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AN ANALYSIS OF FINANCIAL MARKETS AND CENTRAL BANK POLICY: A FLOW-OF-FUNDS APPROACH TO THE CASE OF FINLAND

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3. AN ANALYSIS OF FINANCIAL MARKETS AND CENTRAL BANK POLICY: A FLOW-OF-FUNDS APPROACH TO THE CASE OF FINLAND*)

3.1. Background

The aim of this chapter is to present a theoretical model of the Finnish financial markets, the transmission mechanism of monetary policy and the effects of the various monetary policy measures. We consider the pursuit of macroeconomic stabilization goals when the economy faces various shocks which are real or nominal and arise in the international or in the domestic economy. The main of this chapter is, however, to present a macroeconomic model of the economy and the financial markets in Finland which is more extensive than the previous models and which also serves as a benchmark for the empirical model which has been specified and estimated in separate papers of the study.

Our theoretical model differs from the previous ones in Finland in several respects. First, we specify explicitly - in the tradition of the flow-of-funds approach - the budget constraints of the sectors, including the government budget constraint and a wider menu of assets and liabilities than what is typical. So, we incorporate in the model the equity market in the form of housing capital owned by the households. The housing capital is supplied by the firms, i.e. the housing investment is carried out by the firms. Secondly, we treat inflation and inflation expectations in a systematic way. The previous Finnish models are based on the idea of presenting a variation of the

*) This preliminary report is a chapter in a larger study, the aim of which is to build a macroeconomic model with the financial block based on the flow-of-funds approach.

standard fixed price IS-LM-model which would better fit in the Finnish institutions of the financial market with less developed asset markets and credit rationing in the bank loan market, see the penetrating analysis in this respect by Koskela (1976), Oksanen (1980), Willman (1981), and Kähkönen (1982). The later phase with a "developed" short-term money market is discussed e.g. by Johansson (1985) and Alho et al (1985), chapter 4.

Our theoretical model considers the following sectors of the economy: households, firms, banks, the central bank, government and the rest of the world. The markets in the model are: goods, housing capital, labour, bank deposits (time and demand deposits), domestic free rate market funds, bank loans to households and firms, government bonds, uncovered and covered foreign loans (net) and cash, or alternatively central bank debt of the banks.

Our method is to build a temporary general equilibrium model which also allows for credit rationing effects in the goods and financial markets. The accounting framework for the mutual consistency of the decisions of the sectors in the various markets is provided by the flow-of-funds matrix (presented in table 1 on page 18). In section 3.10. we also make some longer-run considerations with the aid of the model.

We first outline some of the main features and assumptions underlying the model. We assume throughout fixed (effective) exchange rate set by the monetary authorities.[1] Secondly, the central bank controls

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1) However, we allow for expectations concerning possible changes in the effective exchange rate in the next period. These are considered in section 3.3.

directly the average lending rate of the banks to which the deposit rate is tied by a mutual agreement of the banks. The bank loan and deposit rates are changed by a decision of the central bank and therefore they are a part of the policy tools of the central bank. This and the access of the banks to central bank finance at "high" rates, together with imperfect substitutability between domestic and foreign assets and liabilities as a consequence of the exchange regulation, give rise to the case for effective credit rationing in the bank loan markets. We further suppose that the banks can effectively operate as monopolists both in the loan markets of the households and the firms, there being no efficient (secondary) market where these two sectors would have adjusted imbalances between credit demand and supply arising from rationing carried out by the banks.

3.2. Behaviour of the sectors

The behaviour of the sectors is the following. Households allocate their beginning-of-period non-human wealth W^h and income Y^h to consumption C, to hold end-of-period housing stock (equal to the stock at the beginning of the period plus housing investment I_h during the period), cash H, time deposits D and government bonds B.[1)] The household sector does not to a large degree participate in the unregulated short-term money market grown vigorously recently in Finland. These markets contain the markets for domestic free rate funds, the forward exchange market and the call money market of the central bank for the

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1) We use capital letters to refer to nominal variables and lower letters for real variables with the exception of the volume of bank loans, labour input and capital stocks, where capital letters denote volumes.

call money deposits and loans of the banks. The households are supposed to accept all the credit L_h the banks are willing to extend to them at the regulated loan interest rate i_L. So the households are supposed to be off from their notional demand curve for credit, there is a permanent credit rationing in the bank loan market at the loan rate controlled by the central bank.

The real wealth of the households is

$$(1) \qquad w^h = W^h/P = (qK^h + H + D + B - L_h)/P \ .$$

Here q is the market price of a unit of the housing stock, K^h is the volume of the housing stock, and P is the domestic price level. We further treat the government bonds as short assets, they are supposed to have a fixed price and a variable coupon.

The flow of real income of the households is

$$(2) \qquad y^h = \frac{Y^h}{P} = \frac{WN(1-t) - i_L L_{h_{-1}}(1-t) + i_D D_{-1} + i_B B_{-1}}{P} + F_K K^h_{-1} + Y^b_{-1}/P.$$

The labour input is N, we suppose it to be determined by the demand for labour by the firms.[1)] The labour income, with W as the nominal wage rate, is taxed at an average tax rate t. The taxation of personal income is progressive, i.e. t' > 0. The nominal interest income from deposits and government bonds, with nominal interest rates i_D and i_B, is tax exempt, and the nominal interest (i_L) expenses on loans are tax deductible according to the Finnish tax laws. Interest income and

1) The labour demand function is simply specified to be N=N(y,W/P), where y is output. In our model the real wage W/P in terms of the domestic price level P is a constant, see more closely below.

expenses are based on beginning-of-period stocks. The last but one term on the right hand side is the rental income on the housing stock. The last term Y^b is the flow of income of the banks, supposed to be distributed in the next period to households. As implied by (2), the market for firm equity is not specified in our model because of its fairly limited role in the financing of the firm sector in Finland.

The budget constraint of the households requires that the value of all uses of funds equals the value of all sources of funds during each period. This condition can be written as follows:

$$(3) \qquad P_t w_t^h + P_t c_t = P_{t-1} w_{t-1}^h + P_t y_t^h + (q_t - q_{t-1}) K_{t-1}^h \ .$$

Let us denote by $\dot{p}_t$ the rate of inflation in period t, $\dot{p}_t = P_t/P_{t-1} - 1$, and approximate $(1+\dot{p}_t)^{-1}$ by $1-\dot{p}_t$. We can now write (3) as follows

$$(4) \qquad (w_t^h - w_{t-1}^h) + c_t = y_t^h - \dot{p}_t w_{t-1}^h + \frac{q_t - q_{t-1}}{q_{t-1}} \frac{q_{t-1}}{P_{t-1}} K_{t-1}^h \ .$$

It is appropriate to denote the right hand side as real disposable income y^{hd} of the households, it is equal to the flow of real income (y^h) less the net loss in the real value of net wealth with the (real) capital gains of the housing stock (equity) (the last term on the right hand side of (4) taken into account. On the left hand side of (4) we define saving (s_t) to be the increase in the real value of wealth $(w_t^h - w_{t-1}^h)$.[1)]

1) In this case we have followed the treatment of inflation by Papademos and Modigliani (1983).

