Comment

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1. Introduction

Since the formation of the European Monetary Union several countries have been left with little but fiscal policy to react to country specific business cycles. The right fiscal policy has thus become of central importance for stabilization policy in Europe. This paper by Canzoneri, Cumby, and Diba (CCD) on the interaction of monetary and fiscal policy in the EMU is therefore of great practical relevance in Europe today. Somewhat surprisingly relatively few papers have been written about this topic. This paper thus marks the beginning of a new research agenda. And it is an excellent starting point.

The paper explores a sophisticated stochastic general equilibrium model with sticky prices and wages and endogenous capital. The model includes a role for both monetary and fiscal policy. Monetary policy works through nominal interest rates and fiscal policy through distortionary taxes and spending. While monetary policy is set by a common monetary policy—and thus exogenously given from the perspective of a particular country—each country can determine its own fiscal policy. The model in this paper is rich and ambitious and solving it is a contribution in itself. One of the most interesting results of the paper is the estimated welfare cost of giving up independent monetary policy for a "small country." This cost is estimated to be on the order of 1–3 percent in terms of period consumption. This is a surprisingly large number and an important contribution to the literature that will no doubt be debated in the future. Lucas' famous argument is that the welfare cost of business cycles is trivial under complete markets.[1] This has led some to dismiss the business cycle as a worthwhile topic of study. CCD have now given us an example that shows the costs of business cycles can be large in models with realistic nominal and real fric-

tions. This result makes clear that the stakes are high for fiscal policy in the EMU. It indicates that the proper choice of fiscal policy is of great practical importance for countries without an independent monetary policy to counteract the business cycle.

Rather than reemphasizing all the interesting results of this paper I focus my discussion around three results with which I disagree somewhat. 1. For a country to satisfy the Stability and Growth Pact (SGP)—which mandated limits on budget deficits and debt—the authors find that making real wage taxes respond to deficit is harmful, whereas decreasing government spending in response to deficits can increase welfare. The authors suggest that the wage tax rule performs so badly because it violates standard "tax smoothing principles." 2. The authors ask whether fiscal policy is an important source of divergence in the inflation rate across countries. Their answer is no. 3. The authors evaluate the welfare effect of monetary policy that responds imperfectly to domestic conditions and estimate it to be high as discussed above. The key source of fluctuations is productivity shocks, which explains about 80 percent of the business cycle in their simulation.

I first review the CCD model and simplify it to emphasize some aspects of the results. I start with discussing results 1 and 2. I compare the authors' policy rules to the Ramsey/optimal commitment allocation in a simplified version of their model. In contrast to the authors' suggestion I find that the optimal allocation is that taxes should NOT be smoothed over the business cycle—rather they should be changed so that the "target level of real interest rate"—i.e., the real interest rate that is consistent with market clearing and zero inflation—perfectly tracks the nominal interest rate (which is exogenously given by the common monetary policy). This is an interesting parallel to Woodford's (2003) well known "Wicksellian" result that the nominal interest rate should track to the target real rate of interest (which is exogenously given in his model). In my illustration, in contrast to Woodford (2003), it is fiscal policy that can achieve the Wicksellian equilibrium, but not by moving the nominal interest rate (which is exogenously given by the common monetary policy) but by using fiscal instruments to make the target real rate of interest rate track the nominal interest rate. I show that a properly conducted fiscal policy can completely stabilize inflation and the output gap in the simplified framework. This casts new light on the authors' second result, and I reach an opposite conclusion to the authors' suggestion that fiscal policy is not important to explain the divergence of inflation rates across countries in the EMU. My results

suggest that the divergence in the inflation rates across EMU countries is a measure of the *failure* of fiscal policy to achieve the optimal allocation. Turning to result 1 I speculate that the emphasis the authors put on productivity shocks may be problematic and argue that other shocks could be more relevant over the business cycle. I suggest that the omission of these shocks may explain some of the anomalies reported.

1.1 The (Simplified) CCD Framework

The CCD paper starts from the premise that ECB policy can be characterized by a simple policy function

$$i_t = \bar{\imath} + \theta \pi_{EMU,t}$$

where i_t is the short-term nominal interest rate and $\pi_{EMU,t}$ is inflation in EMU. Inflation is imperfectly correlated across countries so that

$$\pi_{EMU,t} = \theta_c \pi_{c,t} + \varepsilon_{ic,t}$$

where $\pi_{c,t}$ is inflation in a particular country and $\varepsilon_{ic,t}$ is noise. Then the monetary policy rule from the perspective of each country is:

$$i_t = \bar{\imath} + \theta\theta_c \pi_{c,t} + \theta\varepsilon_{ic,t} \tag{1}$$

