Seminar Paper No. 262

DEVALUATION, PROFITABILITY AND INVESTMENT

by

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INSTITUTE FOR INTERNATIONAL ECONOMIC STUDIES

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Introduction

This paper analyses the longer run consequences of currency devaluation in a small open economy. In particular, close attention is devoted to the effect of a devaluation on future expected profitability and hence on investment demand and capital formation.

The trade balance is defined from the savings minus investment point of view. Savings is assumed to be positively related to current real income. Investment is determined by Tobin's "q", where q is defined to be the price of a claim on a unit of physical capital in terms of the price of currently produced goods. Whenever the stock market value, q, exceeds one, a firm is stimulated to float equities and undertake investment which subsequently leads to an increase in the market value of the firm. It is assumed that q - which equivalently can be shown to equal the present discounted value of future expected real returns of investing in capital - is determined in a market where agents form rational expectations, which in our deterministic model boils down to perfect foresight. Consequently, the stockmarket value q reflects all relevant current and future information. "News" regarding future profitability is therefore instantaneously discounted at the stock market. The extent to what devaluation news is "good"-or-"bad"-news for the stock market, i.e. to what extent q jumps up or down in response to a devaluation, depends on the assumptions made about the path for costs and profits in the future. Consider for example the case where a "surprise-devaluation" succeeds in reducing the real wage in the economy.

In this case there are two mechanisms working in opposite directions: The fall in the real wage which leads firms to employ more of the variable factor, labour, tends to increase profitability and hence the stock market value q . At the same time the tendency for output and real income to go up due to the expansionary effects of a devaluation puts an upward pressure on the interest rate (the discount rate) provided that the economy's financial markets are not perfectly integrated within the rest of the world's financial markets. Thus the net effect on the stock market and investment demand is a priori indeterminate. It is the purpose of this paper to analyse the precise relationship between devaluation, profitability, and capital formation, and subsequently to derive the effect on trade balance of devaluation.

This "devaluation approach" has its own theoretical interest since virtually all devaluation models in the Keynesian, monetary- and general equilibrium tradition ignore the investment effect of a devaluation simply by assuming investment to be exogenously given, implying that the trade balance effect coincides with the savings effect.¹ This seems to be unduly restrictive since it is well known that a devaluation may be a powerful instrument for reducing the going real wage in the economy and hence stimulate profitability and investment demand. Indeed, we shall show below how the short-run

1) Some examples in the Keynesian literature are: Diaz-Alejandro (1963), Gylfason and Risager (1983), Harberger (1950), Kingston and Turnovsky (1978), Laursen and Metzler (1950) and Krugman and Taylor (1978). The papers of Dornbusch (1973a, b) in the monetary tradition also ignore the issue of investment and capital-accumulation and the same applies to the intertemporal general-equilibrium models of Obstfeld (1982) and Svensson and Razin (1983). The only possible exception to this rule is Kouri (1979), who briefly discusses the implication of the link between devaluation, profitability and investment for the efficacy of devaluation for balance of payments adjustment. It is because of the focus on this almost neglected issue that we have adopted a simple Keynesian specification of savings.

Keynesian devaluation model is nested within our more general Keynesian rational expectations model where a devaluation influences the economy not only through the effect on exports and imports but also through the effect on profitability and investment. The latter aspect is of interest also from a policy view point, particularly in these days when many small open economies not only experience external account deficits but also slow capital formation.

The paper is organized as follows: The model is set up in section 1. In section 2, the effects on savings and investment and the trade balance of a previously unanticipated devaluation are analysed. Section 3 analyses the dynamics of an anticipated devaluation. Until section 4, we assume that the economy's financial markets are isolated from the rest of the world's, while section 4 deals with the case of perfect capital mobility. The last section summarizes the main points of the analysis and discusses briefly extensions of the present framework.

Section 1

The Model Under Zero Capital Mobility

In what follows we set up the demand side of the model. First we model domestic residents' and the rest of the world's demand for the single good produced in the economy. Due to the emphasis on the effect of a devaluation through profitability and investment demand, close attention is devoted to the investment demand component of aggregate demand. Next we briefly set up the monetary sector. There are two financial assets in the model: money and equities cum bonds. Portfolio equilibrium is therefore established when one of the markets is equilibrated via adjustment in the rate of interest (and the level of income). By Walras' law for stocks we treat the equity/bond market as the residual market, thus portfolio equilibrium is described by the LM-schedule. The stock market provides the link from the monetary sector to the real sector in the economy via investment demand. An account of how q is priced is therefore the next step in the development of the model. Under the assumption of perfect substitutability between bonds and equities, total expected return on holding equities must equal the rate of return on bonds. From this efficient market condition we derive the path for $q(t)$, which in turn determines the path for investment and capital accumulation. After having described the demand side of the model, we turn our attention to the supply side. Output is produced according to a well-behaved CRS production-function. There are two production-factors, labour (L) and capital (K). The economy (or the representative firm) will employ the two factors such that the present discounted value of the firm will be maximized. L is assumed to

be a variable factor in both the short - and the long run. Thus L will be hired to the point where the marginal productivity of labour equals the real wage. K, on the other hand, is predetermined in the short run but variable in the long run. Investment demand is governed by Tobin's q. The financing of net investment takes place by issuing equities. When the real price of a claim on a unit of physical capital exceeds one ($q > 1$), the firm has an incentive to invest and float equities, which leads to an increase in its market value. It is through the stock market or investment and exports and imports that a devaluation influences the economy.

Aggregate demand is given by (1):

$$(1) \quad Y = C(Y-T, \frac{e}{p}) + f(q)K + G + X(\frac{e}{p})$$

$$\begin{array}{lll} 0 < C'_1 < 1 & f' > 0 & X' > 0 \\ C'_2 \geq 0 & f(\bar{q}) = 0 & X' + C'_2 > 0 \end{array}$$

Aggregate demand consists of private sectors' consumption - and gross fixed investment demand for the domestically produced good, government absorption of the single good the economy produces and finally exports.¹ Private sectors' consumption of the domestically produced good is positively related to real disposable income but ambiguous with respect to the terms of trade, since we assume that total consumption demand is independent of the terms of trade. Assuming that the Marshall-Lerner condition is fulfilled ensures, however, an aggregate demand increase in response to a terms of

1) List of notation is given below.

trade deterioration, i.e. $X' + C_2' > 0$. (See appendix 1 for a derivation of the restrictions on C_2' and $C_2' + X'$ implied by the Marshall-Lerner condition and the assumption that total consumption demand is independent of the terms of trade). For the sake of simplicity we ignore wealth effects in the behavioural equations, since our emphasis is not on portfolio accumulation or wealth accumulation per se, but rather on the investment effect of a devaluation. In this respect our model departs from the dynamic neoknesian model, see e.g. Kingston and Turnovsky (1978) where asset dynamics - arising from an imbalanced current account and government budget - is at the centre of the analysis. The dynamic

neoknesian devaluation analysis of Kingston and Turnovsky (1978) shares, however, in common with the short run Keynesian devaluation analysis, see e.g. Dornbusch (1980 ch. 4, 5), the assumption of constant investment demand, implying that the trade-balance effect of a devaluation coincides with the savings effect.¹⁾ This seems to be unduly restrictive, in particular in a longer run perspective, since a devaluation may increase profitability and hence investment, through the power of a devaluation to reduce the real wage rate. It is through this channel among others that a devaluation influences the economy in the analysis to follow. Hopefully, the analysis will also demonstrate that the risk of a contractionary effect of a devaluation as emphasized by Diaz-Alejandro (1963) and Krugman and Taylor (1978), due to the redistribution of income from labour to capital and due to a higher propensity to consume out of labour income, is less well-founded when the assumption of exogenously given investment is abolished.

1) As already mentioned the identification of the savings effect with the trade-balance effect of devaluation is also a feature of monetary- and general equilibrium approaches to exchange rate adjustment.

Before we turn our attention to the specification of investment demand we note that taxes are exogenous and assumed to be set at a level capable of financing government consumption, i.e. $T = G$.¹ In the following sections we shall also compare the effects of budget neutral fiscal policy with devaluation policy.

Gross fixed investment is assumed to be a positive function of the stock market value, q , which is the value of a claim on a unit of physical capital in terms of its replacement costs. We use the same specification of gross fixed investment as in Bruno and Sachs (1982).

$$(2) \quad \frac{I}{K} = f(q)$$

$$f'(q) > 0, \quad f(\bar{q}) = \theta,$$

The stock of capital changes according to:

$$(3) \quad \dot{K} = I - \theta K$$

$$= f(q)K - \theta K$$

In the stationary equilibrium where $q = \bar{q} = 1$ and $\dot{K} = 0$, gross fixed investment equals replacement investment, θK .