We now specify the desired asset stocks of the households which refer to the components of the end-of-period real wealth w_t^h, see definition (1). The asset demand functions (5) are homogeneous of degree one in the price level, they can be expressed as a product of P and the real demand functions. The asset demands depend on the vector of nominal interest rates: i_K = rate of return on the housing stock (see more closely (30) on page 25), i_D, i_B, and a zero yield on cash. The real demand functions in (5) are homogeneous of degree zero in this vector of (after-tax) nominal rates of return. Because we can specify the asset demand functions to be functions of the expected real (after-tax) rates of interest, which we denote by r's, and the expected inflation rate $\dot{p}_e$, we have[1),2),3)]

$$
(5)\qquad
\begin{aligned}
H^d/P &= (w_{-1}^h + y^{hd})\,h(\underset{(-)}{r_K},\underset{(-)}{r_B},\underset{(-)}{r_D},\underset{(+)}{-\dot{p}_e},\underset{(+)}{L_h}) \\[1ex]
D^d/P &= (w_{-1}^h + y^{hd})\,d(\underset{(-)}{r_K},\underset{(-)}{r_B},\underset{(+)}{r_D},\underset{(-)}{-\dot{p}_e},\underset{(+)}{L_h}) \\[1ex]
qK^h/P &= (w_{-1}^h + y^{hd})\,k(\underset{(+)}{r_K},\underset{(-)}{r_B},\underset{(-)}{r_D},\underset{(-)}{-\dot{p}_e},\underset{(+)}{L_h}) \\[1ex]
B^d/P &= (w_{-1}^h + y^{hd})\,b(\underset{(-)}{r_K},\underset{(+)}{r_B},\underset{(-)}{r_D},\underset{(-)}{-\dot{p}_e},\underset{(+)}{L_h}) .
\end{aligned}
$$

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1) The expected inflation rate is derived in (26) below.

2) Here the loan stock (as well as the desired asset stocks) refer to end-of-period quantities.

3) The role of the (effective) credit constraint in the demand for assets equations is discussed more thoroughly in section 3.5. below.

This formulation of asset demands implies that we do not here consider slow adjustment towards the optimum, which is later on a key part in the empirical model. Note that these functions do not sum up to total wealth but to total wealth minus consumption. The functions h,d,k,b are supposed to have the normal properties of gross substitutability between the assets and the property $dz_i/dL_h \geq 0$, $z_i = h,d,k,b$, $\sum_i (dz_i/dL_h) \leq 1$.

The consumption equation is now the following

$$(6) \qquad c = (w^h_{-1}+y^{hd})(1-h-d-k-b)\ (\underset{(-)}{r_K},\underset{(-)}{r_B},\underset{(-)}{r_D},\underset{(+)}{-\dot{p}_e},\underset{(+)}{L_h}) .$$

The firms produce all the output y, $y = F(K^f,N)$, F being a constant returns to scale production function. The firms make investments i^f in the productive capital K^f, and they are supposed to build the housing capital which is then sold to the households at the market price q. On the financial side the firms hold demand deposits DD as well as the free rate funds (in net terms) MF at banks and acquire uncovered foreign loans eL_f^{for} and covered foreign loans F,where e is the exchange rate (price of foreign currency in terms of home currency). The firms are also supposed to accept all the loans L_f denominated in the home currency supplied by the banks at the regulated interest rate i_L set by the central bank to the banks.

The investment functions of the firms are specified to be[1)]

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1) The interest rate i in (7) refers to a weighted average of domestic regulated and unregulated rates and the foreign interest rate with fixed (last period) weights.

$$i^f = i^f(y, \frac{P}{W}(i-\dot{p}_e), L_f) \text{ and}$$
$$\quad (+) \quad (-) \quad (+)$$

(7)

$$i^h = i^h(\frac{q}{P}) \; .$$
$$(+)$$

In (7) y is total production in the economy, the second variable is the relative price of the factors. We further define W^f as the nominal wealth of the firms,

$$(8) \qquad W^f = PK^f + DD - MF - L_f - eL_f^{for} - F = PK^f + W^f_{fin},$$

where W^f_{fin} is net financial wealth of firms. The flow of real income y^f of the firms is as follows:

$$(9) \qquad y^f = y + (-WN - T_f - i_L L_{f_{-1}} - i_f eL^{for}_{f_{-1}} + i_c MF_{-1} - (i_f + f)F_{-1})/P \; ,$$

where T_f is firm taxes and f is the forward discount of the markka.

The <u>budget constraint of the firms</u> between uses and sources of funds is now

$$(10) \qquad P_t w^f_t + P_t(d\, K^f_{t-1}) = P_t y^f_t + P_{t-1} w^f_{t-1} + (P_t - P_{t-1})K^f_{t-1} + (q_t - P_t)i_h.$$

On the left hand side d is the depreciation coefficient of fixed capital and on the right hand side we have the capital gains on fixed and housing capital.[1] Dividing both sides by P_t we get

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1) Note that we omit here dividens on firm equity, and assume that all profits are retained in firms.

$$(11) \qquad (w^f_t - w^f_{t-1}) + dK^f_{t-1} = y^f_t - \dot{p}_t w^f_{t-1} + \dot{p}_t K^f_{t-1} + (q_t/P_t - 1)i_h \ .$$

Let us define the right hand side of (11) to be the real disposable (gross) income of firms y^{fd} which consists of the flow of real profits y^f_t plus the net increase in the value of the real wealth of the firms. We can further easily see from (11) that the real capital gains consist of the capital gains related to housing investment less the decrease in the real value of the financial assets (less liabilities).

The investment functions have been stated above in (7) investment being determined in the first stage of the decision making of the firms. So we are left with the financial decisions which are described by the functions[1)]

$$(12) \quad \begin{aligned}
DD/P &= (w^f_{fin_{-1}} + y^{fd} - i^f)dd(\underset{(-)}{r_c}, \underset{(-)}{r_f+\dot{e}}, \underset{(-)}{r_f+f}, \underset{(+)}{-\dot{p}_e}, \underset{(+)}{y}, \underset{(+)}{L_f}) \\
MF/P &= (w^f_{fin_{-1}} + y^{fd} - i^f)mf(\underset{(+)}{r_c}, \underset{(-)}{r_f+\dot{e}}, \underset{(-)}{r_f+f}, \underset{(-)}{-\dot{p}_e}, \underset{(-)}{y}, \underset{(+)}{L_f}) \\
-eL^{for}_f/P &= (w^f_{fin_{-1}} + y^{fd} - i^f)lf(\underset{(-)}{r_c}, \underset{(+)}{r_f+\dot{e}}, \underset{(-)}{r_f+f}, \underset{(-)}{-\dot{p}_e}, \underset{(-)}{y}, \underset{(+)}{L_f}) \\
-F/P &= (w^f_{fin_{-1}} + y^{fd} - i^f)f(\underset{(-)}{r_c}, \underset{(-)}{r_f+\dot{e}}, \underset{(+)}{r_f+f}, \underset{(-)}{-\dot{p}_e}, \underset{(-)}{y}, \underset{(+)}{L_f}) \ .
\end{aligned}$$

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1) Here i_c is the rate on market funds, i_f+f is the rate on covered foreign loans f being the forward discount of the markka, and $i_f+\dot{e}$ is the rate on uncovered foreign loans, $\dot{e}$ being the expected change in the effective exchange rate.

Here y represents the usual transactions motive in asset demand. These asset demand functions are also assumed to satisfy the usual gross substitutability properties.

The government has real outlays g and collects nominal taxes T which are

(13) $$T = t(WN - i_L L_h) + T_f \; .$$

The personal income taxation is progressive, as mentioned above. The budget deficit of the government, is financed either by issuing bonds or by borrowing abroad.[1] According to the normal Finnish case there is no central bank borrowing by the government. So the nominal supply of bonds is

(14)
$$B/P = (B/P)_{-1} + \alpha(Pg + i_B B_{-1} + i_f eL^{for}_{g_{-1}} - T - P\pi_{cb_{-1}})/P - \dot{p}(B/P)_{-1}), \; 0 \leq \alpha \leq 1 \quad \text{and}$$
$$eL^{for}_g/P = (eL^{for}_g/P)_{-1} + (1-\alpha)(Pg + i_B B_{-1} + i_f eL^{for}_{g_{-1}} - T - P\pi_{cb_{-1}})/P - \dot{p}(eL^{for}_g/P)_{-1}$$

Here the term in parenthesis is government deficit (Def_g), T being total nominal taxes.

The banks accept all the deposits the private sector is willing to hold at the ruling deposit rate (i_D for time deposits, zero for the demand deposits, i_c for free rate funds). The banks have three assets: loans to households and to firms and central bank debt CBD

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1) Here we assume that the government does not borrow from the short-term money market which could, however, be easily incorporated in the model. We also assume that the government does not hold any deposits. In (14) we also assume that the profit of the central bank (see table 1) is distributed to the government in the next period.