Divergence of inflation across countries creates noise in the policy rule for each country. This simple framework illustrates two costs of adopting the EURO. First, monetary policy may not respond optimally to domestic inflation, i.e., even if the coefficient θ is set optimally from an ECB perspective the coefficient $\theta\theta_c$ may not be optimal from each country's standpoint. If there are strong inflationary pressures in Italy, for example, ECB may not react very strongly if prices are stable elsewhere. Second, imperfect correlation of inflation rates across countries introduces noise in the policy rule for each country. Interest rates may rise in Italy, for example, because of price developments in Germany that have nothing to do with monetary conditions in Italy. This is a clever and interesting way of capturing the cost of the EURO from the perspective of each member country.[2] One of the key findings of the paper is that the costs of giving up independent monetary policy are considerable. To see this one can compare welfare for a "large" country to a "small" country. These welfare costs are of the order of 1–3 percent of consumption. This cost is staggering as discussed in the introduction and one of the most interesting results of the paper.

I find it useful to simplify the CCD model to put more structure on some of my comments. By doing so I am not pretending that all the richness of the paper is preserved. I abstract from capital accumulation and wage stickiness so that I can simplify the model and obtain only a few equations by log-linearization. The resulting model is, apart from some key additional elements, mostly standard in the literature and is for example explained in detail in Clarida, Gali, and Gertler (1999) and Woodford (2003). The difference between this model and the standard one is that distortionary taxes also enter the equilibrium relationships. In this simplified version of CCD model the Euler Equation of the representative household can be summarized by the IS equation:

$$x_t = E_t x_{t+1} - \sigma[\hat{\imath}_t - E_t \pi_{t+1} - \hat{r}_t^*] \tag{2}$$

where $\pi_t = \log(P_t / P_{t-1})$ is inflation and $x_t = \hat{Y}_t - \hat{Y}_t^*$ is the output gap, i.e., the difference between output, $\hat{Y}_t = \log Y_t / \bar{Y}$, and the welfare relevant measure of an output target Y_t^* defined as

$$\hat{Y}_t^* = \frac{\sigma^{-1}}{\omega + \sigma^{-1}}(g_t + \hat{G}_t) + \frac{1+w}{\omega + \sigma^{-1}} q_t$$

where $\hat{G}_t \equiv \log G_t / \bar{Y}$ is real government spending, a_t is a productivity shock and g_t is a preference shock. The term $\hat{r}_t^*$ is the target real interest rate that corresponds to this definition of the target level of output, i.e., it is the real interest rate that would be consistent with zero inflation and a zero output gap, i.e., it is the interest rate that would "clear the market." I can express $\hat{r}_t^*$ as

$$\hat{r}_t^* = \frac{\omega\sigma^{-1}}{\omega+\sigma^{-1}}(g_t - E_t g_{t+1}) - \frac{(1+\omega)\sigma^{-1}}{\omega+\sigma^{-1}}(a_t - E_t a_{t+1}) - (\hat{\tau}_t^c - E_t \hat{\tau}_{t+1}^c) \tag{3}$$

$$+ \frac{\sigma^{-1}\omega}{\omega+\sigma^{-1}}(\hat{G}_t - E_t \hat{G}_{t+1})$$

where $\hat{\tau}_t^c \equiv \log(1 + \tau_t^c / 1 + \bar{\tau}^c)$ is a tax on consumption expenditures.[3] By varying consumption taxes (or government spending) the government changes the price of consumption today relative to tomorrow and can influence aggregate demand in that way. A temporary cut in the consumption tax, for example, makes consumption today more attractive and thus increases demand so that the market clearing interest rate is higher in equilibrium. Similarly a temporary increase in government spending increases demand today relative to tomorrow and also increases the target level of real interest rate. Since the output gap is

determined by the difference between the nominal and the target rate of real interest both tax cuts and government spending result in a positive output gap—unless monetary policy responds aggressively to offset it.

The other key equation of the model is the Euler Equation of the firm or the AS equation. It can be summarized by the linear approximation

$$\pi_t = \kappa x_t + \kappa\psi(\hat{\tau}_t^w + \hat{\tau}_t^c) + \beta E_t \pi_{t+1} \tag{4}$$

where $\hat{\tau}_t^w \equiv \log(1 + \tau_t^w / 1 + \bar{\tau}^w)$ is the tax on labor income. According to this equation, as is standard in the literature, inflation depends on the output gap and expectations about future inflation. In addition distortionary taxes can create inflationary pressures. The reason is straightforward. An increase in either tax—other things constant—reduces the supply of labor by the representative household. This in turn increases the real wage demanded and thus the marginal cost of firms thereby creating inflationary pressures.

