BUSINESS CYCLES AND FISCAL POLICY IN AN OPEN ECONOMY

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Abstract
The role of demand management policy is considered in a two-sector open economy model with price-taking firms and imperfect competition in the labour market. Demand management policies are shown to affect the equilibrium distribution of prices and hence output in the case of both supply (productivity) and demand (preferences) shocks. As agents are risk-averse, there is a welfare case for pursuing an active stabilization policy, and the optimal fiscal policy as well as the possibility of implementing this via automatic budget rules are discussed.

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1. Introduction

The role of fiscal policy remains a controversial issue. To what extent can an active fiscal policy contribute to macroeconomic stability? Does the stabilizing power only work in relation to demand shocks? Could fiscal policy work even under a balanced budget constraint? The controversial status of the effects of fiscal policy is reflected in huge differences of opinion between schools of thought and in the policy practice in various countries[1)].

In view of the differences in the views and practice on fiscal policy activism, it is noteworthy that all OECD- countries have a substantial fiscal activism via the automatic response of public expenses and in particular tax revenues to the business cycle situation. These may work as automatic stabilizers significantly affecting macroeconomic volatility. For the US the stabilizing effects associated to the federal budget have been estimated to be rather strong and to reduce the impact of shocks by around 30% (Sachs and Sala-i-Martin (1992) and Bayoumi and Masson (1996)) [2)]. At the level of single states Bayoumi and Eichengreen (1995) find that institutional restraints on the budget position limits the cyclical responsiveness of public finances and this adds to macroeconomic volatility. The sensitivity of the public sector budget to the business cycle measured by how a reduction of GDP by 1% increases the borrowing requirement of the government relative to GDP is between 0.3 and 0.8 percentage points for countries in Europe, OECD (1993).That this affects macroeconomic stability is indicated by the fact that budget sensitivity is increasing in the size of government and that empirical analysis finds that there is a negative correlation between government size and macroeconomic volatility (Gali (1994)).

One might have expected that the combination of controversial effects and enormous practical importance should attract a large amount of research. This is not so. As observed by Blanchard and Fischer (1989, page 620), there has been "surprisingly little" work on "fiscal policy as a stabilizer in models with imperfections". As far as we know, this has not changed since then[3)].

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1) Whereas some countries often have used fiscal policy in a Keynesian fashion (eg the Nordic countries like Denmark and Norway), other have more consistently pursued a non-activist policy (eg Germany).

2) Von Hagen (1992) finds that this is an overestimate and asserts that the effect is around 10%.

3) It is revealing that in the subject index of Romer (1996) under the entry "Stabilization policy", one finds "(see monetary policy)".

This is not to say that there has been no research on the effect of fiscal policy on output. Alesina and Perotti (1995) and Giavazzi and Pagano (1990) among others, have done exactly that. But here the focus has been on fiscal consolidation, that is, the output effects of attempts to improve the budget balance. In contrast, we focus on whether fiscal policy can be used to stabilize the economy in a model with exogenous shocks[4)].

There is also a recent literature which has considered the role of fiscal policy in a general equilibrium set-up, see eg Baxter and King (1993) and Dixon and Lawler (1995). In these models fiscal policy is in general found to affect equilibrium allocations both in case of perfect and imperfect competition. However, in both cases the transmission mechanism runs from the induced increase in taxes and the resulting fall in disposable income to an increase in labour supply. For fiscal policy to have non-trivial effects, labour supply has to have a large income elasticity. This is not supported by empirical evidence (see eg Pencavel (1986)) and moreover it suggests a different transmission mechanism than the one usually associated with fiscal policy running via demand effects. The present paper overcomes this problem by assuming individual labour supply to be inelastic and by assuming imperfect competition (monopoly union) in the labour market so as to make variations in employment possible.

The present paper develops an intertemporal two-sector model for an open economy. The labour market is assumed to be characterized by imperfect competition implying that the level of economic activity is inefficiently low. There is access to a perfect international capital market. Shocks to productivity or preferences are the source of business cycle fluctuations in the economy. These shocks affect national wealth, and thus private consumption, directly (only productivity shocks) and via the distribution of production between the tradeables and non-tradeables sector. Households are risk-averse, and the shocks cannot be fully diversified via capital markets implying that there are potential welfare gains by stabilizing private consumption. It turns out that private consumption can be stabilized by an appropriate choice of public demand. Variation in public demand affects private consumption in two ways. First, an increase in public demand involves a tax rise, which has a negative effect on private consumption via a reduction in private disposable income.

[4)] In the real business cycle literature shocks to taxes or spending are seen as a separate source of business cycle fluctuation, see eg Johnson and Klein (1996).

Secondly, the distribution of public demand between traded and non-traded goods affects the relative price of these goods which again affects income in the two sectors. We consider a policy rule for public demand for non-tradeables which stabilizes consumption via stabilization of real income in the traded sector.

An important argument against the use of fiscal measures in the stabilization policy is that expansionary policy and budget deficits over time may lead to excessive public debt. This argument does not apply to our paper, as we assume a balanced budget every year. (Of course, in a Ricardian set-up with an intertemporal budget constraint for the government, as ours, a temporary budget deficit would have no real effects). Our assumption of Ricardian equivalence and balanced budgets clearly precludes an analysis of the traditional effects of activist fiscal policy. Our message is thus that the case for a beneficial activist fiscal policy does not depend on the absence of Ricardian equivalence. In the same vein the model is real without any nominal rigidities to highlight that nominal adjustment failures are not necessary for fiscal stabilization policies to have beneficial effects.

A rules policy for fiscal policy is considered implying that credibility problems are disregarded. Consequently the results of this paper can best be interpreted as telling something on the stabilizing power of automatic budget rules as well as the optimal design of the sensitivity of fiscal policy to the business cycle situation.