(as a negative asset). The distinction between loans to households and firms is a key part of our model. We have discussed the allocation of the bank loans into these two categories more thoroughly in another paper, Alho (1985a). On the basis of those considerations we only note here shortly that these two categories differ from each other in the respect that the firms give rise to other revenues of the banks than the interest revenues and the households supply the bulk of the funds of the banks. The balance sheet of the banking sector is

$$(15) \qquad L_h + L_f^T = D + DD + MF + NFD + CBD \ ,$$

where L_f^T includes the loans extended by the banks to firms denominated both in domestic currency (L_f) and in foreign currency. By NFD, the net foreign debt of the banks, the banks finance the foreign currency loans (net) channelled by them to domestic firms[1] and the foreign loans raised by the banks to cover their net position in the market for forward exchange. The foreign exchange regulation in Finland does not allow the banks to have an open position against the markka in the currency market. So we have an identity for the net forward exchange position of the banks,

$$(16) \qquad F_{cb} + F_b + F = 0 \ ,$$

where F_{cb} is the invervention (stock of purchases) of the Bank of Finland in these markets and F_b is the net forward position of the banks. By inserting this into (15) we get as the <u>balance sheet of the banks</u>

$$(17) \qquad L_h + L_f - CBD = D + DD + MF - F_{cb} - F \ .$$

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1) These are included in the foreign loans eL_f^{for} considered above in (12).

The intervention of the central bank in the forward market is naturally a policy tool, and the forward position F of the firms has already above been specified in (12). The deposits at banks are determined by the demand for deposits by the non-bank private sector, see, however, section 3.5 below.

We specify here without much theoretical reasoning, which is given more thoroughly in Alho (1985a), the asset demand equations of the banking sector to be initially[1]

$$
\begin{array}{lll}
 & L_h & = W_b\, l^h(\underset{(+)}{i_L}, \underset{(-)}{i_D}, \underset{(-)}{i_m}) \\[2ex]
(18) & L_f & = W_b l^f(\underset{(?)}{i_L}, \underset{(+)}{i_D}, \underset{(-)}{i_m}) \text{ and} \\[2ex]
 & -CBD & = W^b(\underset{(-)}{i_L}, \underset{(+)}{i_D}, \underset{(+)}{i_m})
\end{array}
$$

where $W^b = D+DD+MF-F_{cb}-F$. Let $i_{cb}(CBD)$ be the interest cost function on the central bank debt of the banks with $i'_{cb} = i_m$ being the marginal interest rate on the central bank debt. Here we have taken the view that the net forward position of the banks, determined as shown in (16) by the behaviour of the firms and the central bank, is a perfect substitute for the central debt of the banks, for reasons discussed shortly below (and more thoroughly in Alho (1985a)). The signs of the partial effects of the interest rates in (18) need an explanation. We assume that an increase in

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1) In section 3.6. we have to constrain these functions further.

the loan rate increases loan supply to households but reduces the loans to the firms[1]. On balance total loans increase. The effects of an increase in the deposit rate are opposite to the effects of the loan rate.

The flow of income of the banks is $Y^b = i_L(L_h + L_f) - i_D D - i_c MF - i_{cb}(CBD) - i_f F_b$. This is distributed to households in the next period.

The balance sheet of the central bank, Bank of Finland is

$$(19) \qquad A_{cb}^{for} + CBD = H ,$$

where A_{cb}^{for} is the net foreign assets of the central bank and H is the base money, supposed to be held only by the households.

The central bank sets either a rising ($i_m^{'} > 0$) or a flat interest rate schedule ($i_m^{'} = 0$) for the banks on their central bank debt.

The foreign sector supplies with perfect elasticity the import goods, the volume of which is m, demanded by the home economy. The demand for imports depends on the level of production and the relative price of the import goods in terms of the domestically produced good,

$$(20) \qquad m = m^d(\underset{(+)}{y}, \underset{(-)}{\frac{eP_f}{P}}) ,$$

where P_f is the price of the foreign goods.

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1) This is explained more thoroughly in Alho (1985a). In short, these effects depends on the fact that households - contrary to the firms - do not give rise to other revenues than interest revenues and that the bulk of the expenses of the banks are related to deposits of the households.

The volume of exports x depends on the supply price between export goods and domestic costs and the world demand (world output) y_w. So we have

$$(21) \qquad x = x(\underset{(+)}{y_w}, \underset{(+)}{\frac{eP_f}{W}}) .$$

In the goods market we in fact distinquish three goods, our export goods (x), the import good (m) and the domestically produced good sold to the domestic market. We do not, however, have separate prices for export and import goods but suppose them to be equal to the international price level. Therefore the equilibrium condition for the domestic production is

$$(22) \qquad y = c+i^h + i^f + g + \frac{eP_f}{P} (x-m)$$

Foreign loans are supposed to be supplied to the home economy with perfect elasticity at the international interest rate i_f.

3.3. Determination of the domestic prices

In general, there are n assets (one of them base money) in a macro model, n-1 interest rates and at least one real asset (goods), the endogeneous variable for this market being either the level of output or the price level. Further, we have the labour market with either the wage rate or the level of unemployment as the market clearing variable. Of the n-1 interest rates some may be fixed, usually at least the deposit rate is such. These fixed price markets can typically be solved as a residual block in the model because they are always in equilibrium, so that supply in these markets is perfectly elastic and determines the price, and demand determines the quantity in the market solution. Of these in all n+2 markets only n+1, because of Walras' law, produce independent market clearing conditions with n+1 endogeneous variables (prices). As a consequence, one market (either financial (asset) or goods or labour market) can be omitted from the solution of the system. If we omit one asset market, we can think about that the price level is determined by the goods market equilibrium if we stick to the classical view of full employment of productive resources.[1] If we omit the goods market, the price level can be determined in the classical version by the equilibrium between demand for and supply of base money.

With respect to the prices and the inflation rate we have in our model as endogeneous variables the wage rate W, the domestic price level P, and its rate of change, i.e. domestic inflation rate $\dot{p}$, and the expected inflation rate $\dot{p}_e$. We take the domestic wage level W to be largely determined by actual domestic price developments so that there is a sort of real wage rigidity in the labour market (this is analyzed more thoroughly in building of the wage-price sector of the model in Alho (1985b)). We specify

$$(23) \qquad W = \beta e P_f g(y/y^*), \; g' > 0, \; g(1) = 1.$$

Here β represents the target or existing real wage level at the "full employment" or natural rate of unemployment level of output y^*. In (23) we have linked the wage rate to the international price level, which is (at least in a longer-run) the relevant specification in a small open economy.

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1) It is interesting to note that the view of the goods market as a market in equilibrium seems to have been the original idea of Keynes (1936) in contrast to the standard "Keynesian" view, as Malinvaud (1977) has argued.

In Keynesian models both the price level P and the wage rate W are usually considered to be fixed, exogeneous variables in the model. We assume in this spirit that the domestic prices are determined by a mark-up pricing on the basis of the foreign prices P_f and the domestic wage costs W:

$$(24) \qquad P = (eP_f)^a W^{1-a} \ , \ 0 < a < 1 \ .$$

Using this and (23) we can now write the domestic price level in terms of foreign,

$$(25) \qquad P = \beta' e P_f \ g(y/y^*) \ .$$

In monetary models, where the price level is "flexible" and determined by the equality between money demand and money supply in the manner just described, the rate of inflation needs an equation of its own. This is typically an expectations augmented Phillips curve. Still another equation is needed for the inflation expectations which can be either exogeneous as in Tobin (1982) or rational as in the large model of Papademos and Modigliani (1983).

