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Discussion papers

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ALLOCATION OF INVESTMENT IN A SMALL OPEN TWO-SECTOR ECONOMY

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1. INTRODUCTION

The purpose of this paper is to present a model describing a small open economy in a fixed exchange rate regime, and to analyse the development of investment as a result of different pricing behaviour in the open and the sheltered sector on one hand, and of policy changes on the other. The model is a two-sector one, in which an attempt is made to combine some features of two types of models, that is, the neoclassical two-sector model with production of capital and consumption goods as separate sectors, and the so-called Scandinavian model of inflation with separate sectors for internationally traded and nontraded goods. This would in a natural way lead to a four-sector model, but this has been avoided in order to keep the model reasonably small. The sheltered sector is assumed to produce consumption goods only, and the open sector is assumed to produce goods that are used for both investment and consumption purposes. We feel, however, that this simplified framework is a reasonable first approximation to reality and may as such be used to analyse the allocation problems being studied.

The neoclassical two-sector model seems to be a convenient starting point for studying the allocation of funds as a first step of building a growth model. Traditionally, these models have only dealt with closed economies. As a step towards realism, we therefore introduce some market imperfections, the small open economy assumption and the wage determination mechanism of the Scandinavian nontraded/traded goods model. This model in turn has not generally[1] been used to deal with growth problems. We thus attempt to fill a part of the gap between these two types of models.

1) An exception is e.g. Korkman (1977), where a simple growth model is built on the basis of the Scandinavian model. Under some rather restrictive assumptions, Korkman derives conditions for "balanced growth", or a constant sectoral structure of resources with simultaneous external balance. His point of departure is then rather different from this paper's.

The "Scandinavian type" wage equation is in a separate chapter developed towards more realism.

One of the simplifications of the model is that the two productive sectors are assumed to finance their investments entirely through profits. The level of investment is then determined only after prices, output etc. have been decided upon, and thus investment does not affect the level of output or the capital stock in the short run. The model further disregards any wealth effects; consequently, commodity and asset demands are in flow form.

The focus of the paper is on the effects of international inflation, devaluations, and monetary policy. Chapter 2 deals with the simpler version of the model. In chapter 3 the model is developed using a modified wage equation, and chapter 4 concludes.

2. THE MODEL

2.1. Supply of goods

In the following, an economy with two sectors of production is considered: one which produces internationally traded goods (T), and one which produces goods that are neither exported nor exposed to competition from imports (nontraded goods, N). Both sectors use the same inputs, capital (K) and labour (l). The amounts being produced are technologically determined by production functions which are assumed to be homogenous of first degree. In the model to be considered, less than full employment of labour is assumed, and physical capital is assumed to be immobile between sectors, and thus its amount is fixed in the short run. The actual supplies of goods T and N are dependent on the relevant sector's existing capital stock (K), the commodity prices (p), and the wage rate (w). These can be stated as

(1) $$q_T = q_T(\bar{K}_T, p_T, w)$$

(2) $$q_N = q_N(\bar{K}_N, p_N, w).$$

It is assumed that the N sector produces consumption goods only[1), and that the T sector produces a good which can be used alternatively for consumption or investment purposes. The T good is sold at the same price regardless of its use. Imported T goods, if any, are assumed to be used for investment purposes only.

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1) The N sector consists typically of service industries, agriculture, production of foodstuffs etc. In practice, the nontraded goods sector includes also some investment goods industries, e.g. the construction industry, but these are assumed away in our model.

2.2. Prices and wages

The price of the traded good is determined exogenously from the world market price p^* (in foreign currency) through the exchange rate e (price of foreign currency in terms of domestic currency): $p_T = ep^*$. Wages are equal in both sectors because of perfect labour mobility. The standard relationships of the Scandinavian model of inflation[1] between changes in wages (w), prices (p) and labour productivities (q_{ii}), assuming constancy of markups within the sectors, can be stated as

(A) $$\frac{dw}{w} = \frac{dp_T}{p_T} + \frac{dq_{TT}}{q_{TT}}$$

(B) $$\frac{dp_N}{p_N} = \frac{dw}{w} - \frac{dq_{NN}}{q_{NN}} = \frac{dp_T}{p_T} + \frac{dq_{TT}}{q_{TT}} - \frac{dq_{NN}}{q_{NN}} .$$

In our model the assumption about a constant markup in the N sector would, however, lead to overdetermination of the model. We then prefer to define p_N as a demand-determined market clearing variable, and leave equation (B) out. This seems reasonable for empirical purposes also, even though the goods N and T are regarded as imperfect substitutes. A variable markup in the N sector is then assumed to be implicit in the endogenous determination of p_N, whereas in the T sector the functional distribution of income is constant. This means that in the T sector, after reaching equilibrium, there will be no incentive to increase production except for at the rate of growth of productivity. The small country assumption and the determination of wages are thus the main characteristics of our model that are similar to the Scandinavian model.