In the case of distortionary taxes the budget constraint may also be relevant for the equilibrium allocation. In the simplest case of zero steady state debt the budget constraint can be linearized to yield

$$D_t = \beta^{-1} D_{t-1} + G_t - T_t - \bar{\tau}^c Y_t - \tau_t^c - \alpha\tau_t^w - \alpha\bar{\tau}^w Y_t \tag{5}$$

where T_t is lump sum taxes, D_t is one period nominal debt, and α is labor share in the production function. There is also a transversality condition that rules out Ponzi schemes. Finally the monetary policy rule (1) can be summarized as

$$\hat{i}_t = \phi_\pi \pi_t + \varepsilon_t^M. \tag{6}$$

For a given path of the exogenous disturbances $\{g_t, q_t, \varepsilon_t^M\}$ and the policy instruments $\{\tau_t^c, \tau_t^w, G_t, T_t\}$ a rational expectation equilibrium is a set of stochastic processes for $\{x_t, \pi_t, i_t, Y_t, D_t\}$ that satisfy equations (2)–(6).

By what criterion should one evaluate what is the best path feasible equilibrium allocation? The most natural criterion, and the one used by CCD, is the utility of the representative household. One may approximate welfare by a second order expansion of utility of the representative household to yield[4]

$$-\sum_{t=0}^{\infty} \beta^t [\pi_t^2 + \lambda_x x_t^2 + \lambda_G (\hat{G}_t - \hat{G}_t^*)^2] \tag{7}$$

where $\hat{G}_t^*$ is the target level of government spending. This objective says that ideally the government would set the output gap and inflation equal to zero at all times and keep real government spending equal

to its target level. The success of any policy depends on how close this objective is set to zero. Note that the distortionary taxes τ^c_t and τ^w_t do not enter the objective directly. This indicates that these taxes only result in welfare losses to the extent that they prevent the output gap and inflation to be stabilized and if they limit the government's ability to keep government spending at its target.

2. The Optimal Policy: Optimal Monetary and Fiscal Coordination

To understand the role of taxes in the model, and CCD's policy rules, it is useful to study the best solution achievable. If the government can finance its spending by lump sum taxation the budget constraint (5) imposes no restrictions on the set of feasible outcomes. Then optimal solution can be derived by solving a linear-quadratic Lagrangian problem:

$$L=\sum_{t=0}^{\infty}\frac{1}{2}\pi_t^2+\frac{1}{2}\lambda_x x_t^2+\frac{1}{2}\lambda_G(G_t-G_t^*)^2$$

$$+\phi_{1t}[x_t-x_{t+1}+\sigma\phi_\pi\pi_t-\sigma\pi_{t+1}-\sigma r_t^*+\sigma(\tau_t^c-\tau_{t+1}^c)-\frac{\omega}{\sigma^{-1}+\omega}(G_t-G_{t+1})]$$

$$+\phi_{2t}[\pi_t-\kappa x_t-\kappa\psi(\tau_t^w-\tau_t^c)-\beta\pi_{t+1}]$$

This minimization problem yields the first order conditions:

$$\frac{\partial L}{\partial \pi_t}=\pi_t+\sigma\phi_\pi\phi_{1t}-\beta^{-1}\sigma\phi_{1t-1}+\phi_{2t}-\phi_{2t-1}=0$$

$$\frac{\partial L}{\partial x_t}=x_t+\phi_{1t}-\beta^{-1}\phi_{1t-1}-\kappa\phi_{2t}=0$$

$$\frac{\partial L}{\partial \tau_t^c}=\sigma\phi_{1t}-\beta^{-1}\sigma\phi_{1t-1}+\kappa\psi\phi_{2t}=0$$

$$\frac{\partial L}{\partial \tau_t^w}=-\kappa\psi\phi_{2t}=0$$

$$\frac{\partial L}{\partial G_t}=\lambda_G(\hat{G}_t-\hat{G}_t^*)-\frac{\omega}{\sigma^{-1}+\omega}\phi_{1t}+\frac{\omega\beta^{-1}}{\sigma^{-1}+\omega}\phi_{1t-1}=0$$