The paper is organized as follows: Section 2 lays out the model, while section 3 considers the determination of national wealth. The steady state equilibrium to the model and some comparative static results are considered in section 4. Section 5 deals with supply (productivity) shocks, and section 6 with demand (preferences) shocks. Finally section 7 provides a discussion of how to implement the optimal stabilization policy in practice. Section 8 concludes the paper.

2. A Two-sector Model with Involuntary Unemployment

Consider a non-monetary open two sector economy with one sector producing a non-tradeable and the other a tradeable with prices given exogenously from the world market. The economy is fully integrated in the international capital market, and the nominal rate of interest is denoted r[5].

Households

There are H households (indexed by h) possessing a given amount of labour ($\bar{L}$) which is supplied inelastically. Households own the firms and are entitled to the flow of profits. The horizon is infinite and the aim is to maximize expected utility given as

$$V_t^h = E_t\left[\sum_{j=0}^{\infty} (1+\rho)^{-j}\, U\left(b_{t+j}^h\right)\right]$$

where ρ is the subjective rate of time preference, U is the instantaneous utility function defined as

$$U\left(b_{t+j}^h\right) = b_{t+j}^h - \frac{k}{2}\left(b_{t+j}^h\right)^2 \qquad k > 0$$

where b is a composite index of consumption of non-tradeables (c_{t+j}^h) and tradeables ($\bar{c}_{t+j}^h$), ie

$$b_{t+j}^h = \frac{1}{a}\left(c_{t+j}^h\right)^{\alpha}\left(\bar{c}_{t+j}^h\right)^{1-\alpha} \qquad 0 < \alpha < 1 \qquad a \equiv \alpha^{\alpha}(1-\alpha)^{1-\alpha}$$

The optimal consumption decision can most easily be found by first considering how the household maximizes the value of the composite consumption bundle for given expenditures in period t+j,

$$S_{t+j}^h = P_{t+j}\, c_{t+j}^h + \bar{P}_{t+j}\, \bar{c}_{t+j}^h$$

where $P_{t+j}(\bar{P}_{t+j})$ is the price of non-tradeables (tradeables). With Cobb-Douglas preferences it follows straightforwardly that

$$c_{t+j}^h = \alpha\, \frac{S_{t+j}^h}{P_{t+j}}$$

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[5] The model is related to Obstfeld and Rogoff (1995, 1996), Glick and Rogoff (1995) and Razin (1995), but differs by having an imperfectly competitive labour market and by focusing on fiscal policy.

$$\bar{c}^h_{t+j} = (1-\alpha)\,\frac{S^h_{t+j}}{\bar{P}_{t+j}}$$

The indirect utility of the consumption bundle can be written

$$b^h_{t+j} = \frac{S^h_{t+j}}{Q_{t+j}}$$

where Q is the consumer price index defined as

$$Q_t \equiv (P_t)^{\alpha}(\bar{P}_t)^{1-\alpha}$$

The intertemporal budget constraint reads

$$\sum_{j=0}^{\infty} \prod_{k=0}^{j} (1+r_{t+k})^{-1} S^h_{t+j} \le \sum_{j=0}^{\infty} \prod_{k=0}^{j} (1+r_{t+k})^{-1} I^h_{t+j} + F^h_t$$

where I^h is the after-tax nominal income ($\equiv P_t y_t + \bar{P}_t \bar{y}_t - T_t$), r_{t+k} the nominal interest rate and F^h_t is nominal non-human wealth at the start of period t. Assume that the real rate of return is constant, ie

$$\frac{(1+r_{t+1})Q_t}{Q_{t+1}} = 1 + \delta$$

The budget constraint can now be written

where $i^h_t \equiv I^h_t/Q_t$ and $f^h_t = F^h_t/Q_t$.

It is convenient to define

$$A^h_t \equiv \sum_{j=0}^{\infty} (1+\delta)^{-j} E_t\, i^h_{t+j} + f^h_t$$

as household h's total (human and non-human) wealth. We assume that the subjective and objective discount rates are equal $\delta = \rho$[6], in which case the intertemporal utility maximization has a particularly simple solution

$$b_t^h = \frac{\delta}{1+\delta} A_t^h \tag{1}$$

with the associated no ponzi game condition

$$\lim_{T \to \infty} (1+\delta)^{-T} f_{t+T+1}^h = 0$$

The household consumes the real return of its total wealth each year, and the well-known random walk property holds for consumption, ie

$$E_t b_{t+1}^h = b_t^h$$

and likewise for wealth

$$E_t A_{t+1}^h = A_t^h$$

Aggregating over all households, we get

$$c_t = \sum_n c_t^h = \alpha \frac{\delta}{1+\delta} A_t \frac{Q_t}{P_t} \tag{2}$$

$$\bar{c}_t = \sum_h \bar{c}_t^h = (1-\alpha) \frac{\delta}{1+\delta} A_t \frac{Q_t}{\bar{P}_t} \tag{3}$$

[6] The assumption that the real rate of return is constant and equal to the subjective rate of time preference implies that variations in the price of non-tradeables are matched by changes in the nominal rate of interest so as to keep the real rate of return constant. A possible interpretation is that it is possible to insure against uncertainty in relative prices, so that variation in relative prices does not affect households' wealth. Clearly, this assumption cannot be justified as being realistic. Rather, we view it as an analytical simplification that allows us to focus on the consequences of the uncertainty associated with variation in households' real income.

Firms

Let $N = N^{nt} \cup N^{t}$ denote the set of firms in the economy. A firm n is either producing the non-tradeable ($n \in N^{nt}$) or the tradeable ($n \in N^{t}$).