We now derive the formation of the inflation expectations. We first write the wage equation (23) and the price equation (24) for the next period t+1. Then we are able to write the inflation expectations prevailing in period t (the expected change in the logarithmic price level) after some manipulation as follows,

$$(26) \qquad \dot{p}_{e,t} = \log(P^e_{t+1}/P_t) = \log(e^e_{t+1}/e_t) + \log(P^e_{f,t+1}/P_{ft}) + g'(\log(y^e_{t+1}/y_t) - k) \ .$$

Here k is the trend or full employment rate of growth of output, assumed to be a constant. In order to be able to solve the model we have to be able to determine the dependence of inflation expectations on the level of current period output. We have here made the assumption of "asymptotic rational expectations" which is applied in two ways.

First, we have the purchasing power condition that in the long run the real exchange rate eP_f/P is a constant. This gives us the result that if the domestic output expands through expansionary policies, it at the same time raises the domestic price level in relation to the foreign and so gives rise to expectations of a future devaluation. On the other hand, there is the long run condition that output must be at the natural rate level, or at the full employment level. This means that expansionary policies give rise to expectations of future restrictive policies, which dampens the inflationary expectations. On balance, we are uncertain which is the net effect of these two factors. Here we have adopted the evidently more probable case that inflation expectations are raised through an increase in the present period output. More formally we have:

$$(27) \qquad \frac{\partial \dot{p}_{et}}{\partial y_t} = g' \left(\frac{\partial \log e^e_{t+1}}{\partial (P_t/P_{ft})} - (1-b)\right) > 0 \ .^{1)}$$

where $b = \partial y^e_{t+1}/\partial y_t$ which we assume to be positive but less than one.

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1) Because the expected change in the effective exchange rate, $\dot{e}=\log(e^e_{t+1}/e_t)$, is a variable which has an effect on investment i^f and the portfolio decisions of the firm sector, we should also specify the formation of these expectations. We have here for simplicity assumed that $\dot{e}=h(P_t/P_{ft})$, $h'>0$.

Table 1. The flow-of-funds matrix of the model, in real flows.[1)]

Markets	Sectors: Households (H)	Firms (F)	Banks (B)	Public sector (G)	Central bank (CB)	Foreign sector (FOR)	Σ	Within period endogeneous variable
(1) Labour	wN	$-wN$	0	0	0	0	0	N
(2) Interest income net (real)	$r_D D_{-1} + r_B B_{-1}$ $-\dot{p}H_{-1} + F_K K^h_{-1}$ $-r_L L^h_{-1}$	$-r_L L^f_{-1} - r_f e L^f_{for,-1}$ $-\dot{p}DD_{-1} + r_c MF_{-1}$ $-(r_f+f)F_{-1}$	$\pi_B = r_L(L^h+L^f)_{-1}$ $-r_{D-1}D - r_{cb}(CBD)$	$-r_B B_{-1}$ $-r_f e L^g_{for,-1}$	$\pi_{cb} = r_{cb}(CBD)$ $+\dot{p}H_{-1} + r_f e A^{cb}_{for,-1}$	$-er_f(A^{cb}_{for,-1}$ $+L^f_{for,-1}+L^g_{for,-1})$	0	..
(3) Dividends	π_B	0	$-\pi_B$	π_{cb}	$-\pi_{cb}$	0	0	..
(4) Capital gains (real)	$(\Delta q/q_{-1}-\dot{p})K^h_{-1}$ $-(q/P-1)i_h$	$(q/P-1)i_h$	0	0	0	0	0	..
(5) Transfers	$-T_h/P$	$-T_f/P$	0	$(T_h+T_f)/P$	0	0	0	..
(6) Goods	$-c$	$y-(i^h-i^f)$	0	$-g$	0	$\frac{eP_f}{P}(m-x)$	0	y
Σ_{1-6} = Net lending	nl_h	nl_f	0	nl_g	0	$-ca$	0	
(7) Cash	$A^h_H(.) - H_{-1}/P$	0	0	0	$-A^{cb}_H > A^h_H(\cdot)$	0	0	H
(8) Demand dep.	0	$A^f_{DD}(\cdot) - DD_{-1}/P$	$-A^b_{DD} > A^f_{DD}$	0	0	0	0	DD
(9) Time dep.	$A^h_D(\cdot) - D_{-1}/P$	0	$-A^b_D > A^h_D$	0	0	0	0	D
(10) Gov. bonds	$A^h_B(\cdot) - B_{-1}/P$	0	0	$-\theta_B nl_g$	0	0	0	i_B
(11) Housing cap.	$A^h_K(\cdot) - qK^h_{-1}/P$	$(q/p)i_h$	0	0	0	0	0	q
(12) Free rate funds	0	$A^f_{MF}(\cdot) - MF_{-1}/P$	$-A^b_{MF} > A^f_{MF}$	0	0	0	0	$MF, i_{MF} = i_m$
(13) Cb debt	0	0	$-A_{CBD}(\cdot)+CBD_{-1}/P$	0	$A^{cb}_{CBD}(\cdot) = -A^b_{CBD}(\cdot)$	0	0	i_m, CBD
(14) Bank loans (-)	$-A^h_L(\cdot) \geq A^b_{LH}(\cdot)$	$-A^f_L(\cdot) \geq A^b_{Lf}(\cdot)$	$A^b_{Lh}(\cdot) + A^b_{Lf}(\cdot)$	0	0	0	0	A^b_{Lh}, A^b_{Lf}
(15) For.uncov. loans	0	$-eL^{for}_f(\cdot) + eL^{for}_{f,-1}/P$		$-\theta_F nl_g$	$A^{for}_{cb} - A^{for}_{cb,-1}/P$	$-ca$	0	A^{for}_{cb}
(16) For. cov. loans	0	$-A^f_{CF}(\cdot) - F_{-1}/P$	$F_b - F_{b,-1}/P$	0	$F_{cb} - F_{cb,-1}/P$	0	0	$F_b, f = i_m - i_f$
Σ_{7-16} = Net lending	nl_h	nl_f	0	nl_g	0	$-ca$	0	

1) We have used a shorter notation for the demand functions than above, the symbol $A^i_j(.)$ refers to the demand for the real stock of asset j by sector i, or as a negative asset either to the supply of an asset or demand for a liability. The symbol ">" refers to the case of a supposed disequilibrium in this market. For shortness, we have in some places omitted from a demand or supply flow the lagged stock, but instead of this, all entities in the table refer to flows, ca is the current account in real terms and f is the forward discount of the markka.

We now write (26) as follows

(26)' $\dot{p}_e = \dot{p}_f + G(y/y^*)$, $G' > 0$, $G(1) = 0$.

3.4. The full flow-of-funds model

We now turn to consider the whole model. We have condensed the full system in the flow-of-funds matrix presented in table 1. We have already above discussed the assumptions concerning the functioning of the labour and goods market, which are essentially Keynesian in nature. Of these and the ten financial markets one can be deleted, as mentioned above, and we are left with 11 markets. Of the ten financial markets we first go through those markets which reach equilibrium so that at the current price (interest rate) the supply is perfectly elastic and the quantity is determined by the notional demand. These markets do not at all affect the solution of the endogeneous interest rates and they can be handled in a recursive manner after the solution of the simultaneous block of markets.

In our model markets of this recursive type are the market for cash, in contrast to the standard treatment of it [1)], the two deposit markets in the standard manner and the market for unregulated rate funds, as well as the forward market for foreign exchange and the market for foreign loans. Because of arbitrage, we assume that the

---

1) In Finland cash is supplied through the central bank debt of the banks. Recently such a change has been made in this system that the banks can hold the cash they need for their transactions without paying any interest on this.

rate on unregulated rate funds is determined completely by the marginal interest rate of the central bank finance of the banks (see on this more closely Alho et al (1985), chapter 4.2.). At this interest rate the banks are willing to accept all the unregulated rate deposits (net) which the non-bank private sector is willing to hold.