The money market equilibrium condition is standard and is given by (4):

$$(4) \quad r = -\gamma \left(\frac{m}{p} \right) + \lambda(Y) \quad \gamma' > 0, \quad \lambda' > 0$$

Note that money demand is independent of wealth, thus a change in wealth is entirely allocated to bonds/equities.

Consider next the pricing of q , which indeed is a very important aspect of the model because q , the stock market value, provides the link from the monetary sector to the real sector of the model.

1) Interest payments on the budget are ignored. Alternatively, we could assume that bonds are privately issued.

List of symbols

Y	= real GDP
C	= real private consumption demand for the domestically produced good
T	= real taxes
f	= real gross fixed investment demand per unit K by domestic residents for the domestically produced good
K	= stock of capital
L	= level of employment
G	= real government consumption of the domestically produced good
X	= real export demand. Export elasticity: $n_x = X' \frac{\bar{e}}{\bar{X}}$
θ	= proportional rate of depreciation
e	= price of a unit foreign currency in terms of domestic currency
<hr/>	
q	= price of a claim to a unit physical capital in terms of its replacement costs (p)
p	= domestic price level
I	= gross fixed investment
F(K, L)	= production function
w	= money wage
Div	= real dividend payments
r	= domestic nominal interest rate on variable interest-rate bonds
b	= trade balance
r*	= foreign real or nominal interest rate
S	= real savings
m	= domestic nominal money supply
M	= domestic residents imports of the foreign consumption good. Import elasticity: $n_M = - M' \frac{\bar{e}}{\bar{M}}$

A "dot" on a variable denotes its right hand side time derivative, i.e. $\dot{Z}(t) = \lim_{h \rightarrow 0^+} \frac{Z(t+h, t) - Z(t)}{h}$ (the expected change of Z).

Except at those instants where new information arrives, the expected rate of change of q and p equals the actual rate of change of q respectively p. The expected change of K coincides with the actual change since K is unable to make discrete jumps. A bar and a double bar on a variable denotes the initial- respectively long run equilibrium value of the variable. We assume that $\bar{p} = \bar{e} = 1$. The foreign price level equals one throughout the analysis.

We assume that agents who trade on the stock market are endowed with perfect foresight, implying that q at every instant reflects all relevant current and future information. Furthermore, it is assumed that equities and bonds are perfect substitutes. These two assumptions imply that q will be priced according to the following arbitrage condition:

$$(5) \quad \frac{\dot{q}}{q} + \frac{\text{Div}}{q \cdot K} = r - \frac{\dot{p}}{p}$$

Equation (5) says that the expected real return of holding equities must equal the real return on bonds. The total expected real return on equities consists of expected capital gains or losses and dividend payments. The expected return on bonds equals the nominal interest rate minus the expected rate of inflation. Real dividend payments are given by (6):

$$(6) \quad \text{Div} = Y - \frac{w}{p} L - I + q \dot{K}$$

It is assumed that firms finance their net acquisition of capital by issuing equities. Dividend payments are therefore equal to the value of output (less labour costs) minus gross investment costs plus the funds raised from issuing new equities. Under the assumption of CRS, (6) may be written as:

$$(7) \quad \text{Div} = F_K K - I + q \dot{K}$$

Divide (7) by K and using (2) and (3) gives:

$$(8) \quad \frac{\text{Div}}{K} = F_K - f(q) + q(f(q) - \theta)$$

Substitution of (8) into (5) gives:

$$(9) \quad \frac{\dot{q}}{q} + \frac{F_K - f(q) + q(f(q) - \theta)}{q} = r - \frac{\dot{p}}{p}$$

In the initial equilibrium $\frac{\dot{q}}{q} = \frac{\dot{p}}{p} = 0$, hence (9) can be written as:

$$(10) \quad \frac{\bar{F}_K - f(\bar{q}) + \bar{q}(f(\bar{q}) - \theta)}{\bar{q}} = \bar{r}$$

Thus we obtain the following equilibrium relationship:

$$(10') \quad \frac{\bar{F}_K - \theta}{\bar{r}} = \bar{q} = 1$$

Equation (10') says that in a long equilibrium situation where $\bar{q} = 1$, the marginal productivity of capital minus the proportional rate of depreciation equals the nominal or the real rate of interest. Outside equilibrium capital gains or losses on equities make up the difference between real dividend payments and the real interest rate, see equation (5) or equation (9). Integrating the efficient market condition (5) forward (assuming stability) illustrates the forward looking nature of q :

$$(5') \quad q(t) = \int_t^{\infty} \frac{\text{Div}(s)}{K(s)} e^{-\int_t^s (r(v) - \frac{\dot{p}(v)}{p(v)}) dv} ds$$

This gives q at date t to be the present discounted value of current and future real returns of investing in capital. From (5') we observe that a change in the path for $\text{Div}(t)$ —say due to a change in $F_K(t)$ —and a change in the path for $r(t) - \frac{\dot{p}(t)}{p(t)}$ caused for instance by a devaluation instantaneously will be reflected in $q(t)$. The response (jump) in $q(t)$ provides subsequently a signal for the firm to either increase the stock of capital (when q goes up) or decumulate (when q goes down).

Let us now set up the supply side of the model. Output is produced according to the following well-behaved CRS production function: $Y = F(K, L)$. The representative firm is assumed to hire labour to the point where the marginal productivity of labour equals the real wage, which is the usual (myopic) profit maximization condition for a firm facing a horizontal demand curve.¹⁾ From this first order condition we derive the employment equation:

$$(11) \quad L = L(K, \frac{w}{p}) \quad L_K > 0, \quad L_{\left(\frac{w}{p}\right)} < 0$$

Throughout, it will be assumed that the money wage is rigid. Thus ~~an aggregate demand expansion which reduces $\left(\frac{w}{p}\right)$ through the upward pressure on p~~ increases the level of employment in the economy. Admitted, our treatment of the wage formation process is crude. However, it should be mentioned that the results we derive qualitatively go through the case of instantaneous partial wage indexation, while the analysis precludes the case of sluggish wage behaviour. This implies that the path for the real wage is entirely determined by the path for the price-level. In the case of perfect capital mobility, see section 4, it will be shown that the initial reduction in the real wage is handled back in the longer run, which somewhat justifies the assumption of passive money wage behavior. This result arises from the positive effect of a devaluation on capital accumulation which increases labour productivity and indirectly the real wage through the tendency for the price-level to fall in the adjustment phase in the absence of wage-push inflation. Substitution of (11) into the production function gives: $Y = F(K, L(\left(\frac{w}{p}\right), K))$. Total differentiation of this expression gives under the assumption that w is constant: $dY = F_K dK - F_L L \left(\frac{w}{p}\right) dp + F_L L_K dK = (F_K + F_L L_K) dK - F_L L \left(\frac{w}{p}\right) dp$, where $F_K, F_L, L_K > 0$ and $L_{\left(\frac{w}{p}\right)} < 0$. Consequently, we can write the change in the price-level as follows:

1) Note that we assume that the economy consists of many small firms, each facing a horizontal demand-curve, while the economy as such faces a downward sloping demand curve (the specialisation assumption), implying that p is endogenous.

$$(12) \quad dp = h_Y dY - h_K dK \quad h_Y, h_K > 0$$

This is the conventional supply-function written in a total differentiated form. We observe that a change in the price-level is positively related to a change in Y (assuming K to be constant), while an increase in K at a given level of Y shifts the supply function down. The marginal productivity of capital is given by (13):

$$(13) \quad F_K = F_K(K, L), \quad F_{KK} < 0, \quad F_{KL} > 0$$

Substitution of (11) into (13) gives:

$$(13') \quad F_K = F_K(K, L(K, \frac{w}{p}))$$

Total differentiation of (13') gives:

$$(14) \quad dF_K = (F_{KK} + F_{KL} L_K) dK - F_{KL} L \left(\frac{w}{p} \right) dp$$