All firms are price- and wage-takers producing subject to the same production technology

$$y_t^n = \frac{1}{\beta}\eta_t \left(l_t^n\right)^{\beta} \qquad 0 < \beta < 1$$

where labour is the only input and η_t is a productivity parameter. From profit maximizing, we find labour demand to be

$$l_t^n = l\left(\eta_t, \frac{P_t^n}{w_t}\right) \equiv \left(\eta_t \frac{P_t^n}{W_t}\right)^{\frac{1}{1-\beta}} \tag{4}$$

and output supply is

$$y_t^n = y\left(\eta_t, \frac{P_t^n}{w_t}\right) \equiv \frac{1}{\beta}\eta_t^{\frac{1}{1-\beta}}\left(\frac{P_t^n}{W_t}\right)^{\frac{\beta}{1-\beta}} \tag{5}$$

where $P_t^n = P_t$ if $n \in N^{nt}$ and $P_t^n = \overline{P}_t$ if $n \in N^{t}$.

Wage Determination

To each firm is associated $M \equiv H/N$ workers, and they are all organized in firm-specific unions. The unions are assumed to have the power to set the wage rate (the monopoly union assumption of Dunlop, 1944), while employment is determined unilaterally by each firm after the wage is set. Each union sets the wage so as to maximize the expected life-time utility of a representative member. As the households are risk averse, expected utility maximization involves an even sharing of income among the households. Furthermore, as we assume that there is no disutility of labour, utility maximization is equivalent to maximizing the sum of labour income and unemployment benefits in each period.

Among unions there is a self-financing unemployment benefit system covering the whole economy, which provides each household with a real benefit d (exogenous) if unemployed. The unemployment benefits are financed by lump-sum contributions by all union members (= households) in the economy. As there are many firms and unions in the economy, the impact of the employment level in one firm on total costs of unemployment benefits is negligible, so each union will treat the financing of benefits as exogenous in the wage-setting.[7)]

Each union n sets the wage so as to maximize the sum of real labour income and unemployment benefit, ie

$$W_n = \arg\max \left\{ l_n \frac{W_n}{Q} + (M - l_n)\, d \right\}$$

subject to the labour demand function (4). As is well-known, a utilitarian monopoly union facing a constant elasticity of demand for labour will set the real wage as a mark-up (m) on real unemployment benefits, where the mark-up depends on the elasticity of labour demand $(1-\beta)^{-1}$:

$$W/Q = md \quad ; \quad m \equiv \frac{1}{\beta} \qquad \textbf{(6)}$$

Each union has a real wage target defined as a constant mark-up over unemployment benefits. Furthermore, households' utility is not influenced by the rate of unemployment per se, it is only real income that matters. This sharpens the focus on the possible benefits of income stabilization policies.

The assumption that wages are set by monopoly unions is not motivated on the grounds that this is particularly "realistic" (although powerful unions is a fact of life in several European countries). What we want to capture is that real wages are rigid; in spite of involuntary unemployment real wages are not bid down to clear the labour market. A similar feature could be derived in models based on efficiency wages or rent-sharing. However, the particular assumption that we adopt has the convenient feature that the real wage is independent of the rate of unemployment, and thus constant over the cycle (which is not inconsistent with empirical evidence, see eg Romer, 1996, p. 216). This

[7)] Thus, a wage rise has a negative external effect on other unions, which will lead to too high wages in aggregate, cf Jackman (1990). This will, however, not be the focus here.

feature simplifies the analysis considerably. Moreover, it also allows for direct conclusions on welfare effects.

Using the wage equation (6), we can write the supply of non-tradeables and tradeables as (normalizing by setting $\bar{P}_t \equiv 1 \; \forall \; t$)

$$y_t = s(P_t, \eta_t) = \frac{1}{\beta} \eta_t^{\frac{1}{1-\beta}} \left(\frac{P_t^{1-\alpha}}{md} \right)^{\frac{\beta}{1-\beta}} \qquad \frac{\partial s}{\partial P_t} > 0; \; \frac{\partial s}{\partial \eta_t} > 0 \tag{7}$$

$$\bar{y}_t = \bar{s}(P_t \eta_t) = \frac{1}{\beta} \eta_t^{\frac{1}{1-\beta}} \left(\frac{P_t^{-\alpha}}{md} \right)^{\frac{\beta}{1-\beta}} \qquad \frac{\partial \bar{s}}{\partial P_t} < 0; \frac{\partial \bar{s}}{\partial \eta_t} > 0 \tag{8}$$

Note that an increase in the price of non-tradeables (P_t) increases the supply of non-tradeables and decreases the supply of tradeables. The intuition is that an increase in the price of non-tradeables induces an increase in the consumer price index and thus in the wage rate to maintain the real wage unchanged. As the weight of non-tradeables in the consumer price index (α) is less than unity, the wage rises less than proportionately to the increase in the price of non-tradeables. Hence, the product real wage falls and supply increases in the NT-sector. The T-sector faces prices determined in the world market, and the wage increase induced by higher prices of non-tradeables leads thus to a higher product real wage in this sector and therefore output supply falls. This interdependence between the two sectors will be crucial for the results derived in the following.

Government

The government demands non-tradeables g_t and tradeables $\bar{g}_t$ and finances this by lump-sum taxes T_t. As the model is set up, Ricardian equivalence prevails. Hence, it is the level of public expenditure which matters, not whether it is financed by lump-sum taxes today or in the future. Without loss of generality we choose the simple procedure of assuming that the budget is balanced in any period, ie

$$P_t g_t + \bar{P}_t \bar{g}_t = T_t \tag{9}$$

It is noted that public demand is assumed not to affect household utility. This assumption is made to focus on the pure demand effects of public demand.