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1) See e.g. Edgren-Faxén-Odhner (1973) and Kierzkowski (1976).

2.3. Consumption and saving

Aggregate consumption demand (in nominal terms) is assumed to be dependent on household income Y, and the allocation of funds between the two goods is determined by their prices, p_T and p_N. That part of income which is not used for consumption purposes is saved in the form of additions to nominal money balances ($\dot{M}^d$) and holdings of bonds ($\dot{B}^d$). Aggregate asset demand is assumed to be dependent on household income only, and the two distinct asset demands depend on the yield (r_B) on bonds as well. It may be noted that accumulated wealth is assumed to affect neither consumption nor asset demands. Accordingly, the four demand functions below are all formulated as flows:

(3) $$C_T = C_T(Y, p_T, p_N)$$

(4) $$C_N = C_N(Y, p_T, p_N)$$

(5) $$\dot{M}^d = \dot{M}^d(Y, r_B)$$

(6) $$\dot{B}^d = \dot{B}^d(Y, r_B)$$

Household income consists of wages and interest on bonds:

(7) $$Y = w(l_T + l_N) + r_B B,$$

and the budget constraint for households is

(8) $$Y = C_T + C_N + \dot{M}^d + \dot{B}^d .$$

The four demand functions (3)-(6) possess the following consistency properties assuming the signs of their partial derivatives to be as given below:

$$\underset{+}{\frac{\partial C_T}{\partial Y}} + \underset{+}{\frac{\partial C_N}{\partial Y}} + \underset{+}{\frac{\partial \dot{M}^d}{\partial Y}} + \underset{+}{\frac{\partial \dot{B}^d}{\partial Y}} = 1$$

$$\underset{+}{\frac{\partial C_T}{\partial p_T}} + \underset{-}{\frac{\partial C_N}{\partial p_T}} = 0$$

$$\underset{-}{\frac{\partial C_T}{\partial p_N}} + \underset{+}{\frac{\partial C_N}{\partial p_N}} = 0$$

$$\underset{-}{\frac{\partial \dot{M}^d}{\partial r_B}} + \underset{+}{\frac{\partial \dot{B}^d}{\partial r_B}} = 0 .$$

The signs of the price change effects on C_t and C_N may at first sight seem unusual. Their motivation lies in the observation that the T and N goods cannot very easily be treated as close substitutes, and thus it seems plausible that the decreasing effect on consumption demand of a rise in either good's price is divided between the two goods, that is, that both goods' demand will decrease by quantity, but the now relatively more expensive good's demand will increase by value, and that of the other one's will decrease. This means that the price elasticity of demand for both goods is greater than zero but less than one.

2.4. Investment and employment

In both sectors investment is financed exclusively by profits (R). Thus, capital accumulation is dependent on each sector's profitability, but there is no guarantee of an effective allocation of investment between the two sectors, as they are not assumed to face any alternative investment opportunities. The investment equations are

(9) $I_T = R_T = q_T p_T - w l_T,$

(10) $I_N = R_N = q_N p_N - w l_N.$

Employment in the two sectors are rising functions of production:

(11) $l_T = l_T(q_T),$

(12) $l_N = l_N(q_N).$

2.5. The complete model

In the following analysis we are interested in what happens, and particularly to investment, in our model world when a) there is international inflation (or, in this model, equivalently, an exchange rate rise), b) some other policy measure is undertaken. To close the model, we then need equilibrium conditions for the product and the asset markets. We also introduce a central bank sector and a government sector. For simplicity, we abstract from taxes and a banking sector.

There are two commodity markets, one for traded goods and one for nontraded ones. The equilibrium conditions are

(13) $q_N p_N = C_N + G,$

(14) $q_T p_T = C_T + I_T + \dot{I}_N + TB\ p_T,$

where G is government spending and TB is the trade balance (exports minus imports) in real terms, and TB p_T = TB ep^* its value in domestic currency. It is assumed that there are no demand constraints on traded goods so that their market will always be cleared. Contrary to the usual Scandinavian model, as noted earlier, the price of the nontraded good (p_N) is here allowed to vary with demand, in order to clear the market.