With respect to the forward market for foreign exchange we are inclined to argue that the unregulated short-term money market in Finland consisting of the forward market for foreign exchange, the market for domestic free rate funds and the call money market of the Bank of Finland are linked to each other so that the call money rate is a reference rate for the two other markets. So we can consider these two to belong to the category of residual markets. The forward discount of the markka is simply $f = i_m - i_f$.[1)]

So in fact we are left with the following markets: goods, housing capital, government bonds, central bank debt of the banks, bank loans (now for a moment not to be disaggregated into household and firm loan submarkets), of which one can be omitted because of Walras' law. Let this be the loan market. The endogeneous variables in this four-market system would be output y, the bond rate i_B, the rate on the central bank debt i_m and the price on housing equity q (or i_K). So, superficially it would seem that we have a case where, irrespective of the fixed loan rate, there are enough free variables in the model to guarantee a true equilibrium in the financial and goods markets. This is not, however, correct and we have to formulate the solution of the model in a way which differs from the standard.

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1) See Alho (1985a) and Johansson (1985) for a derivation of these results.

3.5. Credit rationing and its consequences on the specification of the bank loan and deposit markets

Let us therefore take a bit closer look at how we come to the credit rationing situation and how we must treat the solution of the model in this case. We can already at the outset mention that the solution to the problem sketched just above is the fact that the interest rate on the central bank debt of the banks cannot play a similar market clearing role in the system as the other interest rates.

Take the simplest possible case of a closed economy with private non-bank sector, the banks and the central bank. The balance sheets are the following (using the notation presented above),

	$H + D = L$	private non-banking sector
(28)	$L = D + CB$	banks
	$CB = H$	central bank.

Let us first take the case where there is no "market" for central bank debt, and the central bank fixes the supply of base money H exogeneously. Let further the private non-bank sector be on its notional demand curve for deposits at the fixed interest rate on deposits. Now it is easy to see that a freely floating loan rate of interest i_L clears the two remaining markets, the markets for cash and bank loans.

Let us next transform the market for central bank debt of the banks to the Finnish case with either a flat interest rate set by the central bank (the present call money market system) or with a rising penalty interest rate schedule (the former system in Finland), and let us further suppose that now the loan rate is fixed. If we assume that the non-bank private sector is at its notional demand curves for deposits and base money, we can quite easily infer that the system operates in the following manner.

The central bank debt is determined by the demand for base money by the public which can be taken as fixed because the relevant interest rates are now fixed. On the basis of the volume of the central bank debt we can calculate the marginal interest rate i_m on it. Next we can solve the loan supply of banks from their balance sheet, $L^s = D+CB = D^d+H^d$. This is the same as the demand for credit by the public because $L^d = D^d+H^d$. So it would appear to be the case that the financial markets would reach an equilibrium through the central bank interest rate, irrespective of the fixed loan rate. This is of course one possibility in reality. But the second, and more realistic, possibility is that the banks would be in the solution just described off from their notional supply credits of curve. This is simply so because at the ruling interest rate on their central bank debt the banks find it unprofitable to extend their credits up to the point $L^s = L^d = D^d+H^d$.

The solution to this problem is that we suppose the banks to be able to determine the solution in the loan markets so that it is on their notional supply of credit curve, and that the public has to decide its portfolio investments in a constrained way. So, because of the binding credit constraint, the demand for deposits and the demand for base money, or at least one of them, has to depend on the volume of the loan supply in the constrained equilibrium.

The bank(s) are aware that by increasing their loan supply the private sector is also willing to hold more deposits at the banks. This is the basis for the deposit multiplier analyzed in connection with the loan supply behaviour of the banks in Finland extensively by Oksanen (1977). From the point of view of the private sector the rationale for this kind of behaviour is the fact that the shortage of credit can be (partly) compensated by running down liquid funds.[1)] Another way to express this is to say that an effective credit constraint imposes a shadow price for credit which is higher than the regulated rate. This then causes that the opportunity cost of holding deposits and money rises with the normal substitution effects of a rise in the price of a good, see Neary and Roberts (1980) for a theoretical discussion of rationing and its price and income effects in the case of consumer theory (see also the discussion on this in Alho (1983). So, we have to include in the model also the (dis)equilibrium condition for the loan market.

3.6. The solution of the model; preliminaries

We now turn to solving the model. As stated above, we are left with the following market "clearing" conditions,[2)]

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1) The demand for assets equations in section 3.2. were specified according to this idea.

2) In this formulation we have already substituted away the equation for the wage rate, r is the vector of real interest rates in equations (5), see next page.

$$-c(y^{hd},\bar{r},L_h) - i^h(q/P) - i_f(y, \frac{P}{W}(i-\dot{p}_e), L_f) - \frac{\dot{e}P_f}{P}(x-m) + y = 0$$ (goods market)

$$A_K^h(y^{hd},\bar{r},L_h) - (q/P)K_{-1} - (q/P)i_h = 0^{1)}$$ (housing market)

$$A_B^h(y^{hd},\bar{r},L_h) + \theta_B Def_g = 0$$ (bond market)

$$L_h^s(W_b,i_L,i_D,i_m) - L_h = 0$$ (the household loan market)

(29) $$L_f^s(W_b,i_L,i_D,i_m) - L_f = 0$$ (the firm loan market)

$$i_m - i_m(L_h+L_f-W_b) = 0 \; .$$ (the market for central bank finance of the banks)

$$P-\beta' eP_f g(y/y^*) = 0$$ (the price level)

$$\dot{p}_e - \dot{p}_f - G(y/y^*) = 0$$ (inflation expectations)

The optimixation problem of a bank is described more thoroughly in Alho (1985a). Anyway, we can see from the sixth equation in (29) that the desired central bank debt depends, on the one hand, on the behaviour of the banks and, on the other hand, partly on the behaviour of the private sector. We can, however, find cases where the behaviour of the private sector, primarily its willingness to hold deposits, does not have any effect on the loan supply behaviour of the banks, and this we are going to do in section 3.8. in order to be able to solve the otherwise quite unmanageable model (29).

The asset demand functions, as well as the real expenditure functions, include as explanatory variables the (real) rates of return of the

---

1) The asset demand functions are here denoted by the symbols used in table 1.

various assets. We have shortly denoted by $\bar{r}$ in (29) the following vector of expected real interest rates,

$$\bar{r} = (r_K, r_B, r_D, -\dot{p}_e), \; r_j = i_j - \dot{p}_e \; .$$

Of these the rate of return on housing capital needs some elaboration. In real terms the expected rate of return on a unit of housing capital is the following (taxes being here omitted)

$$(30) \qquad r_K = F_K(q/P)^{-1} + \dot{q}_e - \dot{p}_e \; ,$$

where F_K is the rental on a unit of housing capital, assumed here to be largely a constant. We suppose that $\frac{\partial r_K}{\partial q} < 0$, i.e. that elasticity of the expected future price q^e_{t+1} with respect to the present price is less than unity in order to be able to derive the "usual" properties of macroeconomic models.

We now turn to consider the solution of the system with endogeneous variables y, i_K(or q), i_B and L_h, L_f and i_m. The credit rationing effects cause problems in the analysis of (29) because these effects often go into opposite direction than the price effects. For instance, an increase in the bond rate increases the demand for bonds, but on the other hand, by releasing funds from deposits, it also decreases the loan supply which decreases the effective demand for bonds. We can, however, on good grounds think that the latter effect is smaller than the former. The signs of the Jacobian of (29) are presented in (31). It is a very complicated task to try to find in this kind of a large simultaneous system the effects of various policy measures. We would get a much more clear-cut system if we could discard the effects running from demand for deposits to loans and further to expenditures. In fact, this can be done in the case where the central bank debt of the banks is organized in the present call money market system with no rising penalty interest rate schedule, see more closely on this Alho (1985a).

$$(31) \qquad A_0 = \begin{bmatrix} + & + & + & + & + & + & + & - \\ + & + & - & - & 0 & 0 & + & - \\ + & - & + & - & 0 & 0 & + & - \\ + & - & - & + & + & - & - & - \\ + & - & - & + & + & - & - & - \\ + & - & - & - & - & + & - & - \\ - & 0 & 0 & 0 & 0 & 0 & 1 & 0 \\ - & 0 & 0 & 0 & 0 & 0 & 0 & 1 \end{bmatrix} \quad \begin{array}{ll} dy & \text{goods} \\ di_K & \text{housing capital} \\ di_B & \text{bonds} \\ -dL_h & \text{household loans} \\ -dL_f & \text{firm loans} \\ di_m & \text{central bank debt} \\ dP & \text{price level} \\ d\dot{p}_e & \text{inflation expectations} \end{array}$$

The result that the matrix A is a dominant diagonal matrix is usually encountered in the asset demand systems with gross substitutability properties, as is the case in the model of Tobin (1982). This property would give us the result that the determinant of A is positive. To ensure this we should have positive diagonal elements, one column with nonnegative elements (here the first) referring to the income effects, and positive column sums.[1] The other off-diagonal elements except those in the first row and column should be negative. In the matrix A in (31) these conditions are satisfied with respect to the reduced

1) See Tobin and Brainard (1967) in Tobin (1971), pages 319-320.

system of the goods, housing and bond markets, i.e. the upper left corner 3x3 matrix, which is (supposed to be) a dominant diagonal matrix.[1)]

Because of these difficulties related to the analysis of the system (31), we are going to constrain the model further.