Equilibrium Conditions

Equilibrium in the non-tradeables market requires

$$y_t = c_t + g_t \qquad \textbf{(10)}$$

and the trade balance is given by

$$tb_t = \bar{P}_t \left(\bar{y}_t - \bar{c}_t - \bar{g}_t\right) \qquad \textbf{(11)}$$

It is noted that combining household and government budget constraints and using the equilibrium condition for the non-tradeables market, we get

$$\sum_{j=0}^{\infty} (1+\delta)^{-j} tb_{t+j} + f_t = 0$$

3. National Wealth

National wealth (A_t) is a crucial determinant of aggregate demand, cf (2) and (3), and therefore it is important for the equilibrium level of activity. It turns out that national wealth can be written in a very simple way as is seen by using that national wealth (or more precisely, the total wealth of all households) is defined as

$$A_t \equiv E_t \sum_{j=0}^{\infty} (1+\delta)^{-j} i_{t+j} + f_t \qquad \textbf{(12)}$$

where

$$i_{t+j} \equiv \frac{P_{t+j} y_{t+j} + \bar{P}_{t+j} \bar{y}_{t+j} - T_{t+j}}{Q_{t+j}}$$

Using the government budget constraint (9) and the equilibrium condition for the non-tradeables market, we get

$$i_{t+j} = \frac{P_{t+j}}{Q_{t+j}} c_{t+j} + \frac{\bar{P}_{t+j}\left(\bar{y}_{t+j} - \bar{g}_{t+j}\right)}{Q_{t+j}}$$

Inserting the consumption function (2) and using that $E_t A_{t+j} = A_t$, we find from (12) that

$$A_t = \frac{1}{1-\alpha}\left[E_t \sum_{j=0}^{\infty} (1+\delta)^{-j} \left(\frac{\bar{P}_{t+j}\left(\bar{y}_{t+j} - \bar{g}_{t+j}\right)}{Q_{t+j}} \right) + f_t \right] \quad \textbf{(13)}$$

This shows that total wealth generated in the economy can be written as a multiplum of the net income generated in the tradeables sector (minus government demand which is pure waste in this model) plus initial net wealth. The multiplier is seen to depend on the consumption share of non-tradeables, the higher its share (α), the higher the multiplier.

The expression (13) can thus be given an interpretation similar to the standard Keynesian multiplier from the income expenditure model. A share (α) of the income generated in the tradeable sector is spent on non-tradeables goods which in turn creates income in this sector. However, in contrast to the traditional Keynesian model, the supply side of the economy (as given by (6), (7) and (8)) entails that there is a negative relationship between output in the two sectors.

4. Steady State Equilibrium

In this section we consider the steady state solution of the model. In the following two sections we allow for supply (productivity) and demand (preferences) shocks as well as variations in government real demand for non-tradeables. To provide some intuition on the functioning of the model, we derive some comparative static results. First, however, let us be explicit on which equations that determine the steady state solution of the model. As the relative price, consumption, production and national wealth are constant over time, we may drop the time subscript in the remainder of this section.

In steady-state, national wealth can, by applying the formula for an infinite sequence, be written

$$A = \frac{1}{1-\alpha}\left[\frac{1+\delta}{\delta}\,\frac{\bar{P}}{Q}\left(\bar{y} - \bar{g}\right) + f\right]$$

By substituting out for the national wealth in the consumption of non-tradeables, (2), we can write private demand for non-tradeables as

$$c = \frac{\alpha}{1-\alpha}\frac{\overline{P}}{P}(\overline{y}-\overline{g}) + \frac{\alpha}{1-\alpha}\frac{\delta}{1+\delta}\frac{Q}{P}f \qquad \textbf{(14)}$$

Equation (14) combined with the equilibrium condition for the non-tradeables market (10), and the supply functions for tradeables and non-tradeables give four equations that determine the steady state solutions for the four endogenous variables c, y, $\overline{y}$ and P.

Now consider the comparative statics results. An increase in productivity (η) has a direct positive effect on the supply of both tradeables and non-tradeables. However, there is also an indirect effect on output in both sectors induced by the wage response to the change in the price of non-tradeables, cf (6). There are two opposing effects on the price of non-tradeables: the increase in supply tends to lower the price, while the productivity rise generates a positive income effect on demand that tends to raise the price. In general, the effect on the price on non-tradeables is indeterminate. However, it turns out that it depends in a simple way on the structure of government demand. It can be shown (see appendix) that[8)]

$$\frac{dP}{d\eta} < 0$$

if and only if

$$\frac{c}{y} < \frac{\overline{c}}{\overline{y}}$$

that is, an increase in productivity will lead to a reduction in the price of non-tradeables if the ratio of private consumption to production of non-tradeables is less than the ratio for tradeables. As public demand tends to have a high share of non-tradeables, this condition is likely to be fulfilled.

[8)] The simple structure is the result of the constant expenditure shares which in turn follows from the Cobb-Douglas utility specification.

For non-tradeables, the direct effect dominates and higher productivity will always lead to higher supply. This is because it is clearly impossible that the price of non-tradeables falls so much that the supply on non-tradeables is reduced, as the price will only fall when supply goes up.

For tradeables the indirect effect via the price of non-tradeables may be so strong as to dominate the direct effect of increased productivity. In this case, higher productivity may lead to reduced supply of tradeables if the productivity rise induces a sufficiently strong rise in the price of non-tradeables. However, this alternative seems unlikely, and in the sequel we shall assume that higher productivity leads to a rise in the supply of tradeables.

Public demand affects output only via the price of non-tradeables. In the appendix we show that a rise in public demand for non-tradeables leads to a rise in the price of non-tradeables, ie

$$\frac{\partial P}{\partial g} > 0$$

thus inducing a rise in the supply of non-tradeables and a reduction in the supply of tradeables. A rise in public demand for tradeables involves a tax increase that has a negative income effect on the demand for non-tradeables.

$$\frac{\partial P}{\partial \bar{g}} < 0$$

The price of non-tradeables falls, inducing a reduction in the supply of non-tradeables and an increase in the supply of tradeables.