The other two markets are the money market and the bond market. Their equilibrium conditions are

(15) $\dot{M}^s = \dot{M}^d,$

(16) $\dot{B}^s = \dot{B}^d.$

The government sector finances its expenditures on N goods (G) and interest payments on bonds held by households by borrowing either from the central bank ($\dot{B}^{CB}$) or households ($\dot{B}^s$). In the former case, money is being printed. The government's budget constraint is then

(17) $G + r_B B = \dot{B}^{CB} + \dot{B}^s.$

The stock of bonds outstanding at the beginning of the period (B) is exogenous in short run analysis.

The reserves of the central bank consist of non-interest bearing foreign currency reserves, or net foreign assets NFA, and receivables from the public sector, B^{CB}. The change in the money supply is then

$$(18) \qquad N\dot{F}A + \dot{B}^{CB} = \dot{M}^{S}.$$

The change in net foreign assets equals the trade balance,

$$(19) \qquad N\dot{F}A = TBp_T.$$

Regarding the public sector and the central bank as one unit, it follows from equations (17)-(19) that their combined budget constraint may be written as

$$(20) \qquad G + r_B B = \dot{M}^S + \dot{B}^S - TBp_T,$$

or equivalently, the equation for the change in the money supply is

$$(21) \qquad \dot{M}^S = G + r_B B + TBp_T - \dot{B}^S.$$

Thus, the government sector has three policy variables, $\dot{M}^S$, G, and r_B, of which only $\dot{M}^S$ and G are independent. In the following, we shall further treat G as fixed, so that the only true policy variable is $\dot{M}^S$.

Treating q_T, q_N, C_T, C_N, $\dot{M}^d$, $\dot{B}^d$, l_T, and l_N as function symbols we then have the following system of equations, where (13)-(16) are equilibrium conditions for the four markets:

(7) $$Y = w(l_T + l_N) + r_B B$$

(8) $$Y = C_T + C_N + \dot{M}^d + \dot{B}^d$$

(9) $$I_T = q_T p_T - w l_T$$

(10) $$I_N = q_N p_N - w l_N$$

(21) $$\dot{M}^s = G + r_B B + TB p_T - \dot{B}^s$$

(13) $$q_N p_N = C_N + G$$

(14) $$q_T p_T = C_T + I_T + I_N + TB p_T$$

(15) $$\dot{M}^s = \dot{M}^d$$

(16) $$\dot{B}^s = \dot{B}^d.$$

The system thus contains the following variables:

exogenous: $\bar{K}_T$, $\bar{K}_N$, p_T, w, B, $\dot{M}^s$, G

endogenous: p_N, Y, r_B, I_T, I_N, TB, $\dot{B}^s$

function symbols: q_T, q_N, C_T, C_N, $\dot{M}^d$, $\dot{B}^d$, l_T, l_N.

Of the above-listed equations, one equilibrium condition, say, (15), as well as equation (8) are obviously redundant.

I_T, I_N, TB, and $\dot{B}^s$ may be eliminated by substituting equations (9), (10), (21), and (16) into (14). Denoting $q_N p_N = Q_N$ and $w(l_T + l_N) = W$ we then have the following system of three equations in three endogenous variables (p_N, Y, and r_B):

$$
(22) \quad \begin{cases} C_T + Q_N - W + \dot{B}^d + \dot{M}^s - G - r_B B = 0 \\ Q_N - C_N - G = 0 \\ -Y + W + r_B B = 0 \end{cases}
$$

or, more accurately,

$$
(22b) \quad \begin{cases} C_T(Y, p_T, p_N) + Q_N(p_N, w) - W(p_T, p_N, w) + \dot{B}^d(Y, r_B) + \dot{M}^s - G - r_B B = 0 \\ Q_N(p_N, w) - C_N(Y, p_T, p_N) - G = 0 \\ -Y + W(p_T, p_N, w) + r_B B = 0 \end{cases}
$$