3.7. An IS-LM fixed price version of the model

It is useful to try to illustrate some properties of the above model by transforming its fixed price and fixed (or zero) inflation expectations version into an IS-LM-type model. Here we substitute away endogeneous variables of the model so that the model is reduced to only two equilibrium conditions, those for goods market and for the market for central bank debt of the banks and then solve for dy and di_m, i.e. we form IS- and LM-curves in the context of our model. We keep prices P and wages W now as fixed and $\dot{p}_e$ is thus zero. The locus of the IS-curve is now as follows,[2)]

---

1) In (31) we have reasoned that the loan stocks are in effect complements to each other from the point of view of the bank. This mechanism is as follows. An increase in the loan supply to the firms has two kinds of effects on the loan supply to the households which are opposite to each other. First, it causes a reduction through a tightening of the central bank position of the bank, and secondly, it causes an increase in the loan supply through the deposit multiplier. We have made the assumption that on balance an increase in the loan supply to the firms also increases that to the households which is also in broad consistency with the data, see Alho (1985a).

2) Here the partial derivatives $\partial q/\partial i_m$ etc. refer to the coefficients between the endogeneous variables when the model is reduced to a two-equation model. These are of the following sign $\partial q/\partial i_m < 0$, $\partial i_b/\partial i_m > 0$, $\partial q/\partial y > 0$, and $\partial i_b/\partial y < 0$.

$$(32) \qquad \left.\frac{dy}{di_m}\right|_{IS} = \frac{\dfrac{\partial td}{\partial i_m} + \dfrac{\partial td}{\partial q}\dfrac{\partial q}{\partial i_m} + \dfrac{\partial td}{\partial i_B}\dfrac{\partial i_B}{\partial i_m}}{1 + \dfrac{\partial m}{\partial y} - \dfrac{\partial td}{\partial y} + \dfrac{\partial td}{\partial q}\dfrac{\partial q}{\partial y} + \dfrac{\partial td}{\partial i_B}\dfrac{\partial i_B}{\partial y}} < 0 .$$

Here td is total domestic demand in the goods market, td = $c+i^h+i^f+g+x$. There is ambiquity related to the signs of the partial derivatives of total demand with respect to q (alternatively i_K) and i_B, but we can on good grounds suppose that the former is positive and the latter negative. We can also find that the slope of the IS-curve is flatter when we allow for the markets for government bonds and housing capital, than without these markets. This is so because, first, an autonomous change in y increases total demand through its effects in the markets for housing and bonds by lowering the rates of return on these markets. So the traditional multiplier (the denominator in (32)) is bigger. And secondly, an autonomous change in i_m reduces demand directly through the credit supply channel, but in addition to this, it raises the rates of return in the bond and housing markets.

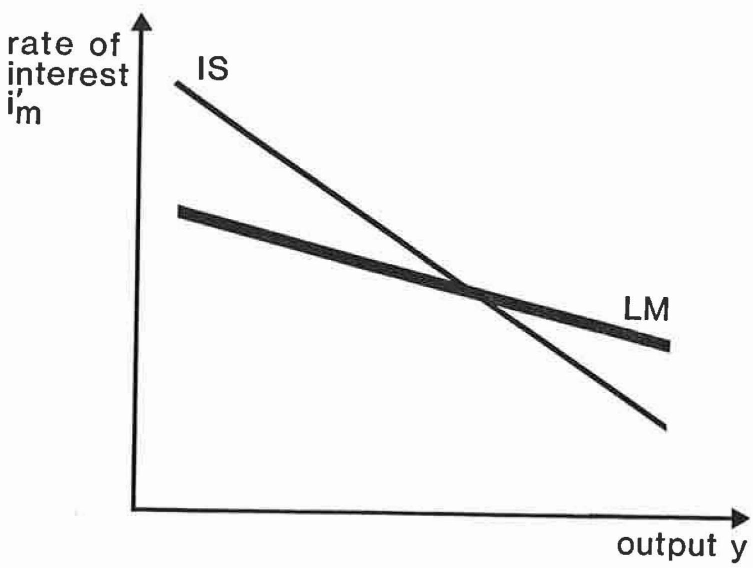
Let us now turn to derive the LM-curve. From the sixth line of the matrix (31) we get

$$(32') \qquad \left.\frac{di_m}{dy}\right|_{LM} = \frac{\left[\dfrac{\partial CBD}{\partial y} + \dfrac{\partial CBD}{\partial q}\dfrac{\partial q}{\partial y} + \dfrac{\partial CBD}{\partial i_B}\dfrac{\partial i_B}{\partial y}\right] i_m'}{1 - \left[\dfrac{\partial CBD}{\partial i_m} - \dfrac{\partial CBD}{\partial q}\dfrac{\partial q}{\partial i_m} - \dfrac{\partial CBD}{\partial i_B}\dfrac{\partial i_B}{\partial i_m}\right] i_m'} .$$

We take the denominator to be positive because otherwise an increase in the marginal interest rate the central bank debt i_m would not reduce the excess demand in that market. The nominator can a priori be of both signs. If $\frac{\partial CBD}{\partial y}$ is negative then we certainly have a downward sloping LM-curve. If the loan supply of the banks does not react at all to the real side of the economy, and a shift in output and income raises the demand for deposits (which is satisfied by an inflow of foreign capital), the central bank debt of the banks diminishes.

If the LM curve is downward sloping, see figure 1, this means that there has been some sort of automatic monetary accomodation in the system which tends to magnify the consequences of shocks which take place in the goods market. Suppose that there is an increase in the total demand which raises income and the demand for deposits and causes a capital inflow. This would lower the central bank debt of the banks which would raise their loan supply and this would raise the economic activity still further. This awkward situation has been eliminated to some extent through the change in May 1983 from the former quota system to the present call money market system in the market for central bank finance of the banks.

Figure 1.



3.8. A recursive version of the flexible price model: the present call money market system

The solution of the general model in (29) is a very awkward. So we have decided to concentrate on a simpler version of the model which is in fact a rough description of the present Finnish financial system with the call money market for the central bank debt of the banks. In this case $i_m' = 0$.[1] If we further assume profit maximization as the only goal of the banks, see Alho (1985a) for details, we get the result that the loan supply of the banks does not at all depend on the volume of deposits. So, in this case we can replace the fourth, fifth and sixth equation in (29) by the following ones

$$
\begin{array}{lll}
 & L_h^S(\underset{(+)}{i_L}, \underset{(-)}{i_D}, \underset{(-)}{i_m}) - L_h = 0 & \\
(33) & L_f^S(\underset{(-)}{i_L}, \underset{(+)}{i_D}, \underset{(-)}{i_m}) - L_f = 0 & \\
 & i_m - \bar{i}_m = 0 \, , & \bar{i}_m = \text{fixed call money rate.}
\end{array}
$$

The Jacobian of the full model is now as follows:

$$
(35) \qquad A_1 = \begin{array}{cl}
\begin{bmatrix}
+ & + & + & + & + & + & + & - \\
+ & + & - & - & 0 & 0 & + & - \\
+ & - & + & - & 0 & 0 & + & - \\
0 & 0 & 0 & 1 & 0 & - & 0 & 0 \\
0 & 0 & 0 & 0 & 1 & - & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 \\
- & 0 & 0 & 0 & 0 & 0 & 1 & 0 \\
- & 0 & 0 & 0 & 0 & 0 & 0 & 1
\end{bmatrix}
&
\begin{array}{l}
\text{goods} \\
\text{housing capital} \\
\text{bonds} \\
\text{loans to households} \\
\text{loans to firms} \\
\text{central bank debt} \\
\text{price level} \\
\text{inflation expectations}
\end{array}
\end{array}
$$

1) See, however, our discussion on the policy rule of the central bank on page 37.