5. Productivity Shocks

Let us next consider the case where the productivity parameter η varies. Denote by ϵ_t the deviation in η_t from its long-run value. We assume that deviations are serially uncorrelated[9)] and unanticipated

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[9)] As productivity shocks are temporary, the income effect on consumption is smaller than the effects associated with permanent changes in section 4 above.

$$E_t \, \epsilon_{t+j} = 0 \quad \forall \, j > 0$$

We shall solve for a rational expectations equilibrium. To this end, it is useful to start by noting that the equilibrium condition for non-tradeables after substitution of the consumption function (2) can be written as

$$\frac{P_t y_t}{Q_t} = \alpha \frac{\delta}{1+\delta} A_t + \frac{P_t g_t}{Q_t} \tag{15}$$

Define the real value of income generated in the NT-sector as

$$in_t = \frac{P_t y_t}{Q_t} \tag{16}$$

and similarly for the T-sector

$$it_t = \frac{\bar{P}_t \bar{y}_t}{Q_t} \tag{17}$$

The complicated structure of the model implies that we have to make a choice between obtaining analytical solutions via a linearization of the model or by taking resort to numerical simulations. As argued forcefully by Campbell (1994), the former method has the advantage of shedding more light on the mechanisms behind the results.

Assume that the economy initially is in steady state (for given initial values A_0 and f_0) and we make the following linearization of (16) and (17) around the steady-state solution

$$\tilde{in}_t = \gamma_0 \tilde{p}_t + \gamma_1 \epsilon_t \tag{18}$$

$$\tilde{it}_t = -\rho_0 \tilde{p}_t + \rho_1 \epsilon_t \tag{19}$$

where a ˜ denotes that the variable is measured in deviations from its steady state value.

The parameters γ_0, γ_1, ρ_0 and ρ_1 are strictly positive in line with the analysis of supply behaviour in section 2 above (equations (7) and (8)).

To focus on the potential stabilizing power of fiscal policy, we keep public demand for tradeables constant at its steady rate level and consider only variations in public demand for non-tradeables[10)]. We assume that variations in the government real demands for non-tradeables follows a contingent rule

$$\left(\frac{P_t \tilde{g}_t}{Q_t}\right) = \kappa \epsilon_t \qquad \textbf{(20)}$$

where κ is the exogenous stabilization parameter, ie (20) has the interpretation as a contingent stabilization rule. Note that κ equal to zero corresponds to a passive fiscal policy.

A solution to equilibrium prices for non-tradeables can be written in terms of the wealth variable ($\tilde{A}$) and the shock variable (ϵ).

Using the equilibrium condition for the non-tradeables market (15) with variables measured in deviations from their steady-state values, we have (using (16), (18) and (20))

$$\kappa \epsilon_t + \frac{\alpha \delta}{1+\delta}\tilde{A}_t = \gamma_0 \tilde{p}_t + \gamma_1 \epsilon_t$$

This implies that

$$\tilde{p}_t = \tau_0 \tilde{A}_t + \tau_1 \varepsilon_t \qquad (21)$$

where

$$\tau_0 = \frac{\alpha \delta}{\gamma_0 (1+\delta)}$$

$$\tau_1 = \frac{\kappa - \gamma_1}{\gamma_0}$$

The parameter τ_0 is greater than zero because higher wealth increases demand, and thus also the price of non-tradeables. The sign of τ_1 is in general ambiguous as it depends on both the supply

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10) Note that it would also be possible to stabilize the economy by use of public demand for tradeables keeping public demand for non-tradeables constant. Here we assume $\left(\frac{\bar{P}_t \tilde{\bar{g}}_t}{Q_t}\right) = 0$

effect and the response of government demand to the productivity shock, but it is likely to be negative.

Notice that ϵ is the impact variable which is assumed to follow a white noise process, while the wealth variable A captures the propagation mechanism induced by intertemporal consumption smoothing. Note that $\tilde{A}_t$ follows a random walk and that $E_t\tilde{A}_{t+1} = \tilde{A}_t$. In general the temporary productivity shock thus has a persistent effect on output in the two sectors.

When the equilibrium price function (21) is inserted into the equations for the income generated in the two sectors (18) and (19), we obtain

$$\tilde{in}_t = \gamma_0\tau_0\tilde{A}_t + (\gamma_1 + \gamma_0\tau_1)\epsilon_t \qquad \textbf{(22)}$$

$$\tilde{it}_t = -\rho_0\tau_0\tilde{A}_t + (\rho_1 - \rho_0\tau_1)\epsilon_t \qquad \textbf{(23)}$$

Equations (22) and (23) bring out the direct positive effect of a productivity rise, and the indirect effect via the price on non-tradeables. The indirect effect will strengthen the direct effect in one sector and dampen the direct effect in the other sector. If an increase in productivity leads to a reduction in the price of non-tradeables, τ_1 negative, as suggested above, this will strengthen the positive effect in the T-sector, and dampen the positive effect in the NT-sector. Income in the NT-sector may even go down.

The equilibrium distribution of prices and thus output depends on the stabilization parameter κ which is seen by noting that

$$\frac{\partial\tau_1}{\partial\kappa} > 0$$

However, the stabilization parameter does not affect the persistency parameter, ie

$$\frac{\partial\tau_0}{\partial\kappa} = 0$$

This is as should be expected since variations in public demand under a balanced budget have no direct bearing on the intertemporal consumption profile, but only work by changing the structure of demand within a single period.

Complete stabilization of the real income generated in the T-sector is from (23) seen to be possible if there exists a choice of κ ensuring

$$\rho_1 - \rho_0\tau_1 = 0$$

or equivalently

$$\tau_1 = \frac{\rho_1}{\rho_0}$$

Substituting out in the expression for τ_1 and solving for κ shows that this condition is fulfilled for the following value of κ

$$\kappa = \kappa^* \equiv \frac{\rho_1}{\rho_0}\gamma_0 + \gamma_1 > 0$$

Thus by an appropriate choice of κ, it is possible to insulate the income generated in the T-sector from productivity shocks. It follows that aggregate wealth is stabilized (cf appendix B) and therefore fluctuations in consumption are removed (cf (2) and (3)), ie the steady state level of consumption can be attained. As households are risk averse the utility function implies aversion to fluctuations in the composite consumption bundle b, their expected utility is maximized by complete stabilization in consumption. (Note that the average consumption level over time is unaffected).