The Jacobian of the system with respect to the endogenous variables is, with $-\partial C_N/\partial p_N = \partial C_T/\partial p_N$,

$$
\begin{array}{cccc}
 & dp_N & dY & dr_B \\
D = & \left| \begin{array}{c} \dfrac{\partial C_T}{\partial p_N} + \dfrac{\partial Q_N}{\partial p_N} - \dfrac{\partial W}{\partial p_N} \\[2ex] \dfrac{\partial Q_N}{\partial p_N} + \dfrac{\partial C_T}{\partial p_N} \\[2ex] \dfrac{\partial W}{\partial p_N} \end{array} \right. & \begin{array}{c} \dfrac{\partial C_T}{\partial Y} + \dfrac{\partial \dot{B}^d}{\partial Y} \\[2ex] -\dfrac{\partial C_N}{\partial Y} \\[2ex] -1 \end{array} & \left. \begin{array}{c} \dfrac{\partial \dot{B}^d}{\partial r_B} - B \\[2ex] 0 \\[2ex] B \end{array} \right| .
\end{array}
$$

To determine the sign of this Jacobian we expand it along its second row. Rearranging terms and substituting $\partial C_T/\partial Y + \partial C_N/\partial Y + \partial \dot{B}^d/\partial Y - 1 = -\partial \dot{M}^d/\partial Y$ we get finally

$$D = -\Big(\underset{+}{\frac{\partial Q_N}{\partial p_N}} + \underset{-}{\frac{\partial C_T}{\partial p_N}}\Big)\Big(-\underset{+}{B\frac{\partial \dot{M}^d}{\partial Y}} + \underset{+}{\frac{\partial \dot{B}^d}{\partial r_B}}\Big) + \underset{+}{\frac{\partial \dot{B}^d}{\partial r_B}}\,\underset{+}{\frac{\partial C_N}{\partial Y}}\,\frac{\partial W}{\partial p_N}$$

We assume that $\partial Q_N/\partial p_N + \partial C_T/\partial p_N = \partial Q_N/\partial p_N - \partial C_N/\partial p_N \geq 0$ since with no inventories, $dC_N > dQ_N$ is impossible. If further the accumulated stock of bonds (B) is taken to be relatively great, and $\partial W/\partial p_N$ is assumed to be positive, D may be concluded to be positive.

2.6. Short run equilibrium and effects of changes in p_T and $\dot{M}^s$ on investment

Next, to see how the model works we solve for the effects of changes in the international price level (p_T) and in the supply of money ($\dot{M}^s$). We then differentiate (22b) with respect to p_T and $\dot{M}^s$:

$$\frac{d(22b)}{dp_T} = \begin{bmatrix} \dfrac{C_T}{p_T} - \dfrac{W}{p_T} \\[2ex] \dfrac{C_T}{p_T} \\[2ex] \dfrac{W}{p_T} \end{bmatrix}, \qquad \frac{d(22b)}{d\dot{M}^s} = \begin{bmatrix} 1 \\ 0 \\ 0 \end{bmatrix}.$$

Solving for the effects of a change in p_T on the three endogenous variables by Cramer's rule and rearranging terms we have

a) $$\frac{dp_N}{dp_T} = \frac{1}{D}\Big[\underset{+}{\frac{\partial C_T}{\partial p_T}}\underbrace{\Big(B\frac{\partial \dot{M}^d}{\partial Y} - \frac{\partial \dot{B}^d}{\partial r_B}\Big)}_{+} + \underset{+}{\frac{\partial \dot{B}^d}{\partial r_B}}\,\underset{+}{\frac{\partial C_N}{\partial Y}}\,\frac{\partial W}{\partial p_T}\Big],$$

$dp_N/dp_T > 0$ if, analogously with $\partial W/\partial p_N > 0$ assumed earlier, also $\partial W/\partial p_T > 0$.

(b) $$\frac{dY}{dp_T} = \frac{1}{D}\{\frac{\partial \dot{B}^d}{\partial r_B}[\underbrace{\frac{\partial W}{\partial p_T}(\frac{\partial Q_N}{\partial p_N} + \frac{\partial C_T}{\partial p_N})}_{+} - \underbrace{\frac{\partial C_T}{\partial p_T}\frac{\partial W}{\partial p_N}}_{-}] + \underbrace{B\frac{\partial C_T}{\partial p_T}(\frac{\partial C_T}{\partial p_N} + \frac{\partial Q_N}{\partial p_N})}_{+}\}$$

$$= \frac{1}{D}\{\underbrace{(\frac{\partial Q_N}{\partial p_N} + \frac{\partial C_T}{\partial p_N})}_{+}\underbrace{(\frac{\partial \dot{B}^d}{\partial r_B}\frac{\partial W}{\partial p_T} + \frac{\partial C_T}{\partial p_T}B)}_{+} - \underbrace{\frac{\partial C_T}{\partial p_T}\frac{\partial \dot{B}^d}{\partial r_B}\frac{\partial W}{\partial p_N}}_{-}\}.$$

If $\partial Q_N/\partial p_N + \partial C_T/\partial p_N$ is very small (and it may of course be even zero), then dY/dp_T may be assumed to be negative. This is, however, a somewhat ambiguous result.