We see that the model is now recursive. The bank loan markets can be solved first and after that the real side, inflation, and the endogenous interest rates. The LM-curve is horizontal.[1)]

It is an interesting problem, under which conditions the determinant of the matrix A_1 in (35) is positive analogously with the usual case in flow-of-funds models. In our model the determinant of the upper left corner 3x3 matrix is positive because it is a modified dominant diagonal matrix, the determinant of which is positive, as Tobin and Brainard (1967) have proved. This does not, however, guarantee that the determinant of the whole matrix A_1 would be positive in our case. We have analyzed our case with the aid of the technique of partitioned matrixes.[2)] It is, however, not self-evident that the determinant of the matrix $A_{11}-A_{12}A_{22}^{-1}A_{21} = \bar{A}_{11}$ is positive, as is the case with A_{11}.

The matrix $\bar{A}_{11}$ is the matrix of a partially reduced model where we have substituted away the influence of variables $Z_2 = (-dL_h,-dL_f,di_m,dP,dp_e)$ and consider the model reduced to contain only three endogeneous variables $Z_1 = (dy,di_K,di_B)$.[3)] The problem with whether $|\bar{A}_{11}|$ is also positive, is related to our flex-price model. In general, we have

---

1) See on this more closely section 3.7. and also Alho et al. (1985), chapter 4.5.

2) We partition the matrix A_1 in (35) so that A_{11} is the 3x3 upper left corner and A_{22} the lower right corner matrix.In the derivation of the results we have used the rule for calculating the determinant of a partioned square matrix A:
$|A| = |A_{22}|\ |A_{11}-A_{12}A_{22}^{-1}\ A_{21}|$. In our case the determinant of the matrix A_{22} is simply unity and its inverse can be easily calculated.

3) See the theory of partially reduced models developed by Vajanne and Pylkkänen (1984).

$$A_{12}A_{22}^{-1}A_{21} = \begin{bmatrix} 0 & 0 & 0 \\ a & 0 & 0 \\ b & 0 & 0 \end{bmatrix} ,$$

where a and b may be positive or negative. We note that a and b refer to income (output) effects in the housing capital and bond equations in the reduced system. These may be negative if the effects running through changes in the price level - which reduce demand for housing and bonds, because the disposable income is reduced as a consequence of an increase in prices - are large enough. On the other hand, however, a and b have positive terms which come from the effects of changes in inflation expectations - which are caused by changes in output - on housing and bond demand. These effects running through the yield variables are positive and so they make a countereffect on the negative effects just mentioned. On balance, we make the assumption that the determinant of A_{11} is positive.

3.9. Effects of the policy measures and exogeneous shocks

Let us next turn to derive the impact effects of various policy measures and changes in the exogeneous variables of the model. We consider the following <u>monetary policy measures:</u> an increase in the loan and deposit rates (di_L,di_D) and a shift in the the central bank call money interest rate (di_m); the following <u>fiscal policy measures</u>: increase in public expenditure (dg), an increase (shift) in the personal income tax rate (schedule) (dt), and an open market operation which increases the bond supply (dB), and as <u>policy measures in a "mixed" field</u>; (or incomes policy): a devaluation of the markka (de) and an exogeneous shift in the wage rate (dW), and as a last item the following <u>shocks arising in the international economy</u>: an increase in the world output (dy_w), a change in the foreign inflation rate ($d\hat{p}_f$) and, and last, an increase in the international interest rate (di_f). The system of simultaneous equations to be solved is now the following:

$$
(36) \qquad A_1 \begin{bmatrix} dy \\ di_k \\ di_B \\ -dL_h \\ -dL_f \\ di_m \\ dP \\ dp_e \end{bmatrix} = \begin{bmatrix} - & + & - & 1 & - & 0 & ? & + & + & + & - \\ + & - & - & 0 & + & 0 & ? & - & 0 & - & 0 \\ + & - & 0 & + & + & 1 & + & - & 0 & - & - \\ - & - & + & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ - & - & + & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & + & + & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 \end{bmatrix} \begin{bmatrix} di_L \\ di_D \\ di_m \\ dg \\ dt \\ dB \\ dW \\ de \\ dy_W \\ dp_f \\ di_f \end{bmatrix}
$$

We are now ready to go over to examine the impact effects of the various policy measures and the exogeneous factors.[1)]

On the basis of the signs of the matrix on the right hand side in (36) we can make some definite inferences concerning the effects of the policy measures and exogeneous shocks, some effects are only probable, and many are uncertain. The results are first summarized in table 2 and are then commented below.

---

1) Here we have utilized the Cramér rule and the technique of partitioned matrices.

Table 2. The effects of the various policy measures and exogeneous factors.

(38)

On (2)	(1) Effect of:										
	di_L	di_D	di_m	dg	dt	dB	dW	de	dy_W	$d\dot{p}_f$	di_f
dy	?	?	–	+	?,–	–	?	?,+	+	+	–
di_K	?,+	?	?,+	?	+	?	?	?	–	?	+
dP	?	?	–	?	0	0	+	+	0	0	0
dp_e	?	?	–	?	–	–	0	?	+	+	?

<u>The effects of changes in the regulated interest rates.</u> The effects of these changes are ambiguous which is a well-known fact in rationed loan markets. This depends on the fact that an increase in the loan rate increases the total loan supply of the banks. This has an expansive effect on output which can outweigh the direct contractive effect on spending.

If we had an equilibriating loan market, see more on this in section 3.10, the effect of an "automonous" change is the loan rate is clearly depressive on output and employment.

<u>The effect of a tightening central bank policy.</u> In the first place the loan supply of the banks diminishes as a consequence of a tightening (shift) in the marginal cost (curve) of the central bank debt of the banks, and consumption and investment are reduced through the substitution effects. A contractive effect on real expenditures is, however, magnified by the inclusion of the asset markets in the model, as mentioned above in section 3.7. If we have in the model a credit constraint effect from household loans to demand for bonds and housing

capital, these can, because of a rise in the interest rates, cause an effect which magnifies the direct negative effects of a tightening central bank policy stance. The effect of a rise in the call money rate on housing prices is not straightforward but it probably depresses these. The monetary policy operating by the call money rate also has an effect on the price developments and inflation expectations.

The effects of the fiscal policy measures

These are fairly standard, the effects of an increase in the public demand being expansive and an increase in the personal tax rate being probably contractive. This last mentioned effect requires that an increase in the tax rate causes a larger drop in the demand for bonds than in the supply of bonds. A contractive open market operation, i.e. an increase in the stock of government bonds at the hands of the public causes a decline in output and an increase in both the endogeneous interest rates. The effect of a bond financed increase in the public expenditure can be derived to be expansive on balance, because of the gross subsitutability properties of the system.[1)]

Devaluation of the markka has an expansive effect on output, if it improves the trade balance more than it reduces consumption because of a decrease in the real income of the households (however, this could be neutralized by an extra investment out of larger profits). The overall effect also depends on the fact that a decrease in the disposable real

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1) This is a standard result in models of Keynesian type, see e.g.Tobin (1982), even though it is a disputed point between Keynesians and monetarists.

income of the households lowers demand in the bond and housing capital markets and therefore a devaluation also unambiguously increases the interest rates on bonds and housing.