Note that to obtain a complete stability of the income from the T-sector, the indirect price effect induced by wage changes must balance the direct productivity effect. Under a positive productivity shock, public demand must rise so that the price of non-tradeables increases sufficiently to counteract the direct effect of the productivity shock.

Note that the policy rule only specifies the optimal degree of variation in public demand for non-tradeables and not the optimal level[11]. It is worth pointing out that variations in public demand for non-tradeables are sufficient to stabilize consumption; therefore there is no loss in generality in assuming public demand for tradeables to be constant at its steady value.

The optimal policy has a Keynesian flavour in the sense that if a shock causes supply of NT-goods to exceed demand at the initial price level (in the present model caused by a positive productivity shock), public demand should be increased, and oppositely if demand comes to exceed supply. On the other hand, it is a less Keynesian feature that the optimal policy is geared to prices rather than activity. The optimal fiscal policy is thus in sharp contrast to the traditional Keynesian recipe of raising public demand in recessions when output is low. In the present model the optimal fiscal policy involves increasing public demand when output is high due to a positive productivity shock. The intuition in the present model is that the effect of public demand goes through the wage and price setting so the government may in fact dampen output in the traded sector by raising public demand of non-tradeables. Moreover, the optimal policy is here defined on welfare terms rather than on stabilization of activity (employment). One should, however, not put too much emphasis on the conflicting policy prescriptions; it should be no surprise that traditional Keynesian policies are not suitable to deal with shocks to the supply side of the economy.

6. Demand Shocks

In this section we consider the effects of demand shocks in the model. The purpose of this is twofold. First, demand shocks may be an as important source of business cycle fluctuations as productivity shocks. Second, this allows for a comparison of the optimal stabilization policies to shocks originating on the demand or the supply side.

The simplest way to introduce demand shocks consistent with the underlying intertemporal consumption model is to assume that there in each period is a shock to households' preferences

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[11] Market imperfections do in general also have implications for the optimal level, cf eg Andersen (1996).

regarding their choice of tradeable vs. non-tradeable consumption[12)]. More precisely, we assume that there are transitory and unanticipated shifts in demand between non-tradeables and tradeables, ie

$$\frac{P_t c_t}{Q_t} = \alpha \frac{\delta}{1+\delta} A_t + u_t \qquad \textbf{(24)}$$

$$\frac{\bar{P}_t \bar{c}_t}{Q_t} = (1-a) \frac{\delta}{1+\delta} A_t - u_t$$

where u_t is the random shock, which is assumed to be white noise.

As in section 5, we shall to solve for a rational expectations equilibrium. To focus on the effect on demand shocks, we neglect productivity shocks in this section. As the firms are price-takers, the demand shock affects output via prices. Increased demand for non-tradeables will raise the price of non-tradeables, which in turn via wage changes affects production of both non-tradeables and tradeables. Following the procedure in section 5 above, we make linearizations of the real value of incomes generated in the two sectors around their steady-state solutions

$$\tilde{in}_t = \gamma_2 \tilde{p}_t \qquad \textbf{(25)}$$

and

$$\tilde{it}_t = -\rho_2 \tilde{p}_t \qquad \textbf{(26)}$$

The government real demand for non-tradeables follows a contingent rule

$$\left(\frac{P_t \tilde{g}_t}{Q_t} \right) = \omega u_t \qquad \textbf{(27)}$$

where ω is the exogenous stabilization parameter.

The equilibrium condition for the non-tradable market (15) can with the variables measured as deviations from their long run value be written (using (24), (25) and (27))

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12) See Thomas (1995) for an analysis of fiscal policy in a setting with an incomplete market structure and shocks to preferences.

$$\omega u_t + \frac{\alpha\delta}{1+\delta}\tilde{A}_t + u_t = \gamma_2 \tilde{p}_t$$

There exists an equilibrium of the form

$$\tilde{p}_t = \tau_2 \tilde{A}_t + \tau_3 u_t \qquad \textbf{(28)}$$

where

$$\tau_2 = \frac{1}{\gamma_2}\frac{\alpha\delta}{1+\delta}$$

$$\tau_3 = \frac{1}{\gamma_2}(\omega + 1)$$

The equilibrium distribution of non-tradeable prices depends on the stabilization parameter as

$$\frac{\partial \tau_3}{\partial \omega} > 0$$

Perfect stabilization is easily achieved in this case since by setting

$$\omega = -1$$

we obtain τ_3=0. By this choice of ω the preference shock has no effect on total demand for non-tradeables and hence equilibrium prices are unaffected. It follows that $\tilde{it}_t = \tilde{A}_t = 0$ implying that national wealth and thus consumption are stabilized. Using the same arguments as in section 5, it follows that this policy is welfare improving.

Optimal stabilization policy takes a simpler form under demand shocks than in the case with productivity shocks. A positive demand shock raises the price and supply of non-tradeables. The price increase induces a wage rise that lowers the supply of tradeables which induces variation in households' wealth and thus also their consumption. By reducing government demand for non-tradeables, the rise in the price of non-tradeables is dampened, and there is thus also a dampening of the further effects on the supply of non-tradeables and tradeables. Thus in this case the optimal policy corresponds to the traditional Keynesian view; public demand of non-tradeables should be increased when production and prices are low in the non-tradeable sector and vice versa.

7. Policy Implications

In the previous sections we have analysed the optimal fiscal policy which aims at stabilizing income from the T-sector so as to stabilize households' wealth and consumption. Under productivity fluctuations public demand for non-tradeables is used to affect the wage level via the price on non-tradeables. If a positive productivity shock takes place, raising income in the T-sector, public demand for non-tradeables should be increased so as to raise the price of non-tradeables, inducing a rise in wages that dampens the increase in the income in the T-sector. If there is a shock to private demand for non-tradeables, optimal fiscal policy involves an offsetting change in public demand for non-tradeables, so that the price of non-tradeables is kept constant. Thus one avoids destabilizing price impulses to the wages.