(c) $$\frac{dr_B}{dp_T} = \frac{1}{D}\{\underbrace{\frac{\partial \dot{M}^d}{\partial Y}}_{+}[\underbrace{\frac{\partial W}{\partial p_T}(\frac{\partial C_T}{\partial p_N} + \frac{\partial Q_N}{\partial p_N})}_{+} - \underbrace{\frac{\partial W}{\partial p_N}\frac{\partial C_T}{\partial p_T}}_{-}]\},$$

$$\frac{dr_B}{dp_T} < 0 \text{ if } \frac{\partial W}{\partial p_N}\frac{\partial C_T}{\partial p_T} > \frac{\partial W}{\partial p_T}(\frac{\partial C_T}{\partial p_N} + \frac{\partial Q_N}{\partial p_N}).$$

If these assumptions are made, the signs in a)-c) are according to expectations.

The effects of a change in $\dot{M}^s$ are

(d) $$\frac{dp_N}{d\dot{M}^s} = \frac{1}{D}\cdot B\,(-\frac{\partial C_N}{\partial Y}) < 0,$$

(e) $$\frac{dY}{d\dot{M}^s} = -\frac{1}{D}\cdot B\,(\frac{\partial Q_N}{\partial p_N} + \frac{\partial C_T}{\partial p_N}) \leq 0 \text{ (if } \frac{\partial Q_N}{\partial p_N} \geq |\frac{\partial C_T}{\partial p_N}|),$$

(f) $$\frac{dr_B}{d\dot{M}^s} = \frac{1}{D}(\underbrace{-\frac{\partial Q_N}{\partial p_N} - \frac{\partial C_T}{\partial p_N}}_{\leq 0} + \underbrace{\frac{\partial W}{\partial p_N}}_{+} - \underbrace{\frac{\partial C_N}{\partial Y}}_{-}) \gtrless 0,$$

with $dr_B/d\dot{M}^s > 0$ a more plausible result since $\partial C_N/\partial Y < 1$. The signs in d)-f) are somewhat unexpected. Monetary policy thus seems to have unusual effects in this model.

What are the effects of a price rise on investment? The expression for dp_N/dp_T may be written

$$\frac{dp_N}{dp_T} = \frac{\frac{\partial C_T}{\partial p_T}\left(B\frac{\partial \dot{M}^d}{\partial Y} - \frac{\partial \dot{B}^d}{\partial r_B}\right) + \frac{\partial \dot{B}^d}{\partial r_B}\frac{\partial C_N}{\partial Y}\frac{\partial W}{\partial p_T}}{\left(\frac{\partial Q_N}{\partial p_N} + \frac{\partial C_T}{\partial p_N}\right)\left(B\frac{\partial \dot{M}^d}{\partial Y} - \frac{\partial \dot{B}^d}{\partial r_B}\right) + \frac{\partial \dot{B}^d}{\partial r_B}\frac{\partial C_N}{\partial Y}\frac{\partial W}{\partial p_N}}.$$

The difference between the numerator and the denominator of this expression comes through $\partial C_T/\partial p_T$ versus $(\partial Q_N/\partial p_N + \partial C_T/\partial p_N)$ and $\partial W/\partial p_T$ versus $\partial W/\partial p_N$. As $(\partial Q_N/\partial p_N + \partial C_T/\partial p_N)$ may be very small, we assume it to be smaller than $\partial C_T/\partial p_T$. As a change in p_N does not affect w but only l_N, a unit rise in p_T may be assumed to cause a greater increase in the wage bill W than a rise in p_N would do. Thus dp_N/dp_T may be concluded to be greater than one in absolute value, or $dp_N > dp_T$. This, however, does not guarantee that the change in p_N would be relatively greater, or that $dp_N/p_N > dp_T/p_T$. This would be necessarily true only if $p_N \leq p_T$, which of course is an empirical question. As labour productivity in the N sector is usually noted to rise more slowly than in the T sector, we may assume that p_N rises relatively faster than p_T.