Suppose that the shocks a_t and q_t follow an $AR(1)$process with correlation ρ but that $G_t^* = 0$ at all times. Then one can show that a solution that satisfies all the first order conditions and the equilibrium constraints is

$$\pi_t = x_t = 0$$

$$\hat{G}_t = \hat{G}_t^* = 0$$

$$\tau_t^c = \frac{\sigma^{-1}\omega}{\omega + \sigma^{-1}} g_t - \frac{\sigma^{-1}(1+\omega)}{\omega + \sigma^{-1}} a_t + \varepsilon_t^M$$

$$\tau_t^w = -\tau_t^c$$

$$\hat{i}_t = \hat{r}_t^*$$

This solution shows that optimal fiscal policy stabilizes both inflation and the output gap. The optimal solution also violates tax smoothing. This indicates that in the class of models studied in CCD tax volatility will increase welfare if properly done, contrary to Barro's classic tax smoothing result. The logic of the result can be seen from the second order expansion of the representative household utility (7). Taxes only cause welfare losses if they cause output to deviate from its efficient level, positive inflation or public consumption to deviate from its target. In contrast Barro (1979) assumes an *ad hoc* quadratic objective in taxes that implies—by assumption—that there is welfare cost of any tax variations. In the model outlined here the government uses taxes to ensure that the target level of real interest rate tracks the nominal interest rate at all times. This guarantees that the output gap and the inflation rate stay at zero but requires volatility in the tax rates.

To illustrate the optimal solution let us consider the effect of a positive productivity shock in the model, which is the main driving force in the CCD calibration. Figure 1 shows the solution of the model to a negative productivity shock when the fiscal instruments are held constant. A negative productivity shock increases the target level of real interest rate. This results in a positive output gap and inflation. The reason is the wedge between the target level of real interest rate and the nominal interest rate in the IS equation. Since monetary policy is set by ECB—and thus outside the scope of the government—this gap cannot be bridged by monetary policy. Thus the government cannot follow the Wicksellian policy proposed by Woodford (2003), which mandates that monetary

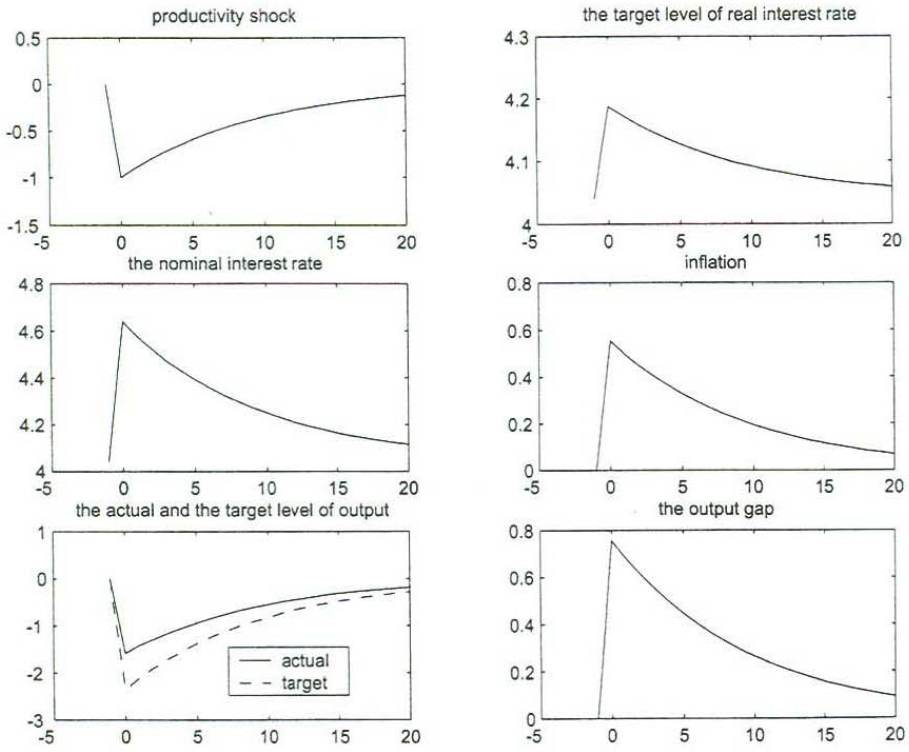

Figure 1
The equilibrium when fiscal policy is held constant

policy should set the nominal interest rate to equal the target level of real interest rate. Even if the government cannot change the nominal interest rate, however, it can directly influence the target level of real interest rate by fiscal policy. The solution above indicates that rather than using *monetary policy* to make the nominal interest rate track the target level of real interest rate the government should use *fiscal policy* to make the target level of real interest rate track the nominal interest rate.

How is this policy achieved? This is shown in Figure 2. As illustrated in Figure 1 a positive productivity shock increases the target level of real interest rate. To offset this the government can raise the consumption tax rate, as shown in Figure 2, and thereby neutralizing the effect productivity has on the target level of real interest rate. The consumption tax increase, however, creates a cost-push shock, since each household wants to work less for a given real wage, resulting in higher marginal costs for firm—holding other things constant. This can be seen by the AS equation (4). To offset this cost push shock the government could cut its labor tax rate.