In practice, it would be difficult to implement the optimal fiscal policy. First, the government has incomplete information both with respect to the structure of the economy and the nature of the shocks. Secondly, there are often considerable lags in the implementation of the fiscal policy. Third, fiscal policy is also influenced by other concerns. In this section we thus consider how the optimal policy compares with types of policies that are more likely to be pursued. Automatic budget reactions is a way to overcome some of the abovementioned problems and thereby to implement an active stabilization policy. We shall consider automatic budget rules in two versions.

First, consider automatic budget rules defined as variations in the real demand for non-tradeables by the public sector as prescribed for equations (20) and (27) above. It is easily seen that such automatic budget rules work in the opposite direction of optimal fiscal policy under productivity fluctuations. If a positive productivity shock takes place, output increases. Automatic stabilization would imply a reduction in public demand, while as shown above the optimal fiscal policy requires an increase in public demand for non-tradeables. But as observed above, it is not surprising that Keynesian policies are not in general suitable to deal with shocks to the supply side of the economy.

Automatic budget rules work better under demand shocks. If a positive demand shock takes place, output and prices increase in the NT-sector. Optimal fiscal policy requires a reduction in public demand for non-tradeables, and this is also ensured via the effect of automatic stabilization. Automatic variations in public sector real demands for non-tradeables thus work differently to shock originating on the supply and the demand side. Accordingly, it is difficult to design simple automatic reactions of public real demand for non-tradeables which will be stabilizing to all types of shocks.

Automatic budget rules in real-world economies mainly arise from the fact that tax revenues and expenditures on transfers are cyclically dependent. The point is to affect the intertemporal demand structure, raise demand in some periods and reduce demand in others. However, when introduced in our model most of these measures do not have the prescribed effect. As households optimize as to their choice of consumption over time, the timing of taxes or transfers it not relevant (Ricardian equivalence prevails). However, if one modifies our model by assuming that one part of the population is liquidity constrained, (eg the unemployed), transfers to this part of the population paid for by taxes on the whole population, would affect the intertemporal demand structure. Such an effect would correspond to variation in public demand in the present model. Expenditure on active labour market policies which usually varies over the cycle can also be viewed as public demand for non-tradeables.

There is, however, a type of automatic budget rule which will address the stabilization problem adequately, namely nominal budgeting rules. A nominal budgeting procedure specifying[13)] eg that total nominal outlays on the non-tradeables should be G_t implies that real demand is given by

$$g_t = \frac{G_t}{P_t}$$

implying that

$$\frac{P_t\, g_t}{Q_t} = \frac{G_t}{Q_t}$$

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13) For an analysis of the implications of cash limits for public sector wage determination, see Holmlund (1997). Bar-Ilan and Zanello (1994) show in an ad hoc macromodel that the government by its choice of nominal budgeting procedure (degree of indexation) in general can offset whatever rigidity of the contractual wage there exists in the economy. This result holds as long as stabilization is ensured by stabilizing the real wage rate.

and hence

$$\frac{\partial\left(G_t/Q_t\right)}{\partial Q_t} = -\frac{G_t}{Q_t^2} < 0$$

That is, real demand goes down when prices increase and vice versa. This ensures that public demand for non-tradeables changes in the direction implied by the optimal stabilization policy in the case of both productivity and preference shocks. The reason why this works in the right direction to both supply and demand shocks is that the transmission mechanism from the non-tradeable to the tradeable sector runs via the price of non-tradeables. A nominal budget rule for government demand for non-tradeables tends to stabilize prices of non-tradeables. It is worth stressing that the case for a nominal budgeting rules arises despite that the model is non-monetary.

The intuition here is that a nominal budgeting rule involves lower real public demand of non-tradeables when prices of non-tradeables are high (and vice versa), thus stabilizing prices of non-tradeables. Stabilization of prices of non-tradeables then works to stabilizing the income from the tradeables sector, and thus also private consumption via stabilization of the real product wage in the tradeables sector. This demonstrates that it is possible to design practically implementable automatic budget rules which work adequately to both supply and demand shocks.

8. Concluding Remarks

In this paper we have investigated to what extent the fiscal policy can be used to stabilize the economy under various types of shocks. This an issue of considerable importance from a policy point of view, yet it has not received much attention in recent research. The main results are as follows. Fiscal policy can be used to stabilize the economy both under supply (productivity) and demand (preferences) shocks. In our model, fiscal policy works by affecting the product real wage in the traded sector via the effect of the price level in the non-traded sectors on the economy-wide wage level, thus stabilizing income in the traded sector. Stabilizing income in the traded sector entails stabilization of national wealth, with the consequence that private consumption is stabilized. Given an incomplete capital market precluding diversification of income risks and risk-averse agents, there is a welfare case for such a policy. Under productivity shocks, the optimal fiscal policy is in sharp contrast to the Keynesian prescription, as public demand should be increased when output is high, owing to a positive productivity shock. However, under demand shocks the traditional Keynesian strategy prevails: public demand for non-traded goods should be increased in periods with low output in the non-traded sector.

In practice, incomplete information makes it difficult to implement the optimal fiscal policy. Thus, we also investigate to what extent automatic budget reactions are in accordance with the optimal fiscal policy. We find that automatic budget rules where public real demand is cyclically dependent has a stabilizing (and thus welfare improving) effect under demand shocks, whereas the effect is destabilizing under supply shocks. Nominal budgeting rules, specifying a certain level of nominal outlay on public demand for non-tradeables have, however, a stabilizing effect both under productivity and demand shocks.