As the income share of firms in the T sector is assumed to keep constant, dw/w equals dp_T/p_T. Then, under the assumptions made, if $dp_N/dp_T > p_N/p_T$, profits rise more in the N sector than in the T sector as a result of an increase in p_T. The nontraded goods sector would thus expand faster than the traded goods sector. It follows from the definition of p_T that the results are similar with an exchange rate rise as with a world market price rise.

On the other hand, as we found that $dp_N/d\dot{M}^S < 0$, and as $dw/dp_N = 0$, an increase in the supply of money would tend to decrease the N sector's relative share of investment. This result is of course somewhat questionable. Government spending is not treated as a policy variable here, but with our model formulation increased spending would obviously directly favour the nontraded goods sector.

3. A MODIFICATION OF THE MODEL

In this chapter we discuss the effects on the model of changing the wage equation towards a more realistic formulation. While the mechanism indicated by equation (A) seems realistic in the long run, a short-run modification is here considered relevant. Trade unions are, in the short run, assumed to demand compensation for changes in the consumer price index p_C rather than the price of traded goods only. While equation (A) is derived from an equation of the form

$$\text{(C)} \qquad w = Aq_{TT}p_T,$$

the corresponding short-run wage equation is defined as

$$\text{(23)} \qquad w = Bq_{TT}p_C = Bq_{TT}[h\ p_T + (1-h)p_N]$$

$$= ap_T + bp_N,$$

where h and (1-h) are the base-year weights of traded and nontraded goods in the price index.

It follows from equation (23) that the N sector tends to raise its price at least as much as the T sector, as otherwise its profit share will decrease. This aim is increased by the tendency of slower productivity growth in the N sector than in the T sector. It is, however, restricted by demand. Wages then rise faster, as fast as, or more slowly than p_N according to whether dp_N/p_N is smaller than, equal to, or greater than dp_T/p_T.

The main effect of this new formulation of the wage equation is that the wage rate w becomes endogenous and its definition must be included in the system of equations. (22b) then becomes

$$(22c)\quad \begin{cases} C_T(Y,p_T,p_N) + Q_N(p_N,w) - W(p_T,p_N,w) + \dot{B}^d(Y,r_B) \\ \quad + \dot{M}^s - G - r_B B = 0 \\ Q_N(p_N,w) - C_N(Y,p_T,p_N) - G = 0 \\ - Y + W(p_T,p_N,w) + r_B B = 0 \\ w - ap_T - bp_N = 0 \end{cases}$$

The Jacobian of the system with respect to the endogenous variables is now

$$E = \begin{array}{cccc} dp_N & dY & dr_B & dw \end{array}$$

$$E = \begin{vmatrix} \frac{\partial C_T}{\partial p_N} + \frac{\partial Q_N}{\partial p_N} - \frac{\partial W}{\partial p_N} & \frac{\partial C_T}{\partial Y} + \frac{\partial \dot{B}^d}{\partial Y} & \frac{\partial \dot{B}^d}{\partial r_B} - B & \frac{\partial Q_N}{\partial w} - \frac{\partial W}{\partial w} \\ \frac{\partial Q_N}{\partial p_N} - \frac{\partial C_N}{\partial p_N} & - \frac{\partial C_N}{\partial Y} & 0 & \frac{\partial Q_N}{\partial w} \\ \frac{\partial W}{\partial p_N} & -1 & B & \frac{\partial W}{\partial w} \\ -b & 0 & 0 & 1 \end{vmatrix}$$

To determine the sign of E we expand it along its fourth row, and the resulting subdeterminants along their second rows respectively. Rearranging terms and substituting again $\partial C_N/\partial p_N = - \partial C_T/\partial p_N$ and $\partial C_T/\partial Y + \partial C_N/\partial Y + \partial \dot{B}^d/\partial Y - 1 = - \partial \dot{M}^d/\partial Y$ we get finally

$$E = [- b \frac{\partial Q_N}{\partial w} - (\frac{\partial Q_N}{\partial p_N} + \frac{\partial C_T}{\partial p_N})](- B \frac{\partial \dot{M}^d}{\partial Y} + \frac{\partial \dot{B}^d}{\partial r_B})$$

$$+ \frac{\partial C_N}{\partial Y} \frac{\partial \dot{B}^d}{\partial r_B} (\frac{\partial W}{\partial p_N} + b \frac{\partial W}{\partial w}).$$