The first term reflects the change in F_K as K increases at a given real-wage. The assumption of CRS implies that any change in K will cause an equiproportionate change in L (at a constant $(\frac{w}{p})$) leaving F_K unaffected. Hence the term $(F_{KK} + F_{KL} L_K)$ equals zero. The latter term reflects the effect on F_K of an increasing p which causes $(\frac{w}{p})$ to fall and hence L to increase. This term is positive. In simplified notation we may write:

$$(15) \quad F_K = \Gamma(p), \quad \Gamma_p > 0.$$

We have now described both the demand side and the supply side of the model. What remains is to specify how inflation expectations are determined. According to the rational expectations hypothesis, the expected rate of inflation equals the rate predicted by the model. Let us therefore proceed to find the expected rate of inflation implied

by the model. Upon taking the right hand side time derivative of the demand equation (1) and supply equation (12) and substituting the time derivative of (1) into the time derivative of (12) we obtain the following expression (assuming e , G and T to be constant over time):

$$(16) \quad \dot{p} = \frac{h_Y}{1 - C'_1} (- C'_2 \dot{p} + f'(q) \dot{q} K + \theta \dot{K} - X' \dot{p}) - h_K \dot{K}$$

From this equation we obtain:

$$(16') \quad \dot{p} = \frac{h_Y}{1 - C'_1 + h_Y(C'_2 + X')} (f'(q) \dot{q} K + \theta \dot{K}) - \frac{h_K(1 - C'_1)}{1 - C'_1 + h_Y(C'_2 + X')} (\dot{K})$$

This equation says that the expected change of p is a linear combination of the expected change of q and expected or actual change of K . The first term represents the expected change of p as anticipated investment demand shifts the demand schedule up along a given supply curve. The second term represents the downward shift in the supply schedule as K increases over time, which of course has a negative effect on inflation expectations. The assumption of perfect foresight implies that (16') also describes the actual rate of inflation except at those instants where new information arrives.

Finally, the trade balance is defined to be the excess of savings over investment:

$$(17) \quad b = S(Y - T) - f(q)K \quad 0 < S' < 1$$

Note that we have chosen a simple approach to savings behavior because we want to emphasize the hitherto neglected link between devaluation, profitability and investment. Thus, we make the conventional assumption that total consumption spending is independent of the terms of trade implying that the terms of trade does not appear in

the savings-function, see the appendix for a further discussion. Further, we do not consider the role of wealth effects, because it has been exhaustively discussed both in the Keynesian- and the monetary balance-of-payments literature how the real balance- or the wealth effect may increase the likelihood of a positive savings effect of a devaluation in the short run, see e.g. Gylfason and Risager (1983) and papers in Frenkel and Johnson (1976), and because it greatly simplifies the dynamic analysis, cf. below. The second term in the trade-balance definition is investment demand, through which a devaluation in the short run may have a negative trade-balance effect provided a devaluation results in increased profitability and investment. In the longer run, however, an increased stock of capital tends to decrease the relative price of the domestically produced good, i.e. improves the competitive position of the economy, see equation (16'), which may reverse the initial external deficit position. Since we want to consider the longer run trade-balance effect of a devaluation, we do not restrict the new stationary equilibrium to be a balanced-trade equilibrium. In the Monetary Approach to Balance of Payments literature, see Frenkel and Johnson (1976), it has frequently been argued that the monetary implications of an external disequilibrium position tends to restore equilibrium on the external balance in the very long run - this is the so-called "automatic monetary mechanism" - rendering trade policies ineffective for balance of payments purposes in that time perspective. The fact that many small open economies experience external account deficits often of a duration of more than a decade indicates that the "automatic monetary mechanism" is working with considerable inertia. It is therefore of interest to see whether a terms of trade depreciation can speed up the

adjustment process. Thus we exclude the monetary implications of trade-balance disequilibrium in the analysis by implicit assuming that the monetary authorities sterilize the money supply effect of a balance-of-payments disequilibrium. This assumption also simplifies the dynamic analysis, since we avoid specifying a third dynamic equation, describing the evolution of the real money supply. The model is summarized below. Note that we have substituted the balanced budget condition into the demand equation and the trade balance equation.

The model:

Goods market, supply and demand:

$$\begin{aligned} \text{a) } p &= h_Y Y - h_K K \\ \text{b) } Y &= C(Y - G, \frac{e}{p}) + f(q)K + G + X(\frac{e}{p}) \end{aligned}$$

Money-market equilibrium:

$$\text{c) } r = -\gamma \left(\frac{m}{p} \right) + \lambda(Y)$$

Efficient-market condition:

$$(18) \text{ d) } \frac{\dot{q}}{q} + \frac{F_K - f(q) + q(f(q) - \theta)}{q} = r - \frac{\dot{p}}{p}$$

Marginal productivity of capital:

$$\text{e) } F_K = \Gamma(p)$$

Capital dynamics:

$$\text{f) } \dot{K} = f(q)K - \theta K$$

Expected rate of inflation:

$$\text{g) } \frac{\dot{p}}{p} = \frac{h_Y}{p(1 - C'_1 + h_Y(C'_2 + X'))} (f'(q)\dot{q}K + \theta\dot{K}) - \frac{h_K(1 - C'_1)}{p(1 - C'_1 + h_Y(C'_2 + X'))} (\dot{K})$$

Trade balance definition:¹⁾

$$h) \quad b = S(Y - G) - f(q)K \quad \text{or} \quad = x\left(\frac{e}{p}\right) - \frac{e}{p} M\left(Y - G, \frac{e}{p}\right)$$

Let us next proceed to solve the model. First we substitute (18g) into (18d). Upon linearizing this expression (see appendix B) we obtain (19d). The next step is to linearize (18f), which gives (19f). We next proceed to take the total differentials of (18a, b, c, e, h), where the differentials are interpreted as deviations from their initial equilibrium values, i.e. $dz = z - \bar{z}$. The linearized version of the model is summarized below. (For notational simplicity we omit the bar to all the partial derivatives):

$$\begin{aligned}
 (19) \quad & a) \quad dp = h_Y dY - h_K dK \\
 & b) \quad dY = C'_1(dY - dG) + (C'_2 + X')de - (C'_2 + X')dp + f'(q)dqK + \theta dK + dG \\
 & c) \quad dr = -\gamma'(dm - dp) + \lambda'(dY) \\
 & d) \quad \dot{q} = \frac{(1 - C'_1 + h_Y(X' + C'_2))}{(1 - C'_1 + h_Y(X' + C'_2) + h_Y f'(q)K)} (dr + dqK - dF_K) \\
 & \quad - \frac{(h_Y \theta - h_K(1 - C'_1))}{(1 - C'_1 + h_Y(X' + C'_2) + h_Y f'(q)K)} \cdot (f'(q)dqK) \\
 & e) \quad dF_K = \Gamma_p dp \\
 & f) \quad \dot{K} = f'(q)dqK \\
 & h) \quad db = S'(dY - dG) - f'(q)dqK - \theta dK
 \end{aligned}$$

Equations (19a, b, c) give together semireduced form expressions for dp , dY , dr :

1) Unnecessary to say, the two trade-balance definitions give identical results. Except at a few times we shall make use of the savings less investment-definition.

$$\begin{aligned}
a) \quad dp &= \frac{h_Y}{(1 - C'_1 + (C'_2 + X')h_Y)} [f'(q)dq K + (\theta + (C'_2 + X')h_K)dK + \\
&\quad + (1 - C'_1)dG + (C'_2 + X')de] - h_K dK \\
(20) \quad b) \quad dY &= \frac{1}{1 - C'_1 + (C'_2 + X')h_Y} [f'(q)dq K + (\theta + (C'_2 + X')h_K)dK + \\
&\quad + (1 - C'_1)dG + (C'_2 + X')de] \\
c) \quad dr &= -\gamma' dm + \frac{\gamma'h_Y + \lambda'}{1 - C'_1 + (C'_2 + X')h_Y} [f'(q)dq K + (\theta + (C'_2 + X')h_K)dK + \\
&\quad + (1 - C'_1)dG + (C'_2 + X')de] - \gamma'h_K dK
\end{aligned}$$

These equations are labelled semireduced because the endogenous variable q appears in them. This feature of the model reveals the assumption of forward looking expectations in the stock market, implying that the current state of the economy (i.e. the current value of γ , p , r etc.) is a function of q which by definition is a forward looking integral of future real returns of investing in capital, cf. equation (5'). This property of the model stands in sharp contrast to the existing body of devaluation models which either assume that expectations are static or employ the notion of backward looking expectations, for instance adaptive expectations, rendering it impossible to analyse the effect of an anticipated devaluation.¹ The assumption of rational expectations, however, permit us to study how anticipated policy changes affect the path

1) The only exception is Turnovsky (1980) who analyses the case of an anticipated devaluation in a monetary model and consequently puts the emphasis on the capital-flows aspect.

of the economy before they have been implemented. Finally, observe that the multiplier $(1 - C' + (C'_2 + X')h_Y)^{-1}$ contains the element $(C'_2 + X')h_Y$, which is positive provided the Marshall-Lerner condition is fulfilled. This term appears because an exogenous demand increase, for a given value of q , causes a rise in p and hence a fall in $(C + X)$ which lowers the multiplier.