In our model, households dislike variation in private consumption, while public consumption has no direct impact. Thus, the optimal policy involves complete stabilization of private consumption, while public consumption is allowed to vary. In a more general setting, households' utility depend on both private and public consumption, and presumably households dislike variation in both. An interesting topic for future research would be to look for an optimal mix of stabilization of the two components, private and public consumption.

Appendix A: Steady-State Solution

To simplify notation, it is useful to write the consumption function (14) on the form

$$c = e_0(P)\left(\bar{s}(P) - \bar{g}\right) + e_1(P)f$$

where

$$e_0(P) = \frac{\alpha}{1-\alpha}\frac{\bar{P}}{P} > 0, \quad e_1(P) = \frac{\alpha}{1-\alpha}\frac{\delta}{1+\delta}\frac{Q}{P} > 0$$

and $e_0^{/}(P) < 0$, and $e_1^{/}(P) < 0$.

The effects of an increase in public demand for non-tradeables can be found by implicit differentiation of the equilibrium condition for the non-tradeables market (10):

$$s_1 dP = \left(e_0^{/}\left(\bar{y} - \bar{g}\right) + e_1^{/}f + e_0\bar{s}_1\right)dP + dg$$

Rearranging yields

$$\frac{dP}{dg} = \frac{1}{s_1 - e_0^{/}\left(\bar{y} - \bar{g}\right) - e_1^{/}f - e_0\bar{s}_1} > 0$$

That is, a rise in government demand for non-tradeables leads to a rise in the price of non-tradeables. The rise in the price of non-tradeables then leads to a rise in y, and a reduction in c and $\bar{y}$.

The effect of a rise in government demand for tradeables can be found in the same way. Implicit differentiation of the equilibrium condition for the non-tradeables market and rearranging gives us

$$\frac{dP}{d\bar{g}} = \frac{-\ e_0}{s_1 - e_0^{/}\left(\bar{y} - \bar{g}\right) - e_1^{/}f - e_0\bar{s}_1} < 0$$

The price of non-tradeables falls due to the negative impact on consumption of the tax rise that takes place when government demand for tradeables increases.

Formally, the effect of a productivity shock on the price of non-tradeables is also found by implicit differentiation of the equilibrium condition of the non-tradeables market.

$$s_1 dP \;+\; s_2 d\eta \;=\; e_0^{/} dP(\bar{y} - \bar{g}) \;+\; e_0(\bar{s}_1 dP + \bar{s}_2 d\eta) \;+\; e_1^{/} dP\, f$$

Rearranging gives us

$$\frac{dP}{d\eta} = \frac{-s_2 + e_0 \bar{s}_2}{s_1 - e_1'(\bar{y} - \bar{g}) - e_0 \bar{s}_1 - e_1' f} \tag{A1}$$

To see this, it is useful to write the supply functions on the form

$$y \;=\; s(P,\eta) \;=\; \eta^{\frac{1}{1-\beta}} s^*(P)$$

$$\bar{y} \;=\; \bar{s}(P,\eta) \;=\; \eta^{\frac{1}{1-\beta}} \bar{s}^*(P)$$

The partial derivatives with respect to η are

$$s_2^{/} \;=\; \frac{1}{1-\beta}\eta^{\frac{\beta}{1-\beta}} s^*$$

$$\bar{s}_2^{/} \;=\; \frac{1}{1-\beta}\eta^{\frac{\beta}{1-\beta}} \bar{s}^*$$

Substituting in the numerator in (A1), we obtain

$$-\; s_2 \;+\; e_0 \bar{s}_2 \;=\; \frac{1}{1-\beta}\eta^{\frac{\beta}{1-\beta}}\left(-\, s^* + \frac{\alpha}{1-\alpha}\,\frac{\bar{P}}{P}\bar{s}^* \right)$$

Now, we have that $s^* = \bar{s}^* y/\bar{y}$ and $\frac{\alpha}{1-\alpha} \;=\; \frac{cP}{\bar{c}\bar{P}}$ (from (2) and (3)), so

$$-\; s_2 \;+\; e_0 \bar{s}_2 \;=\; \frac{1}{1-\beta} y^{\frac{\beta}{1-\beta}} s^* \left(-\, 1 + \frac{c}{\bar{c}}\,\frac{\bar{y}}{y} \right)$$

which is strictly positive if and only if $\frac{c}{y} \;>\; \frac{\bar{c}}{\bar{y}}$.

Appendix B: Optimal Stabilization Policy

We shall show that $\kappa = \kappa^* \equiv \frac{l_1}{l_0}\gamma_0 + \gamma_1$ implying $\tilde{it}_t = 0$ leads to stabilization of net-wealth ($\hat{A}_t$ = 0) and therefore consumption ($\hat{b}_t = 0$).

From (1) we have

$$\hat{b}_t = \frac{\delta}{1+\delta}\hat{A}_t$$

and from the budget constraint

$$\hat{f}_{t+1} = (1+\delta)\left(\hat{f}_t + \tilde{i}_t - \hat{b}_t\right)$$

From section 3 it follows under the assumption $\left(\frac{\bar{P}_t\tilde{\bar{g}}_t}{Q_t}\right) = 0$ that

$$\hat{A}_t = \frac{1}{1-\alpha}\left[\sum_{j=0}^{\infty} E_t(1+\delta)^{-j}\,\tilde{it}_t + \tilde{f}_t\right]$$

and

$$\tilde{i}_t = \alpha\frac{\delta}{1+\delta}\hat{A}_t + \tilde{it}_t$$

It follows from $\tilde{it}_t = 0$ that there is a solution where $\hat{A}_t = \hat{f}_t = \hat{b}_t = 0$.

Using the same procedure as in appendix B we have for $\omega = \omega^* \equiv -1$ that $\tilde{it} = 0$ and hence there is a solution where $\hat{A}_t = \hat{f}_t = \hat{b}_t = 0$.

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