong case from a stabilisation point of view of insisting on a rapid fiscal correction of debt disequilibria.

3. Conclusions

The Fiscal Stability Pact for EMU, where tight constraints on fiscal policy are thought by policy makers to be necessary to ensure that the independent European central bank can control inflation, has highlighted potential interrelationships between monetary and fiscal policy. Our analysis has looked at the interrelationship between fiscal and monetary policy when both follow simple rules.

We identify two stable policy regimes. In the 'active' regime, real interest rates rise if inflation is above target and fiscal policy must ensure that the government debt is stabilised. In the passive regime, fiscal policy is not self-stabilising, and stability requires that real interest rates are reduced when there is excess inflation.

This passive regime is related to what has been called the 'fiscal theory of the price level'. However, in our model, this description may be misleading, because the conduct of monetary policy is still critical in determining prices in this passive regime. We show that, if fiscal policy is passive, then stability following demand shocks may be increased by making monetary policy more passive, for example by following a fixed nominal interest rate rule. We also show that a passive policy may lead to lower inflation following a positive demand shock than an active policy. However the passive policy remains undesirable relative to its active counterpart when the overall stability of inflation and output are considered.

Within active policy regimes, the model suggests that strong debt targeting for a given monetary rule may achieve few benefits from the perspective of stabilisation, and in some cases may lead to greater inflation disequilibrium. If fiscal feedback takes place through taxation, then it has virtually no impact on the economy for 'normal' deviations from Ricardian Equivalence. If it takes place through government spending there is some impact, but it remains small and there are cases where greater feedback can increase instability. Discretionary changes in government spending do influence output, and the monetary authorities might consider such changes a nuisance, but this argues for seeking co-ordination or stability in fiscal policy, not stability in government debt.

Overall, our results suggest that from a stabilisation perspective the central bank has a legitimate interest in ensuring that there is some degree of stabilisation of government debt, but it does not need to seek the degree of debt stabilisation that appears to be implied by the fiscal stability pact.

Our results on the critical degree of fiscal feedback, as well as the undesirability of aggressively targeting debt, are dependent on the structure of the model we have used. One obvious extension of our analysis is to consider an open economy, where consumers can hold their wealth in the form of overseas assets as well as government debt. The range of assets held, as well as the overall richness of the model, would also be increased by introducing capital into the analysis.

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Appendix I – The Linearised Models

(A) *Fixed Government Spending and Debt Targeting through Taxation*

The model is linearised around the following steady-state,

$$\overline{C} = \nu(k+\theta)(\overline{W}+\overline{H}),\ \overline{B} = \frac{\overline{T}-\overline{G}}{\overline{r}},\ \overline{Y} = \overline{C}+\overline{G} = 1,\ \overline{H} = \frac{\overline{Y}-\overline{T}}{\overline{r}+k},\ \overline{r} = \frac{1-\nu}{\nu}\frac{\overline{C}}{\overline{\overline{M}}}$$

and $\overline{M} = \overline{W} - \overline{B}$, where a primed variable denotes a deviation from that steady-state.

$$C'(t) = \nu(k+\sigma)[W'(t)+H'(t)] \tag{27}$$

$$dW'(t) = \overline{r}W'(t) + \overline{W}r'(t) + G'(t) - T'(t) - \overline{r}M'(t) - \overline{M}[r'(t)+\pi'(t)] \tag{28}$$

$$B'(t) = W'(t) - M'(t) \tag{29}$$

$$T'(t) = fB'(t) \tag{30}$$

$$G'(t) = 0 \tag{31}$$

$$M'(t) = \frac{(1-\nu)}{\nu}\frac{C'(t)}{\overline{r}} - \frac{(1-\nu)}{\nu}\frac{\overline{C}}{\overline{r}^2}[r'(t)+\pi'(t)] \tag{32}$$

$$r'(t) = \mu\pi'(t) \tag{33}$$

$$dH'(t) = (\overline{r}+k)H'(t) + \overline{H}r'(t) - Y'(t) + T'(t) \tag{34}$$

$$Y'(t) = C'(t) + G'(t) \tag{35}$$

$$d\pi'(t) = -\alpha Y'(t). \tag{36}$$

It is then possible to represent the model in matrix form as,

$$\begin{bmatrix} dW'(t) \\ dH'(t) \\ d\pi'(t) \end{bmatrix} = \mathbf{A}\begin{bmatrix} W'(t) \\ H'(t) \\ \pi'(t) \end{bmatrix}, \tag{37}$$

where

$$\mathbf{A} = \begin{bmatrix} \left(\overline{r} - f - (1-\nu)(k+\sigma) + \dfrac{f(1-\nu)(k+\sigma)}{\overline{r}}\right) & \left(\dfrac{f(1-\nu)(k+\sigma)}{\overline{r}} - (1-\nu)(k+\sigma)\right) & \left(\mu\overline{W} - \dfrac{(1+\mu)f(1-\nu)(k+\sigma)(\overline{W}+\overline{H})}{\overline{r}^2}\right) \\ \left(f - \nu(k+\sigma) - \dfrac{f(1-\nu)(k+\sigma)}{\overline{r}}\right) & \left(\overline{r} + k - \nu(k+\sigma) - \dfrac{f(1-\nu)(k+\sigma)}{\overline{r}}\right) & \left(\mu\overline{H} + \dfrac{(1+\mu)f(1-\nu)(k+\sigma)(\overline{W}+\overline{H})}{\overline{r}^2}\right) \\ -\alpha\nu(k+\sigma) & -\alpha\nu(k+\sigma) & 0 \end{bmatrix}$$

(B) *A Fixed Tax Rate and Debt Targeting Through Government Spending*

In the second case considered, the tax rate is assumed to be fixed so that (30) is replaced with,

$$T'(t) = \tau Y'(t) \tag{38}$$

and government spending is altered in response to debt disequilibrium,

$$G'(t) = -fB'(t). \tag{39}$$

In this case, the transition matrix, **A**, is now given by,

$$\begin{bmatrix} \left(\overline{r} - (1-\tau)f - (1-\nu)(k+\sigma) + \dfrac{(1-\tau)f(1-\nu)(k+\sigma)}{\overline{r}} - \tau\nu(k+\sigma)\right) & \left(\dfrac{(1-\tau)f(1-\nu)(k+\sigma)}{\overline{r}} - \tau\nu(k+\sigma) - (k+\sigma)(1-\nu)\right) & \left(\mu\overline{W} - \dfrac{f(1-\tau)(1-\nu)(k+\sigma)(\overline{H}+\overline{W})(1+\mu)}{\overline{r}^2}\right) \\ (1-\tau)\left(f - \nu(k+\sigma) - \dfrac{f(1-\nu)(k+\sigma)}{\overline{r}}\right) & \left(\overline{r} + k - \nu(k+\sigma)(1-\tau) - \dfrac{f(1-\tau)(1-\nu)(k+\sigma)}{\overline{r}}\right) & \left(\mu\overline{H} + \dfrac{f(1-\tau)(1-\nu)(\overline{H}+\overline{W})(1+\mu)}{\overline{r}^2}\right) \\ \left(-\alpha\nu(k+\sigma) + \alpha f - \dfrac{\alpha f(1-\nu)(k+\sigma)}{\overline{r}}\right) & \left(-\alpha\nu(k+\sigma) - \dfrac{\alpha f(1-\nu)(k+\sigma)}{\overline{r}}\right) & \dfrac{\alpha f(1-\tau)(1-\nu)(\overline{H}+\overline{W})(1+\mu)}{\overline{r}^2} \end{bmatrix}$$