Substitution of (19e) and (20a, c) into (19d) gives together with (19f) a linear two-differential equation system in $K(t)$ and $q(t)$. (Since we do not consider monetary policy we have set $dm = 0$). In matrix-notation we obtain:

$$(21) \quad \begin{bmatrix} \dot{K} \\ \dot{q} \end{bmatrix} = \begin{bmatrix} a_{11} & a_{12} \\ a_{21} & a_{22} \end{bmatrix} \begin{bmatrix} K - \bar{K} \\ q - \bar{q} \end{bmatrix} + \begin{bmatrix} b_{11} & b_{12} \\ b_{21} & b_{22} \end{bmatrix} \begin{bmatrix} de \\ dG \end{bmatrix}$$

Where;

$$a_{11} = 0$$

$$a_{12} = f'(q)K$$

$$a_{21} = \frac{(\gamma'h_Y + \lambda' - \Gamma_p h_Y)(\theta + (C'_2 + X')h_K) - \Omega\gamma'h_K + \Omega\Gamma_p h_K}{D}$$

$$a_{22} = \frac{(\gamma'h_Y + \lambda' - \Gamma_p h_Y)f'(q)K + r\Omega - (h_Y\theta - h_K(1 - C'_1))f'(q)K}{D}$$

$$b_{11} = 0$$

$$b_{12} = 0$$

$$b_{21} = \frac{(\gamma'h_Y + \lambda' - \Gamma_p h_Y)(C'_2 + X')}{D}$$

$$b_{22} = \frac{(\gamma' h_Y + \lambda' - \Gamma_P h_Y)(1 - C')}{D}$$

$$\Omega = 1 - C'_1 + h_Y(X' + C'_2) > 0$$

$$D = \Omega + h_Y f'(q)K > 0$$

The determinant of the A matrix in (21) equals:

$$(22) \quad \Delta = -f'(q)K a_{21}, \quad \text{where} \quad f'(q)K > 0$$

For there to be a unique saddle point equilibrium as well as a unique convergent saddle path, Δ must be negative. We assume throughout that $\Delta < 0$ or $a_{21} > 0$. The condition $a_{21} > 0$ will be satisfied under the following alternative pair of assumptions:

$$(23) \quad \begin{aligned} \text{a)} \quad & \frac{(\gamma' h_Y + \lambda' - \Gamma_P h_Y)}{D} (\theta + (C'_2 + X')h_K) > 0 \quad \text{and} \\ \text{b)} \quad & \frac{(\gamma' h_Y + \lambda' - \Gamma_P h_Y)}{D} (\theta + (C'_2 + X')h_K) + \frac{\Omega \Gamma_P h_K}{D} > \frac{\Omega \gamma' h_K}{D} \end{aligned}$$

or

$$(24) \quad \begin{aligned} \text{a)} \quad & \frac{(\gamma' h_Y + \lambda' - \Gamma_P h_Y)}{D} (\theta + (C'_2 + X')h_K) < 0 \quad \text{and} \\ \text{b)} \quad & \frac{\Omega \Gamma_P h_K}{D} > - \frac{(\gamma' h_Y + \lambda' - \Gamma_P h_Y)}{D} (\theta + (C'_2 + X')h_K) + \frac{\Omega \gamma' h_K}{D} \end{aligned}$$

Condition (23a) has the following interpretation: Consider an increase in K which causes both investment-, consumption- and export demand to go up, i.e. $(\theta + (C'_2 + X')h_K)dK > 0$. Increased demand induces a tendency for the interest rate to go up both via the jump increase in p and hence a fall in $(\frac{m}{p})$, see the term $\gamma'h_Y$, but also via increased transactions demand, see the term λ' . Thus the expression $\frac{\gamma'h_Y + \lambda'}{D}$ represents the impact increase in r caused by an aggregate demand increase at a given expected rate of inflation and nominal money supply, cf. equation (20c). Since the expected rate of inflation changes only gradually over time, the above impact effect on r coincides with the impact effect on the expected real cost of capital. The term $\frac{\Gamma_p h_Y}{D}$ in (23a) captures the instantaneous increase in profitability triggered off by a demand expansion. This effect arises from the fall in $(\frac{w}{p})$ which causes an increase in L and therefore an increase in F_K , cf. equation (19e). Thus, condition (23a) represents the case where the rise in the expected cost of capital at given inflation expectations outweighs the increase in profits. Condition (23b) is the stability condition, which basically says that the cost of capital effect eventually must outweigh the profit effect of an increasing stock of capital when account has been taken of all effects inclusive the direct effect on $(F_K - r)$ of the downward shift of the supply curve, cf. the term $(\Omega \Gamma_p h_K - \Omega \gamma' h_K)$. We shall later refer to (23a, b) as the 'bad-news' case. 1) 2)

1) In a model of Blanchard (1981) the labels 'bad' and 'good news' are also used. The content differs, however, from the definitions used here.

2) Observe that (23a) is satisfied for: $\frac{\gamma'h_Y + \lambda' - \Gamma_p h_Y}{D} > 0$

Condition (24a) has the opposite interpretation as (23a), while (24b) is a restatement of $a_{21} > 0$. This case will be referred to as the 'good-news' case.¹⁾

The assumption that $\Delta < 0$ is tantamount with assuming that the system (21) is driven by a stable and an unstable eigenvalue. At any moment in time where K is given, there exists a unique value of q which will put the system on the unique convergent saddle path. Following a now widely adopted practice in the literature, I shall assume that rational agents endowed with perfect foresight always will choose the stable path. This amounts to assume that the jump variable q in response to news always will take the value required to put the system on the unique convergent trajectory, labelled SS in the diagrams below.

Diagram 1, 2 and 3 below show the phase diagrams corresponding to the good- and bad news case. The locus of stationary values for K is in all cases horizontal. The slope of the locus of stationary values for q differs in the two cases. In the bad-news case, the slope is most likely negative: $\left. \frac{\partial q}{\partial K} \right|_{\substack{\text{bad} \\ \text{news} \\ q=0}} = - \frac{a_{21}}{a_{22}} < 0$, given that $a_{21} > 0$

and given that $a_{22} > 0$, provided $h_K(1 - C'_1) > h_Y \theta$ (a sufficient condition).

In the good news case: $\left. \frac{\partial q}{\partial K} \right|_{\substack{\text{good} \\ \text{news} \\ q=0}} = - \frac{a_{21}}{a_{22}} > 0$.

The two possible cases are pictured in diagram 2 and 3. Diagram 2 corresponds to the case where $a_{22} < 0$, and diagram 3 shows the case where $a_{22} > 0$. The stable convergent saddle path, labelled SS, is downward sloping in

1) Observe that (24a) is satisfied for: $\frac{\gamma' h_Y + \lambda' - \Gamma_P h_Y}{D} < 0$

Fig 1 Bad News Case

Fig 2 Good News Case

Fig 3 Good News Case

all three diagrams. The unstable path, UU , is upward sloping in all the cases. (For a derivation of the SS -curve and the UU -curve, see Appendix A). Given that the good-news case in diagram 2 and 3 gives qualitatively the same results, we confine our attention to diagram 2 and 1.

Section 2

The Dynamics of An Unanticipated Devaluation Under Zero Capital Mobility.

We are now ready to consider the long run effect on K (and q) of a devaluation and a balanced budget fiscal expansion.