E is negative if

a) $\quad - B \frac{\partial \dot{M}^d}{\partial Y} + \frac{\partial \dot{B}^d}{\partial r_B} < 0,$

b) $\quad - b \frac{\partial Q_N}{\partial w} - \frac{\partial C_T}{\partial p_N} > \frac{\partial Q_N}{\partial p_N},$ and

c) $\quad |b \frac{\partial W}{\partial w}| > \frac{\partial W}{\partial p_N},$

or, if $\partial W/\partial w > 0$, $E < 0$ if conditions a) and b) hold and also

(c2) $$[(- b \frac{\partial Q_N}{\partial w} - \frac{\partial Q_N}{\partial p_N} - \frac{\partial C_T}{\partial p_N})(- B \frac{\partial \dot{M}^d}{\partial Y} + \frac{\partial \dot{B}^d}{\partial r_B})] > \frac{\partial C_N}{\partial Y} \frac{\partial \dot{B}^d}{\partial r_B}(\frac{\partial W}{\partial p_N} + b \frac{\partial W}{\partial w}).$$

Of these conditions, a) is quite plausible, but the signs of b), c), and c2) are not so clear. E's negativeness is therefore, unfortunately, more or less an empirical matter, but we shall assume this sign to be true.

Differentiating (22c) with respect to p_T and $\dot{M}^s$ we have

$$\frac{d(22c)}{dp_T} = \begin{bmatrix} \frac{\partial C_T}{\partial p_T} - \frac{\partial W}{\partial p_T} \\ \frac{\partial C_T}{\partial p_T} \\ \frac{\partial W}{\partial p_T} \\ - a \end{bmatrix}, \quad \frac{d(22c)}{d\dot{M}^s} = \begin{bmatrix} 1 \\ 0 \\ 0 \\ 0 \end{bmatrix}.$$

The comparative static multipliers of this system are as follows:

a) $$\frac{dp_N}{dp_T} = \underset{-}{\frac{1}{D}}\{(\underbrace{- a \frac{\partial Q_N}{\partial w}}_{+} - \underbrace{\frac{\partial C_T}{\partial p_T}}_{-})(\underbrace{- B \frac{\partial \dot{M}^d}{\partial Y} + \frac{\partial \dot{B}^d}{\partial r_B}}_{-}) + \underset{+}{\frac{\partial C_N}{\partial Y} \frac{\partial \dot{B}^d}{\partial r_B}}(a \frac{\partial W}{\partial w} + \frac{\partial W}{\partial p_T})\},$$

$$\frac{dp_N}{dp_T} > 0 \text{ if } a \frac{\partial W}{\partial w} + \frac{\partial W}{\partial p_T} < 0 \text{ and}$$

$$- a \frac{\partial Q_N}{\partial w} - \frac{\partial C_T}{\partial p_T} > 0.$$

b) $$\frac{dY}{dp_T} = \underset{-}{\frac{1}{D}} \underset{+}{\frac{\partial \dot{B}^d}{\partial r_B}} [- \underbrace{\frac{\partial C_T}{\partial p_T}}_{-} \underbrace{(\frac{\partial W}{\partial p_N} + b \frac{\partial W}{\partial w})}_{-\text{ (see above)}} - \underbrace{\frac{\partial Q_N}{\partial w}}_{+}(a \frac{\partial W}{\partial p_N} - b \frac{\partial W}{\partial p_T})$$

$$+ \underbrace{(\frac{\partial Q_N}{\partial p_N} + \frac{\partial C_T}{\partial p_N})}_{+} \underbrace{(\frac{\partial W}{\partial p_T} + a \frac{\partial W}{\partial w})}_{-\text{ (see above)}}] \gtrless 0.$$

c) $$\frac{dr_B}{dp_T} = \underbrace{-\frac{1}{D}\frac{\partial \dot{M}^d}{\partial Y}}_{+}\{\underbrace{-\frac{\partial Q_N}{\partial w}}_{+}\underbrace{(b\frac{\partial w}{\partial p_T} + a\frac{\partial W}{\partial p_N})}_{+} + \underbrace{(\frac{\partial C_T}{\partial p_N} + \frac{\partial Q_N}{\partial p_N})}_{+}\underbrace{(-a\frac{\partial W}{\partial w} - \frac{\partial W}{\partial p_T})}_{+\text{ (see above)}}$$