An increase in the wage rate may be expansive or contractive in this model. This depends on the fact that progressive income taxation may cause a decline in the disposable real income of households as a consequence of a wage shock. An increase in wages does not crowd out domestic demand in this model, most notably this could concern investment, but these effects have not been taken into account so far.

An increase in world output is of course expansive and at the same time it reduces the domestic interest rates (i_B and i_K).

An increase in world inflation rate is clearly expansive, but its effects on domestic rates of return variables are not definite in sign. The effect of an increase in the foreign interest rate on output is clearly negative, which are likely to be depressed. In models of the small open economy flexible exchange rates will provide perfect insulation against disturbances in the foreign inflation rate in the short run as well as in the long run if and only if the foreign nominal interest rate fully adjusts to the foreign inflation rate, i.e. if the foreign real (expected) interest rate is a constant, see Turnovsky (1984). In our model the effective exchange rate is fixed, but it can be in a discretionary way changed by a policy decision. In our model the consequences of a foreign inflationary shock, if the foreign interest rate is in real terms a constant, are probably expansive on the domestic economy if the exchange rate is kept unchanged. In order to insulate the economy a revaluation is needed, if devaluation is, as argued above, likely to be an expansive measure.

As a summary, we can make the conclusion that the effects in table 2 are to a large degree accepted by intuition. One feature of the model in the formulation (34) is that it has a very loose connection between the domestic money market and the various shocks because of the interest rate pegging by the central bank. In this formulation it is clearly inadequate and can be considered to be quite a rough approximation of the present Finnish financial markets. It is anyway true that the link between real and monetary sides is nowadays based more than previously - if not almost totally - on interest rates, especially on the call money rate, because the regulated rates are changed fairly infrequently.

Therefore, we should consider the policy reaction function of the central bank so that the central bank reacts to "excessive" changes in its foreign exchange reserves by changing its call money interest rate. At the moment we have omitted this informal link between goods and financial markets from the model. Another weakness in the model is that, even though there are theoretical grouns for doing so, there is in (35) no influence from deposit behaviour of the public on the loan supply of the banks. As mentioned earlier, this would, however, complicate the analysis very much, and we are inclined to think that this change in the model would leave the basic results presented in table 2 virtually intact.

We still want to make some notes on a version of the model where the financial markets reach an equilibrium solely through interest rates in section 3.11.

3.10. Longer-run considerations

One striking feature in the above model is that the domestic economy has a large monetary autonomity, it may even be described to be perfect. This is of course based on the relatively tight foreign exchange controls in Finland. All long-term foreign lending and borrowing needs a permission by the Bank of Finland. So, the problem focuses on the elasticity of the short-term capital flows with respect to interest rate differentials. Our model has the view that this elasticity is low enough, so that the central bank can effectively fix the (effective) exchange rate and the short-term interest rate within the unit period of the model (say, one or two years). In the longer run, in order to maintain its foreign reserves on a meaningful level, the central bank has to set its short-term rate to be the same as the foreign short rate, we have the first long (or intermediate) run equilibrium (LR) condition,

(38) $LR_1\colon\ i_c = i_m = i_f$.[1)]

This also contains the condition that the expected change in the exchange rate is zero, which we already above on page 16 showed to be related to the purchasing power parity condition,

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1) It is interesting to note that the emerging short-term money market makes it much more difficult to pursue in the long-run independent interest rate policy than before. This is due to the fact that in the "old" financial system with no well operating short-term money market the marginal interest rate on the central bank debt of the banks - in contrast to the present situation - did not have a (strong) direct substitute effect on capital flows, only an indirect one through changes in the degree of credit rationing. Nowadays, in contrast to the old situation, the domestic short-term rate is "fully" determined by the call money rate of the central bank and so changes in it cause immediate substitute effects on foreign capital flows.

(39) LR_2: $P_f/P = A/e$, A is a constant.

Next, we have a condition for the natural rate of output

(40) LR_3: $y = y^*$.

Let us now assume a steady state equilibrium in the international economy, i.e. $y_f = y_f^* =$ (a constant) and a constant inflation rate $\dot{\bar{p}}_f$ with which the domestic inflation and inflation expectations are equal. We have

(41) LR_4: $\dot{p} = \dot{p}_e = \dot{\bar{p}}_f$.

In this steady-state equilibrium we have on the domestic asset side the following conditions,

$$
(42)\quad
\begin{aligned}
&LR_5: c = y^{hd} && \text{(i.e. net saving is zero)}\\
&LR_6: i^h = i^f = 0 && \text{(no net investment)}
\end{aligned}
$$ [1)]

In equilibrium, all stocks of financial assets and liabilities grow in nominal terms at the rate of inflation. The stock of the government bonds is also at a fixed real level, so the budget deficit in relation to income is equal to the decrease in the real value of public debt (here bonds) in ratio to income, i.e. $(g-t-rb)/y = -\dot{p}b$, $b = B/Py$. Now we are left with the problem: how the central should manipulate the only remaining policy instrument, the regulated loan (and deposit) rate to achieve a equilibrium in the financial markets. In the long-run the regulated loan rate i_L and the unregulated rate i_c have to be equal,

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1) See Lassila (1984) for an analysis of long-run effects of monetary and fiscal policies.

(43) $LR_7\colon\ i_L = i_c(=i_m)$.

This means that in the long-run solution there is no effective credit rationing in the economy because the free funds market is by hypothesis a market which reaches its equilibrium through the demand for funds behaviour by the non-bank private sector.

Our model presented above is based on the idea that nowadays monetary policy primarily operates through interest rates and does not try to control domestic liquidity directly. Indirectly it does through the credit rationing channel in the short-run, but in the long-run it cannot do this. This is a fairly recent change in Finland, because formerly monetary policy tried (and also succeeded in its effort) to control simultaneously domestic interest rates, liquidity (or bank lending), i.e. tightness of credit, and the (effective) exchange rate.

3.11. An equilibrium version of the model

So far we have considered the case of credit rationing which has been the key part of the transmission mechanism, and which has also been studied vigorously in the Finnish monetary research in the late 1970's and early 1980's. The financial markets in Finland are in the process of rapid change from tightly regulated to more competitive and less regulated markets, i.e. we are in a process towards "free and efficient" financial markets. So, as a final part of this paper we consider the problem, how to analyze with the aid of the above model a possible future situation where we would have "freely floating" interest rates, especially a free loan rate in the domestic financial markets, even though we would still have fairly much exchange regulation related to the foreign capital flows to insure sufficient monetary autonomity.

This transformation in our model is fairly straightforward. To the asset demand equations (5) and (12) we have to add in this new case loans as a negative asset,and accordingly drop the credit constraint from its present position as an argument on the right hand side to the left hand side of the demand equations as an endogeneous item of the asset demand systems. We do not here discuss any more thoroughly this shift operation and its consequences on the specification of the asset demand equations.

The loan market disequilibrium conditions with supply determined solutions in our model above should be now replaced by "true" equilibrium condition for a common loan market:

$$(44) \qquad L_h^d + L_f^d = L_h^s + L_f^s \, .$$

This means that in this new situation the bank loan markets would not be any more divided into two sectors which do not have an efficient adjustment of imbalances in loan demand and supply between the two sectors. So, now we would have only one common loan market which would be cleared by a common rate of interest for the two sectors.

The short-term money market in Finland is at the present moment in a process of being transformed from a fix rate market, where the central bank sets the rate through arbitrage between the call money market and the various parts of the short-term money market, into a market where the private sector and the banks adjust imbalances in liquidity in their inner markets, and the central bank has the role of a market participant rather than that of a pegger of a fixed short term rate. The functioning of these markets is analyzed and discussed more thoroughly in Alho et al (1985), chapter 4 and in Alho and Mustonen (1986).

In our model this change would mean that we should transform the short-term money market from its role as a "residual" market and a recursive part of the model into an equation belonging to the simultaneous block of the model. The model would then resemble in its treatment of financial markets the standard flow-of-funds model presented by Tobin (1969). It could also be analyzed by the methods presented above.

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