Upon setting $\begin{bmatrix} \dot{K} \\ \dot{q} \end{bmatrix} = \begin{bmatrix} 0 \\ 0 \end{bmatrix}$ in (21) we obtain (25) below:

$$(25) \quad \begin{bmatrix} K - \bar{K} \\ q - \bar{q} \end{bmatrix} = - \bar{A}^{-1} \cdot B \cdot \begin{bmatrix} de \\ dG \end{bmatrix}, \text{ where } \bar{A}^{-1} = \frac{\begin{bmatrix} a_{22} & -a_{12} \\ -a_{21} & a_{11} \end{bmatrix}}{\Delta} \text{ and } \Delta < 0$$

From (25) we obtain the following long run effects:

$$\frac{dK}{de} = \frac{f'(q)K}{\Delta} \frac{(\gamma' h_Y + \lambda' - \Gamma_p h_Y)}{D} (C'_2 + X') \stackrel{>}{<} 0, \frac{dq}{de} = 0$$

(26)

$$\frac{dK}{dG} = \frac{f'(q)K}{\Delta} \frac{(\gamma' h_Y + \lambda' - \Gamma_p h_Y)}{D} (1 - C'_1) \stackrel{>}{<} 0, \frac{dq}{dG} = 0$$

In the good news case, where a demand increase on impact increases profitability more than the expected cost of capital, i.e. $\Gamma_p h_Y > \gamma' h_Y + \lambda'$, we observe that a devaluation leads to an increase in the stock of capital in the long run, provided $(C'_2 + X') > 0$. The latter condition is equivalent to the Marshall-Lerner condition, (which we have assumed to be fulfilled) since C'_2 can be shown to equal $(\eta_M - 1)\bar{M}$, see Appendix A. Hence we may write $(C'_2 + X')$ as $(\eta_X + \eta_M - 1)\bar{X}$, where we have made use of the assumption that the trade balance initially is balanced. Thus in case a devaluation results in the desired switching effect on the demand side, we observe that devaluation also expands the economy's stock of capital.

In the bad news case we observe that a devaluation leads to a fall in the stock of capital, provided $(\eta_X + \eta_M - 1) > 0$. In summary:

Table 1. Long Run Effects

Policy	Good News Case	Bad News Case
Devaluation	$\frac{dK}{de} > 0$	$\frac{dK}{de} < 0$
Balanced Budget Fiscal Expansion	$\frac{dK}{dG} > 0$	$\frac{dK}{dG} < 0$

Note that the good-news case is also the case where expansionary fiscal policy has a long run 'crowding in' effect in the economy.

Until now we have bypassed the question as to whether the change in the policy instrument has been anticipated or has come as a surprise. This is of great importance for the dynamic adjustment of the economy. Diagram 4 and 5 below shows how the economy responds to an unanticipated devaluation in the bad- and good news case, while we shall discuss the dynamics of an anticipated devaluation in section 3.

Diagram 5 represents the case where the upward pressure on the discount rate dominates the positive effect on profitability of the reduced real wage. The current- and expected future reduced return of investing in equities is immediately reflected in the stock market, implying that q instantaneously jumps down (from E_0 to 0).

Fig 4 Good News Case

Fig 5 Bad News Case

This signals to the firms to decrease their level of investment.

In the absence of further news, the economy converges along SS' to the new steady-state equilibrium (E_1), characterised by a lower stock of capital. Diagram 4 shows that the adjustment is symmetric in the good news case. Further insight in the different adjustment paths for $q(t)$ in the two cases can be obtained by looking at the arbitrage condition, restated here for convenience: $\frac{\dot{q}}{q} + \frac{\text{Div}}{qK} = r - \frac{\dot{p}}{p}$, and the forward integral of this equation:

$$q(t) = \int_t^{\infty} \frac{\text{Div}(S)}{K(S)} e^{-\int_t^S (r(v) - \frac{\dot{p}(v)}{p(v)}) dv} dS .$$

In e.g. the good news case q jumps up instantaneously in response to a devaluation, because the expected path of dividend payments (profits) discounted by the anticipated real interest-cost exceeds one, i.e. the profit effect outweighs the cost of capital effect. The initial jump in q gives rise to (unanticipated) capital gains to shareholders. Because of the stimulus to profitability and dividend-payments, $\frac{\dot{q}}{q}$ must be negative throughout the transition period, otherwise the condition of no excess return to shareholders would be violated, see the arbitrage equation.¹⁾ In the new stationary equilibrium where $\bar{q} = 1$ and $\frac{\dot{p}}{p} = 0$, dividend payments will again equal the nominal (or real) return on bonds, i.e. $\bar{F}_K - \theta = \bar{r}$.

The next step is to solve the model for the long run effect of a devaluation and balanced budget expansion on Y , p , r and b . The information stored in table 1 gives together with (20 a, b, c) and (19 h') the results in table 2 below. (Given the symmetry of the two cases, we only present the detailed expressions in the good new case).

1) See also Blanchard (1981) for a more detailed discussion of arbitrage conditions.

Table 2

Long Run Effects

Policy	Good News Case	Bad News Case
Devaluation	$\frac{dY}{de} = \frac{1}{1 - c'_1 + (c'_2 + x')h_Y} \left[(\theta + (c'_2 + x')h_K) \frac{dK}{de} + (c'_2 + x') \right] > 0$ $\frac{dp}{de} = \frac{h_Y}{1 - c'_1 + (c'_2 + x')h_Y} \left[(\theta + (c'_2 + x')h_K) \frac{dK}{de} + (c'_2 + x') \right]$ $- h_K \frac{dK}{de} \geq 0$ $\frac{dr}{de} = \frac{\gamma'h_Y + \lambda'}{1 - c'_1 + (c'_2 + x')h_Y} \left[(\theta + (c'_2 + x')h_K) \frac{dK}{de} + (c'_2 + x') \right]$	$\frac{dY}{de} \geq 0$ $\frac{dp}{de} \geq 0$ $\frac{dr}{de} \geq 0$
	$- \gamma'h_K \frac{dK}{de} \geq 0$ $\frac{db}{de} = s' \frac{dY}{de} - \theta \frac{dK}{de} \geq 0$	$\frac{db}{de} \geq 0$
Fiscal Policy	$\frac{dY}{dG} = \frac{1}{1 - c'_1 + (c'_2 + x')h_Y} \left[(\theta + (c'_2 + x')h_K) \frac{dK}{dG} + (1 - c'_1) \right] > 0$ $\frac{dp}{dG} = \frac{h_Y}{1 - c'_1 + (c'_2 + x')h_Y} \left[(\theta + (c'_2 + x')h_K) \frac{dK}{dG} + (1 - c'_1) \right]$ $- h_K \frac{dK}{dG} \geq 0$ $\frac{dr}{de} = \frac{\gamma'h_Y + \lambda'}{1 - c'_1 + (c'_2 + x')h_Y} \left[(\theta + (c'_2 + x')h_K) \frac{dK}{dG} + (1 - c'_1) \right]$ $- \gamma'h_K \frac{dK}{dG} \geq 0$ $\frac{db}{dG} = s' \left(\frac{dY}{dG} - 1 \right) - \theta \frac{dK}{dG} \geq 0$	$\frac{dY}{dG} \geq 0$ $\frac{dp}{dG} \geq 0$ $\frac{dr}{dG} \geq 0$ $\frac{db}{dG} \geq 0$

Let us first look at the long run devaluation effects. We start with the output effect. Consider first the good news case, where a devaluation unambiguously increases output, contrary to the bad news case. The output effect is split up into two terms. Since the term $(C'_2 + X')$ is equivalent to $(\eta_X + \eta_M - 1)\bar{X}$ and since $(1 - C'_1)$ equals $(S' + M'_1)$ we observe that the second term in the output expression represents the switching effect in exports and imports of consumption goods, through which a devaluation has an expansionary output effect, provided the Marshall-Lerner condition is fulfilled. This is the well-known Keynesian devaluation multiplier extended to conditions of a positively sloped supply curve, compare with e.g. Dornbusch (1980, ch. 4).

The first term in the output expression represents the investment- or capital stock effect of a devaluation, which is ignored in the literature with the exception of Kouri (1979), despite the fact that a devaluation can be a powerful instrument for reducing the real cost of labour services and increasing profitability. In the good news case, the higher stock of capital tends to expand output further via increased investment demand, $\theta \frac{dK}{de}$, and via increased net exports or increased exports plus domestic consumption demand, $(X' + C'_2)h_K \frac{dK}{de}$. The latter effect comes about via the tendency for an increased stock of capital to reduce the domestic output price, see the term $h_K \frac{dK}{de}$, which increases $(X + C)$ or $(X - \frac{e}{p} M)$ due to improved competitiveness. In the bad news case we observe that the depressive effect resulting from the negative effect on the stock of capital, may outweigh the direct positive switching effect of a devaluation, rendering the output effect indeterminate.

Consider next the trade-balance effect. Table 2 shows that in both cases, the long run trade-balance effect is uncertain, although for different reasons. In the good news case both savings and investment demand are higher in the new stationary equilibrium rendering the trade-balance effect uncertain. In the bad news case the trade-balance effect is indeterminate, because the savings effect is indeterminate. The efficacy of devaluation for balance of payments purposes is also uncertain in the short run in both cases, since the savings minus investment effect is indeterminate in the good news case, while the income - and hence the savings - and therefore the trade-balance response is uncertain in the bad news case. Thus, we conclude that a devaluation can be a powerful instrument for adjusting internal balance provided the economy fits into the good news case, while the efficacy for adjusting external balance in both the short and the long run is uncertain.