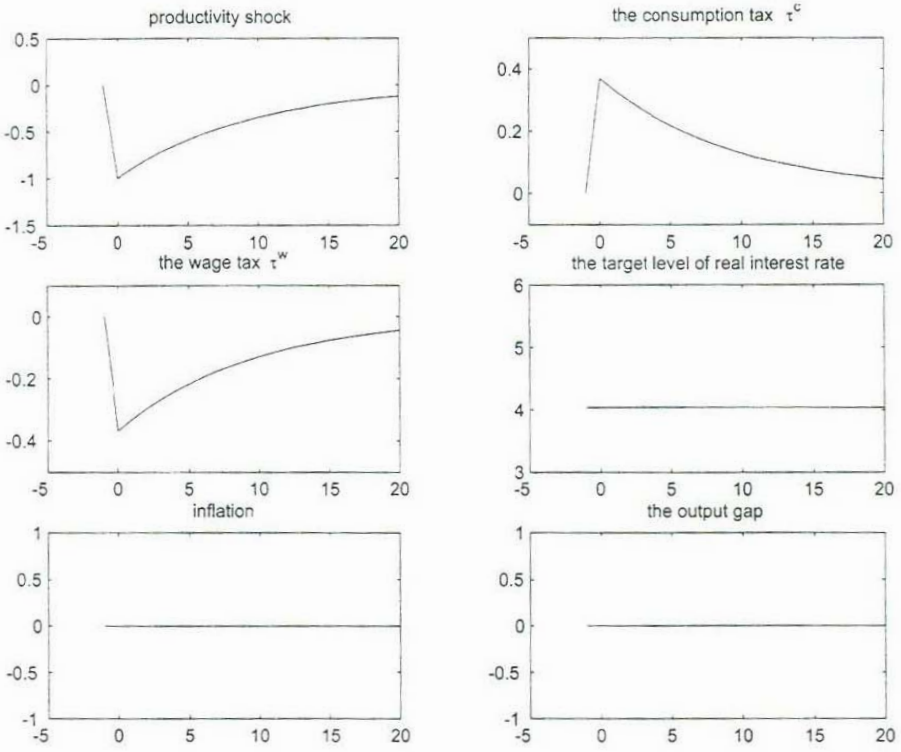

Figure 2
The equilibrium under optimal fiscal policy

The government's response to a monetary policy shock could be guided by a similar Wicksellian principle. In that case, however, the effect of the shock is to change the nominal interest rate. To offset this change, the government could vary consumption and labor taxes so that the target level of real interest rate changes correspondingly—while neutralizing the cost-push effect of the consumption tax in the AS equation by changing labor taxes.

What is the role of real government spending in the optimal allocation? The answer is: Not much. Ideally the government would focus on setting real government spending so that the marginal utility of public consumption is equal to the marginal utility of private consumption. Government consumption would only vary to the extent that shocks shift those marginal utilities. If government spending does not enter utility (as in CCD) they could be set at zero at all times. It is useful to note, however, that government spending can also be used to stabilize

inflation and the output gap. It is easy to verify, for example, that the following is a rational expectation equilibrium in the model

$$\pi_t = x_t = 0 \tag{8}$$

$$\hat{G}_t = -g_t + \frac{1+\omega}{\omega} a_t \tag{9}$$

$$\hat{\tau}_t^c = \hat{\tau}_t^w = 0 \tag{10}$$

$$\hat{i}_t = \hat{r}_t^* \tag{11}$$

Figure 3 shows the equilibrium in this case. The government reacts to a negative productivity shock by cutting government spending. This neutralized the effect of productivity on the target level of real interest rate, so that inflation and the output gap stay at zero. This