$$+ \frac{\partial C_T}{\partial p_T}\underbrace{(b\frac{\partial W}{\partial w} + \frac{\partial W}{\partial p_N})}_{-\text{ (see above)}}\} \gtrless 0.$$

d) $$\frac{dw}{dp_T} = \frac{1}{D}\{[\underbrace{b\frac{\partial C_T}{\partial p_T}}_{+} - \underbrace{a(\frac{\partial Q_N}{\partial p_N} + \frac{\partial C_T}{\partial p_N})}_{-}](\underbrace{B\frac{\partial \dot{M}^d}{\partial Y} - \frac{\partial \dot{B}^d}{\partial r_B}}_{+})$$

$$+ \underbrace{\frac{\partial \dot{B}^d}{\partial r_B}}_{+}[\underbrace{\frac{\partial C_N}{\partial Y}}_{+}\frac{\partial W}{\partial p_T}(b-a)]\}.$$

Sufficient conditions for $dw/dp_T > 0$ are that

$$a(\frac{\partial Q_N}{\partial p_N} + \frac{\partial C_T}{\partial p_N}) > b\frac{\partial C_T}{\partial p_T} \text{ and } a > b.$$

We thus see that no definite conclusions can be drawn about the effects of a change in p_T on the endogenous variables.

e) $$\frac{dp_N}{d\dot{M}^s} = -\frac{1}{D}\cdot B\frac{\partial C_N}{\partial Y} > 0,$$

f) $$\frac{dY}{d\dot{M}^s} = -\frac{1}{D}B\underbrace{(\frac{\partial Q_N}{\partial p_N} + \frac{\partial C_T}{\partial p_N} + b\frac{\partial Q_N}{\partial w})}_{-\text{ (see above)}} < 0,$$

g) $$\frac{dr_B}{d\dot{M}^s} = \frac{1}{D}\{\frac{\partial C_N}{\partial Y}\underbrace{(\frac{\partial W}{\partial p_N} + b\frac{\partial W}{\partial w})}_{-\text{ (see above)}} - \underbrace{(\frac{\partial Q_N}{\partial p_N} + \frac{\partial C_T}{\partial p_N} + b\frac{\partial Q_N}{\partial w})}_{-}\},$$

$$\frac{dr_B}{d\dot{M}^s} < 0 \text{ if } \frac{\partial Q_N}{\partial p_N} + \frac{\partial C_T}{\partial p_N} + b\frac{\partial Q_N}{\partial w} > \frac{\partial C_N}{\partial Y}(|\frac{\partial W}{\partial p_N} + b\frac{\partial W}{\partial w}|).$$

h) $$\frac{dw}{d\dot{M}^S} = -\frac{1}{D}\, b\, B\, \frac{\partial C_N}{\partial Y} > 0.$$

The sign of $dr_B/d\dot{M}^S$ is more or less debatable, whereas those of $dp_N/d\dot{M}^S$ and $dw/d\dot{M}^S$ are according to expectations. The sign of $dY/d\dot{M}^S$ is, on the other hand, again a bit surprising, and should be examined more carefully.

We then see that the inclusion of the wage equation (23) into the model in some cases changed the results, but also, more importantly, made them more ambiguous. The results a)-h) should be regarded as of a tentative character only. Therefore we do not draw any conclusions as to the effects on the allocation of investment. We feel, however, that the model should be developed in this direction rather than using the simple wage determination mechanism of equation (A).

4. CONCLUSIONS

In this paper we have discussed a two-sector, small open economy model with two slightly different wage equations. The simpler version - with the standard "Scandinavian", in a sense long run wage equation - produced under certain assumptions the following results: international inflation, or equivalently exchange rate rises, would favour (in a resource allocation sense) the nontraded goods sector at the expense of the traded goods sector. This result is somewhat unexpected. A non-standard result was also that an increase in the supply of money would lower the N sector's price, and therefore its share in total investment. These results, however, are dependent on the assumptions made about the partial derivatives.

The second version of the model, with in our view a more realistic "short run" wage equation, unfortunately produced fairly ambiguous results. The clearest result was that an increase in the supply of money would favour the nontraded goods sector.

The simple model presented offers some insight into the allocation problems in a small open economy, but is in need of a few refinements to be fully usable. It seems especially important to make the assumptions about the investment behaviour of firms more realistic, including the possibility of equity and debt financing.

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