Finally, observe that the price- and interest rate effect is indeterminate in both cases, which is straightforward to understand: Consider eg. the good-news case:

The term $\frac{h_Y}{1 - C' + (X' + C'_2)h_Y} [(\theta + (X' + C'_2)h_K \frac{dK}{de} + (X' + C'_2))]$ represents

the upward shift in the demand curve in (Y, p) -space, while the term

$- h_K \frac{dK}{de}$ represents the downward shift in the supply-curve, rendering

the price-level effect indeterminate. The same explanation applies to the

ambiguous interest-rate effect: The first term in the reduced form expression

for the interest-rate effect is positive and represents the upward pressure on r of the higher level of real income which causes transactions demand to increase. The second term represents the increase in the real money supply, due to the tendency for p to fall as K increases. The net effect on r is uncertain. In the bad news case we note that as long as the real income effect is uncertain, the sign of the interest-rate effect remains uncertain.

Let us finally consider 'balanced budget fiscal policy'. In the 'crowding in' case, we observe that the output effect is positive. The trade-balance effect is uncertain. This is in contrast to the prediction of the short-run Keynesian model where a balanced budget fiscal expansion always worsens the trade balance, since the open-economy balanced budget multiplier is less than one. The possibility of crowding in implies that the long-run balanced budget multiplier may exceed one. Thus the long-run effect on private sector's savings may be positive rendering the trade-balance effect uncertain. In the crowding out case - the bad news case - we note that the trade-balance effect is uncertain in principle, although most likely negative. In the limiting case, where $\theta = 0$, fiscal expansion unambiguously worsens the trade balance. In the good-news case, however, the trade balance effect remains indeterminate.

In the next section we shall discuss the dynamics of an anticipated devaluation. This case differs from the previously discussed only in the dynamic response of the economy, while the long run effects are the same. These long run effects can now be summarized: In the good-news case, a devaluation increases the economy's stock of capital and expands output. The trade-balance effect is uncertain: The increased real income causes savings to go up, while the higher level of investment tends to worsen

the trade balance.

In the bad news case, we conclude that the output and trade-balance effect of a devaluation is uncertain, while the stock of productive capital in the economy will be lowered unambiguously.

Section 3

The Dynamics of An Anticipated Devaluation.

In this section we analyse the dynamics of an anticipated devaluation. Following Turnovsky (1980) we assume that agents have perfect information with respect to the devaluation date, while uncertainty may prevail as regards to the magnitude of the devaluation. The devaluation experiment is modelled as follows: The actual path for the exchange rate is described by (27):

$$(27) \quad e(t) = \begin{cases} e_0 & 0 \leq t < t_1 \\ e_1 & t \geq t_1 \end{cases}$$

Where $(e_1 - e_0) = de$ and t_1 denotes the devaluation date, assumed to be known. Agents expectation formation is described by (28):

$$(28) \quad e^e(S, t) = \begin{cases} e_0 & S < t_1 \\ e_0 + \alpha \cdot de & S \geq t_1 \end{cases}$$

Where $e^e(S, t)$ denotes the expected exchange rate for time $S > t$, formed at time t . The parameter α measures the exactness of agents forecasts. We will consider the following cases:

- $\alpha = 1$: The expected devaluation equals the actual
- (29) $0 < \alpha < 1$: The expected devaluation is less than the actual
- $1 < \alpha < \infty$; The expected devaluation is greater than the actual

Let us first look at the case where $\alpha = 1$. The dynamics in the good- and bad news case is illustrated in diagram 6 and 7 below.

We consider first the bad news case. In the bad news case, where the higher expected cost of capital dominates the positive effect on profits of a devaluation, the stock market value jumps instantaneously down, see fig. 7. The magnitude of the initial fall in q depends on the length of the time interval between the date where a devaluation becomes anticipated and the devaluation date. For a given time interval - say of length T - we know for certain that q at the devaluation date exactly will have to be on the new saddle-path (labelled SS'), which corresponds to the new value of the exchange rate. This is guaranteed by the arbitrage equation. Thus, for a time interval of length T , q will follow the path OA and will be at A exactly at date t_1 . For a greater time interval of length $T' (> T)$, q will proceed along $O'A'$ and will be at A' at date t_1 . From that date on, q will move along the stable saddle-path towards E_1 . Thus we observe that the fall in q increases the shorter the time interval is between the 'announcement' date and the devaluation date. In the limiting case where the time interval goes to zero and the devaluation is a complete surprise, q jumps vertically down, as shown in the former section. This gives rise to a huge disinvestment process in particular in the beginning of the adjustment phase and hence a fairly rapid decumulation of the stock of capital. In case the devaluation has been anticipated, the stock of capital decumulates at a lower speed in the beginning in comparison to the case where the devaluation comes as a surprise due to the moderate downward jump in q . The decumulation speed gradually increases until time t_1 , thereafter slowing down again, see figure 8.

Fig. 6 Good News Case, $\alpha = 1$ Fig. 7 Bad News Case, $\alpha = 1$

Surprise devaluation
Bad-news case

Anticipated devaluation
Bad-news case

Fig. 8

We now turn our attention to the output dynamics. Consider first the impact effect on output and employment in the bad news case. At the instant where a devaluation becomes anticipated, output declines due to the contractionary effect on the stock-market and hence on investment demand. For the same reason, an anticipated devaluation has on impact a contractionary employment effect. The initial adjustment in output and employment differs from the earlier discussed case where a devaluation comes as a surprise since the initial rise in net-exports in the latter case may offset the fall in investment rendering the output effect on impact indeterminate. Finally, we note that the impact trade-balance effect is positive because the fall in p and Y unambiguously improves the trade balance; this is most clearly seen when the trade-balance is viewed from the net-export side, see (18h).

From the initial date, the economy now starts adjusting in the anticipation of a future devaluation. Thus both the adjustment of the stock of capital (determined by the path for q see (19f)) and the level of employment (depends on the path for K and p , see (11)) will be such that the actual level of output at the devaluation date will be consistent with the level implied by the anticipation of a devaluation. Thus provided the magnitude of the devaluation has been correctly foreseen ($\alpha = 1$) very little happens at the devaluation date. The economy therefore proceeds in a smooth way towards the stationary state. The fall in the stock of capital has a negative effect on output in the long run, but since the employment effect is indeterminate - for the reason that the long run price-level effect is indeterminate, we conclude that the effect on output is uncertain in the long run. Alternatively, viewing the output determination from the demand side,

we note that while an anticipated devaluation in the short run has a contractionary effect on output through the fall in investment demand, the long-run output effect is indeterminate, since the lower level of investment may be offset by a higher level of net-exports.

In the good news case we observe that the anticipation of a devaluation has an expansionary output- and employment effect through the positive effect on the stock market and hence on investment demand, see fig. 9. It is also interesting to note that an anticipated devaluation results in a deficit on the trade balance on impact, which may rationalize the implementation of the devaluation at some future date. This is most clearly seen when the trade balance is defined from the export minus import side, since the rise in p and Y unambiguously deteriorates the net-export balance.

From the initial instant, the economy proceeds in a smooth way towards the stationary state driven by the anticipation of a devaluation at date t_1 . In the adjustment period up to the devaluation date, it is plausible that the trade-balance continues to be in a deficit due to the investment led expansion in the economy.¹⁾ Provided the magnitude of the devaluation has been correctly foreseen, very little happens at the devaluation date since f.i. output is already at the level required to satisfy the higher export demand. Thus the economy continues the smooth adjustment towards the long run equilibrium. Although it is uncertain whether the trade balance in the new equilibrium is in a surplus or deficit, we observe that the path for the trade balance has similarity to the well known J-curve response.

Let us now briefly consider the case where $0 < \alpha < 1$. The adjustment of the capital stock in the good-and the bad news case is illustrated

1) This will be the case when the upward pressure on p resulting from increased investment demand dominates the downward pressure on p of the increased stock of capital, since the adjustment phase in that case will be characterised by both an increasing Y and p .