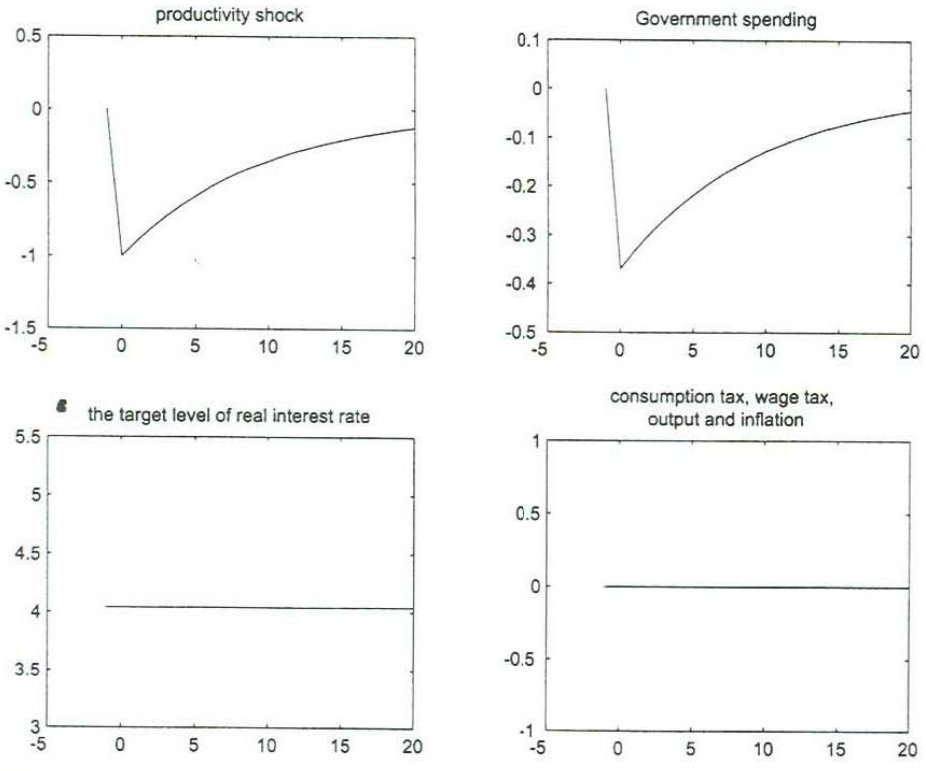

Figure 3
The equilibrium when government spending is used to stabilize inflation and the output gap

solution, however, is inferior to the optimal commitment solution. The reason is that although inflation and the output gap stay at zero, government spending deviates from its efficient level.

3. Should the Government Cut Spending in Response to Budget Surpluses?

A key question the authors address is how fiscal policy should be used to stabilize the government budget. The motivation for this question is that in the absence of "fiscal rules" in EMU, fiscal policy may become "irresponsible." Irresponsible fiscal policy could, for example, lead high debt countries to bully the ECB into inflationary policies in order to inflate away their nominal debts. Taking the need for fiscal responsibility as given the authors ask how it can best be achieved. They find a surprising and interesting result: It enhances welfare to make real government spending react aggressively to budget deficits. In particular the government could cut government spending when there is a budget deficit and raise spending when there are surpluses. In contrast, making the wage taxes respond to budget deficits reduces welfare.

The analytical results from the last section are helpful to interpret CCD results. The policy rules they suggest can be written in a linearized form as:

$$\hat{G}_t = \rho_G \hat{G}_{t-1} + S_G \hat{S}_t + \varepsilon_t^g$$

$$\hat{\tau}_t^w = \xi_w \hat{S}_t + \varepsilon_t^w$$

$$\hat{\tau}_t^C = \xi_C \hat{S}_t + \varepsilon_t^C$$

$$\hat{G}_t = \rho_G \hat{G}_{t-1} + \xi_G \hat{S}_t + \varepsilon_t^G$$

$$\hat{T}_t = \rho_T \hat{T}_{t-1} + \rho_d \hat{D}_{t-1} + \varepsilon_t^T$$

where $\hat{S}_t \equiv \log(S_t / \bar{Y})$ is the budget surplus. These rules say that the government should allow each of the variables to respond to budget deficits. The key motivation for the policy rules the authors consider is the Stability and Growth Pact, so that they are interested in rules that make taxes increase in a response to deficits or government spending fall. But alternative interpretations are possible. Giannoni and Woodford (2003) suggest that a "robust" policy rule should involve a mapping

between endogenous variables and the policy instrument but should not depend on any particular shocks. The rules suggested by CCD can also be considered as special examples of "robust" rules that specify that the policy variables should only depend on easily observed variables (the budget surplus in this case).

On the one hand the above rules are a simplified version of CCD's rules, since I linearize around zero debt and zero surpluses, and abstract from the informational delay they assume (so that E_{t-1} does not appear in front of S_t in the rule above). On the other hand they are more general because I assume that the consumption tax can also respond to budget deficits and do not impose any sign restrictions on the coefficients. What is the optimal set of rules in this framework? To answer this question let us suppose that the only shock is the shock to productivity. This is not a bad approximation to their model since productivity shocks explain about 80 percent of the variations in most variables. The answer to this question is somewhat surprising. It can be shown that a rule that fully implements the optimal equilibrium illustrated above is one which has the coefficients

$$\xi_c = -[\sigma(\tau^c + \alpha\tau^w) - (1 - \alpha)]^{-1}$$

$$\xi_w = [\sigma(\tau^c + \alpha\tau^w) - (1 - \alpha)]^{-1}$$

$$\xi_G = 0$$

$$\rho_d = (\beta^{-1} - 1),\ \rho_T = \rho_G = 0,\ \varepsilon^g_t = \varepsilon^T_t = \varepsilon^w_t = \varepsilon^C_t = \varepsilon^G_t = 0$$