Surprise devaluation
Good-news case

Anticipated devaluation
Good-news case

Fig. 9

in diagram 10 and 11. Until the devaluation date the adjustment of the economy is qualitatively the same as in the two cases just discussed. At the devaluation date, however, agents realize that they underestimated the magnitude of the devaluation. In the good news case where the underestimated devaluation is tantamount with an underestimation of the future return of investing in capital, q jumps instantaneously up as shown by the movement from point A to B in diagram 10. The expectations-revision gives rise to a further expansion in the economy through increased investment demand and through increased net exports. In the bad news case, q jumps down at the devaluation date, which causes a contraction in output and employment. From the date where expectations have been revised, the economy adjusts towards the long run equilibrium in the same way as when the devaluation has been correctly foreseen. Finally, the case where $\alpha > 1$ is symmetrical to the case where $0 < \alpha < 1$ and can be worked out by the reader himself.

Good News Case

$$0 < \alpha < 1$$

Fig 10

Bad News Case

$$0 < \alpha < 0$$

Fig 11

Section 4

The Dynamics of A Devaluation Under Perfect Capital Mobility

Next we proceed to consider the long run effects of a devaluation under perfect capital mobility. The main difference to the zero-capital mobility case, studied in the previous sections, is that the domestic real interest rate now is fixed by the foreign. For this reason the structure of the model becomes much more simple since we can now leave out the LM-equation and the equation describing the evolution of the expected rate of inflation.

In what follows, we briefly run through the model and solve it for the long run effects of devaluation (and balanced budget fiscal expansion) on capital formation, the level of output and the trade balance.

The model reads in a total differentiated form;

Goodsmarket, supply and demand:

$$a) \quad dp = h_Y dY - h_K dK$$

$$b) \quad dY = C'_1(dY - dG) + f'(q)dq \cdot K + dK \cdot \Theta + dG + (C'_2 + X')de - (C'_2 + X')dp$$

Arbitrage - condition:

$$c) \quad \dot{q} = dq r^* - \Gamma_p dp \quad (\text{is the linearized version of } \frac{\dot{q}}{q} + \frac{F_k - f(q) + q(f(q) - \Theta)}{q} = r^*)$$

(30) Capital Dynamics:

$$d) \quad \dot{K} = f'(q)dq \cdot K$$

Trade-balance definition:

$$e) \quad db = S'(dY - dG) - f'(q)dq \cdot K - \Theta dK$$

Note that we have already made use of the fact that $dT = dG$ and $dF_K = \Gamma_p dp$

From (30a) and (30b) we derive the following semireduced form expressions for dY , dp :

$$(31) \quad \begin{aligned} a) \quad dY &= \frac{1}{1 - C'_1 + (X' + C'_2)h_Y} [f'(q)dq \cdot K + (\Theta + (X' + C'_2)h_K)dK + (1 - C'_1)dG + (X' + C'_2)de] \\ b) \quad dp &= \frac{h_Y}{1 - C'_1 + (X' + C'_2)h_Y} [f'(q)dq \cdot K + (\Theta + (X' + C'_2)h_K)dK + (1 - C'_1)dG + (X' + C'_2)de] \\ &\quad - h_K dK \end{aligned}$$

These expressions are identical to the earlier derived semi-reduced forms for dY and dp .

The state space form of the model is given below;

$$\begin{aligned}
 (32) \quad \begin{bmatrix} \dot{K} \\ \dot{q} \end{bmatrix} &= \begin{bmatrix} 0 & f'(q)K \\ \frac{\Gamma_p h_Y (\Theta + (X' + C'_2) h_K)}{\Omega} + \Gamma_p h_K & r^* - \frac{\Gamma_p h_Y f'(q)K}{\Omega} \end{bmatrix} \begin{bmatrix} (K - \bar{K}) \\ (q - \bar{q}) \end{bmatrix} \\
 &+ \begin{bmatrix} 0 & 0 \\ -\frac{\Gamma_p h_Y (X' + C'_2)}{\Omega} & -\frac{\Gamma_p h_Y (1 - C'_1)}{\Omega} \end{bmatrix} \begin{bmatrix} de \\ dG \end{bmatrix}
 \end{aligned}$$

where $\Omega = 1 - C'_1 + (X' + C'_2) h_Y$.

For there to be a unique saddle point equilibrium as well as a unique convergent saddle-path, the determinant of A , Δ , must fulfill the following condition:

$\Delta = -f'(q) K a_{21} < 0$. Thus, a_{21} must be positive. For a_{21} to be positive, we require:

$$\Gamma_p h_K > \frac{\Gamma_p h_Y (\Theta + (X' + C'_2) h_K)}{1 - C'_1 + (X' + C'_2) h_Y}$$

This condition is fulfilled when $h_K = h_Y$ and $\Theta < (1 - C'_1)$, which is a set of sufficient conditions. We assume that the saddlepoint condition is fulfilled and that the economy locates the stable manifold in response to shocks.

Diagram 12 and 13 below shows the two possible phase portraits. The locus of stationary values for q has the slope:

Fig 12

Fig 13

Fig 14

$$\left. \frac{\partial q}{\partial K} \right|_{\dot{q}=0} = \frac{a_{21}}{r^* - \frac{\Gamma_p h_Y f'(q) K}{\Omega}} > 0. \text{ For}$$

$$r^* - \frac{\Gamma_p h_Y f'(q) K}{\Omega} < 0, \quad \left. \frac{\partial q}{\partial K} \right|_{\dot{q}=0} > 0. \text{ This case is pictured in diagram}$$

$$12. \text{ In case } r^* - \frac{\Gamma_p h_Y f'(q) \cdot K}{\Omega} > 0, \quad \left. \frac{\partial q}{\partial K} \right|_{\dot{q}=0} < 0,$$

as shown in diagram 13. In both cases, the locus of stationary values for K is horizontal. The saddlepath is downward sloping in both diagrams, while the unstable path is upward sloping. Given that the two cases give qualitatively the same results, we confine our attention to diagram 12.

Let us now look at the long run effect of a devaluation on capital formation. Upon solving (32) we obtain table 3:

Table 3.

Policy	Long Run Effects
Devaluation	$\frac{dK}{de} = \frac{f'(q)K}{\Delta} \frac{(-\Gamma_p h_Y (X' + C'_2))}{\Omega} = \frac{h_Y (X' + C'_2)}{h_K (1 - C'_1) - h_Y \theta} > 0$
Balanced Budget Fiscal Expansion	$\frac{dK}{dG} = \frac{f'(q)K}{\Delta} \frac{(-\Gamma_p h_Y (1 - C'))}{\Omega} = \frac{h_Y (1 - C'_1)}{h_K (1 - C'_1) - h_Y \theta} > 0$

We observe that we obtain qualitatively the same results as in the 'zero capital-mobility good-news case'. Note that the pair of stability conditions $h_K = h_Y$ and $(1 - C'_1) > \theta$ together with the Marshall-Lerner condition, $(X' + C'_2) = \bar{X}(n_X + n_M - 1) > 0$, ensure a positive $\frac{dK}{de}$ and $\frac{dK}{dG}$. The

long run positive effect of a devaluation on K stems from the positive effect on profitability via the power of a devaluation to reduce the real wage rate at a constant cost of capital, cf. the term

$-\Gamma_p h_Y (X' + C'_2) = -\Gamma_p h_Y (n_X + n_M - 1) \bar{X}$. This causes the stockmarket to respond positively, which in turn leads to higher investment demand and gradually to a higher stock of capital, see Fig. 14. The same explanation applies to the crowding in result. Let us next turn our attention to the output-, pricelevel- and trade-balance effects. These long-run effects are contained in table 4.

Table 4.

Policy	Long Run Effects
Devaluation	$\frac{dY}{de} = \frac{1}{\Omega} [(\Theta + (X' + C'_2)h_K) \frac{dK}{de} + (X' + C'_2)] = \frac{(X'_2 + C'_2)h_K}{h_K(1 - C'_1) - h_Y\Theta} > 0$ $\frac{dp}{de} = \left[\frac{h_Y(\Theta + (X' + C'_2)h_K)}{\Omega} - h_K \right] \frac{dK}{de} + \frac{h_Y(X' + C'_2)}{\Omega} = 0$ $\frac{db}{de} = \frac{S'}{\Omega} [(\Theta + (X' + C'_2)h_K) \frac{dK}{de} + (X' + C'_2)] - \Theta \frac{dK}{de}$ $= \frac{(X' + C'_2)(S'h_K - h_Y\Theta)}{h_K(1 - C'_1) - h_Y\Theta} > 0$
Fiscal policy	$\frac{dY}{dG} = \frac{1}{\Omega} [(\Theta + (X' + C'_2)h_K) \frac{dK}{dG} + (1 - C')] = \frac{(1 - C'_1)h_K}{h_K(1 - C'_1) - h_Y\Theta} > 1.$ $\frac{dp}{dG} = \left[\frac{h_Y(\Theta + (X' + C'_2)h_K)}{\Omega} - h_K \right] \frac{dK}{dG} + \frac{h_Y(1 - C')}{\Omega} = 0$ $\frac{db}{dG} = S' \left[\frac{dY}{dG} - 1 \right] - \Theta \frac{dK}{dG} = \frac{S'(-\Theta h_Y M'_1)}{h_K(1 - C'_1) - h_Y\Theta} < 0$

Consider first the output-effects. As in the zero capital mobility good news case a devaluation increases output both through the positive effect on net exports and through the expansionary investment effect.