These equations reveal that the fully optimal rule takes the same form as suggested by CCD when productivity shocks are the only source of uncertainty. When $\xi_c < 0$ and $\xi_w > 0$ this result indicates that the government might increase consumption taxes in a response to budget deficit and cut them them in response to budget deficits. The wage tax moves in the opposite direction. Government spending, on the other hand, could be kept at constant at all times.

There are some important differences between the optimal rule and the rules studied by CCD. They calculate the welfare implication of a rule that makes the wage taxes increase in a response to deficits (while holding the consumption tax constant) and compare it to a rule where real government spending is reduced in response to budget deficits. They find that between these two alternatives the rule that makes government spending respond to budget deficits is better, and may even increase welfare.

How does CCD's experiment relate to the optimal rule? The optimal rule suggests that labor and consumption taxes should be moved simultaneously in a response to budget surpluses. This is a key reason for why they find little room for using distortionary taxes for economic stabilization. Their results, therefore, do not imply that it is bad to vary distortionary taxes for the standard Barro tax smoothing reasons. In this model it is optimal to change distortionary taxes—but only as long as it is done in the correct way!

As noted above the authors suggest that it may be useful to make government spending respond to budget surpluses. This is one of the most interesting results in the paper. To understand this result it is useful to recall from the last section that government spending can indeed by used to eliminate inflation and the output gap. It can be verified that a rule that implements the equilibrium (8)–(11) is given by:

$$\xi_c = \xi_w = 0$$

$$\xi_G = 1 + \sigma(\tau^c + \alpha\tau^w) > 0$$

A rule of this form may be better than nothing since it stabilizes both inflation and the output gap. It is not optimal, however, since ideally real government spending would only be aimed at equating the marginal utility of private and public consumption, while using the other fiscal instrument to do the rest. If there are some constraints or costs on moving consumption and wage taxes that are not as severe for government spending, a rule of this sort may be better than no rule at all. Given the stakes illustrated by CCD's welfare calculations there is no doubt that more research will be done to address this issue.

4. Is Fiscal Policy a Source of Inflation Divergence in EMU?

To address this question the authors analyze a model that has empirically estimated policy rules and ask the question: What fraction of the variance of inflation can be explained by fiscal policy shocks? One problem with this approach is that this variance decomposition only answers the degree to which unforcastable movements in the fiscal variable contribute to the inflation divergence (while assuming that they are uncorrelated with other shocks). This does not give a full answer to whether fiscal policy is responsible for the inflation divergence because it says nothing about whether the systematic component of fiscal policy has had any effect—positive or negative. If there are no unforcastable

shocks in the fiscal rules this would imply that fiscal policy is irrelevant according to this criterion. But this would be a little bit misleading, since the systematic component of fiscal policy may have large effects on inflation variability. To see this one could rephrase the question of this section by: Can fiscal policy stabilize inflation across countries? The answer to this question is yes—even if it has not been successful in doing so to date. The Wicksellian fiscal policy outlined in the last sections completely stabilizes inflation divergence across countries in EMU. In the model sketched out here inflation divergence is a sign of that fiscal policy has failed and that all variations in inflation across countries are due to badly designed fiscal rules.

Similar comment applies to the authors' analysis of the contribution of fiscal shock to the variability of the debt to output ratio. The authors find that fiscal shocks do not contribute much to the variability of this measure leading the authors to conclude that "rules like SGP that try to discipline fiscal policy by requiring the government to limit unconditional standard deviation of the debt-to-GDP ratio seems rather perverse in this context." But again this result only says what the unforcastable component of the fiscal rule contributes to the variability of the debt-to-GDP ratio. It gives little indication of the role of the systematic component of the fiscal policy rules. If the systematic component implies a balanced budget at all times and the initial level of debt is zero, for example, this ratio would be zero at all times. Thus if the goal is to limit the variability of debt to output, any deviation of this ratio from zero would be due to a "failure" of the systematic component of the fiscal rule that in principle could be eliminated it. Drawing conclusion from simple variance composition of the unforcastable part of fiscal rules is thus difficult.

5. Are Productivity Shocks the Most Important Driving Force in the Business Cycle?

The first result of CCD summarized in the introduction of this commentary a that productivity shocks are driving the business cycle. One may even call this an assumption, since it is assumed that productivity evolves in the same way as an estimated Solow residual. This assumption is in line with a long tradition in the RBC literature. I think that it can possibly raise some problems. The first is that it appears to imply—at least in the stylized example I illustrate above—that the cost of business cycle is somewhat awkward. If productivity shocks drive the business

cycle it appears it is costly because output moves *too little*. This is probably not what most policy makers have in mind. Most policy makers worry about business cycles because output fluctuates too much and creates involuntary movements in unemployment. The second problem with the heavy reliance on productivity shocks is related to a key failure of the model that is carefully stressed by the authors in another paper. They document that there is negative correlation between inflation and output in their model simulation whereas this correlation is positive in the data. My conjecture is that both these problems can be solved by considering alternative shocks. I should note, however, that this issue requires more careful study than the few preliminary conjectures that I offer here.

To see the first problem consider a unit decrease in productivity and suppose that this is an iid shock. What is the effect of this disturbance? A negative productivity shock causes the target level of output to decrease. The effect on the other exogenous term, i.e., the target level of real interest rate, is that it increases—because household wants to spend more today relative to the future. One may then combine the IS and the AS equation to yield:

$$x_t = \hat{Y}_t - \hat{Y}_t^* = \sigma \frac{1}{1+\sigma\phi_\pi\kappa} r_t^* > 0 \quad \text{for} \quad r_t^* < 0 \tag{12}$$

This implies that output moves by more than the target level of output under CCD's policy rule. We see that the cost of business cycles is that output does not move enough. Figure 1 reveals that the same applies for a simple AR(1) process for productivity. Again a productivity shock is costly in the model because output does not move enough. Hence one obtains the awkward conclusion that the main goal of stabilization policy is to make output less stable. I suspect that the same result holds in CCD. One indication of this is that CCD report an improvement in welfare associated with the government spending rule even if output and employment fluctuates more with the rule than without it in their simulation.

Let us now turn to the second problem. To see why productivity shocks results in a negative correlation between output and inflation consider again a unit decrease in productivity and suppose that this is an iid shock. Then we can write the AS equation as

$$\pi_t = \kappa x_t = \kappa\hat{Y}_t - \kappa\hat{Y}_t^* \ . \tag{13}$$

A decrease in productivity means that the target level of output decreases, so that it works as a negative supply shock in the aggregate supply equation. It increases marginal costs of firms since now they have to employ more labor to produce a given quantity of output. One can see by equation (13) that the shock can be offset by either a decrease in current output or an increase in inflation. Both adjust in equilibrium and there is therefore a negative correlation between output and inflation. This is more clear in Figure 1 where productivity follows an AR(1).

These two problematic features of the model can be addressed by considering different shocks such as a positive shock to the utility of consumption, denoted by g_t in equation (3). Consider first an iid shock as before and note that a positive preference shock has the same effect on the target level of real interest rate as the negative productivity shock. Thus by equation (12) it increases the output gap. In contrast to a negative productivity shock, however, the positive shock to preferences increases the target level of output. Thus it acts as a positive supply shock in equation (13) and thus induces a positive correlation between output and inflation. Another interesting feature of this shock is that output fluctuates more than the target level of output. In the case of preference shocks, therefore, the cost of business cycles is that output moves excessively. It would be interesting for future research on the interaction of optimal monetary and fiscal policy to consider more shocks than are reported in CCD. Assuming a more dominant role for preference shocks would also be consistent with recent Bayesian estimates of the importance of technology shocks such as those reported in Smets and Wouters (2002) and Gali and Rabanal (2004).

6. Conclusion

It is hardly a criticism of the CCD paper to say that it is not the final word on the interaction of monetary and fiscal coordination in EMU. The points raised here are not a criticism but reflect my greed in wanting even more than is already contained in this ambitious paper. This paper, therefore, is more like the start of a research agenda rather than the final word on this issue. And it is an excellent start. We have much to look forward to from these authors and others in the field as our understanding of the interaction of monetary and fiscal policy improves.

Notes

1. Most recently put forward in Lucas (2003).

2. Although it is important to note that it assumes a structural relationship between the inflation rates in each country. This relationship, however, will in general depend endogenously on the policy regime of each country. In this sense the analysis is only a "partial equilibrium analysis" but the hope is that it captures some of the general issues at hand.

3. This corresponds to what Eggertsson and Woodford (2004) call an "American-style sales tax" so that it does not enter the posted price of the sticky price of the firms.

4. I choose the steady state taxes so that I expand around the fully efficient steady state. This means that there is no inflationary bias. In deriving this objective I've assumed that public spending enters the utility of the household additively.

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