Upon using $h_K = h_Y$ and $1 - C'_1 = M'_1 + S'$, we observe that the model generates the simple Keynesian devaluation multiplier, $\frac{dY}{de} = \frac{(n_x + n_M - 1)\bar{X}}{S' + M'_1 - \theta}$, modified for capital-depreciation in the denominator. This result arises from the positive effect on capital accumulation of devaluation, which throughout the adjustment period has a deflationary effect in the economy, implying that the system converges towards an equilibrium where - among other things - the price level is restored to its initial level, cf.

below. Observe next that balanced budget neutral fiscal policy expands output not only through the demand-side effect but also through the positive effect on capital accumulation, implying that the balanced budget multiplier exceeds one. Hence we conclude that both devaluation and fiscal policy are effective instruments for correcting internal balance in the model.

Let us now proceed to consider the long run price level effect. The neutrality of a devaluation and a fiscal expansion with respect to the price level can most easily be understood by reconsidering the arbitrage condition in its original version: $\frac{\dot{q}}{q} + \frac{F_K - f(q) + q(f(q) - \theta)}{q} = r^*$. Under conditions where the real cost of capital, r^* , is exogenous given to the economy, the net marginal productivity of capital must eventually converge towards the constant foreign real interest rate, i.e. $\bar{F}_K - \theta = r^*$. Hence the long run increase in K is in both cases accompanied by an equi-proportionate increase in L , which in turn implies that the real wage rate in the long run is unaffected of -say-a devaluation. Due to the assumption of a rigid money wage this implies that the initial rise in the price level is succeeded by a period of deflation - or improved rate

of competitiveness.¹⁾ This result shows that a devaluation (and a fiscal expansion) does not lead to higher inflation in the longer run, provided the trade unions are willing to accept the temporary drop in real wages at the gain of higher future employment.

Diagram 15 below illustrates the adjustment of q , K , p , L and Y .²⁾

The role of devaluation for balance-of-payments correction is uncertain a priori. However, given the weak and empirically plausible assumption that $S' > 0$, table 4 shows that devaluation is an effective instrument for correcting external balance in the long run.³⁾ Uncer-

1). Formally, it is easily checked that the price-level in the long-run is unaffected by a devaluation: by solving the model recursively which also checks the results in table 3 and 4: From (30d) we obtain $dq = 0$, which together with (30c) gives $dp = 0$. Upon using this result and the assumption that $h_K = h_Y$ we obtain $\frac{dK}{de} = \frac{dY}{de}$ from (30a). Finally, (30b) gives the analytical expressions for $\frac{dK}{de}$ and $\frac{dY}{de}$ as stated in table 3 and 4.

2) Although the long-run employment and output effect of a devaluation are unambiguously expansionary, it is uncertain whether L and Y initially overshoot or undershoot the new long-run equilibrium levels. Formally, the adjustment of L can be written as: $\dot{L} = L_{\left(\frac{w}{p}\right)}(-\dot{p}) + L_K^+ \dot{K}$.

Thus, the level of L undershoots when the second term dominates the first in the $\dot{L}$ -equation. Whenever L undershoots (overshoots) we can be certain that Y undershoots (overshoots) as shown in fig. 15.

3) This result is in contrast to the view taken by Kouri (1979) who postulated within a framework where "the current account balance is simply equal to the difference between profit income and investment since domestic saving is by assumption equal to profit income" (Kouri (1979) p. 134), that. "The real exchange rate has an ambiguous effect on the current account balance: a depreciation of the exchange rate, for example, increases profits and saving on the one hand and profitability and the rate of investment on the other. It is not possible to say a priori which of these two effects dominates. Thus, the exchange rate cannot be viewed as an instrument for adjusting external balance. Rather, it is an instrument for adjusting internal balance and for keeping the economy on its full employment growth path". (Kouri (1979), p. 134).

tunity prevails, however, with regard to the impact trade balance effect of exchange rate policy. Upon taking the r.h.s. time derivative of the trade balance viewed from the export-import side we obtain: $\dot{b} = -\bar{X}(n_X + n_M - 1)\dot{p} - M_1^i \dot{Y}$, where the first term is positive throughout the adjustment period, while the sign of the second term is indeterminate. First we consider the case where Y initially overshoots, implying that Y is continually falling throughout the adjustment, see fig. (16a).¹ Thus in this case we can be certain that the trade balance continually improves throughout the adjustment phase. However, since the impact effect is uncertain we obtain two feasible paths for b as shown in fig. (16b). Consider next the case where Y initially undershoots, implying that $\dot{Y} > 0$ throughout the adjustment phase, see fig. (16c). From the equation for $\dot{b}$ we observe that this may still be compatible with a continually improving trade balance throughout the adjustment phase. Because of the indeterminacy of the impact trade-balance effect, we therefore obtain two feasible paths for b as shown in fig. (16d). Finally, in the case of rising imports due to increasing income outweighing the positive effect on b of the falling price level we obtain fig. (16e). In the latter case, we can be certain that devaluation is an effective balance-of-payments instrument also in the short run.

Finally, table 4 shows that expansionary fiscal policy is an effective instrument for correcting internal disequilibrium at the cost of a negative external account effect. Thus, the results obtained for the perfect capital mobility regime extend the conclusion drawn from a short run type Keynesian model concerning the effects of fiscal policy and exchange rate policy to be valid also in a longer run perspective.

1) See also note 2 on p. 48.

Fig 15

Note 1:

Fig. (16b) corresponds to the output path in fig. (16a).

Note 2:

Fig. (16d) and fig. (16e) show three feasible paths for the trade balance in the case when the output path is as shown in fig. (16c).

Conclusion

This paper has analysed the relationship between devaluation, profitability (discounted at the stockmarket), capital formation and the trade balance in a dynamic rational expectations macro model. Our point of departure has been a Keynesian unemployment situation. The analysis has been divided into two polar-cases: zero capital mobility and perfect capital mobility.

In the zero capital mobility regime, it has been shown that the long-run effects depend critically upon whether a devaluation increases expected future profitability more than the cost of capital, or vice-versa. In the "bad-news" case where the cost of capital effect dominates the higher expected future profitability which arises as a result of a lowered real-wage, the stock market responds negatively to a devaluation. Thus the valuation ratio (Tobin's q) jumps instantaneously down. This signals to the firms to decrease their level of investment; which gradually leads to a decumulation of the stock of capital. The dynamic adjustment of the economy depends, however, crucially upon whether the devaluation comes as a surprise or has been anticipated. In the case where the devaluation has been anticipated, it was shown that the decumulation of capital will take place at a lower speed in the beginning compared to the case where the devaluation comes as a surprise. The decumulation speed gradually increases until the devaluation date, thereafter slowing down again. At the date where the devaluation becomes anticipated, output and employment decline as a result of falling investment demand. The rise in net exports which occurs when the devaluation is implemented tends to offset the falling investment demand but the net effect on output (or real income) is

uncertain in the long run. This implies that the long run savings effect is indeterminate. Thus, the long run effect on the trade balance, defined from the savings minus investment point of view, is uncertain. Finally, it should be mentioned that a tax financed fiscal expansion in this case gives rise to a long-run crowding out effect.

In the "good-news" case where the stock market responds positively to devaluation, investments start immediately increasing in response to a previously unanticipated and an anticipated devaluation. The new long-run equilibrium is characterised by a higher stock of capital and also a higher level of real income. The higher stock of capital tends to worsen the trade balance through the higher level of gross-investment, while the higher income level works in the opposite direction via increased savings. The net trade-balance effect is indeterminate. In this case it was also shown that an anticipated devaluation expands output and employment before the devaluation date. Hence in the good news case, the trade balance goes initially into a deficit due to the investment led upturn in the economy which occurs in the anticipation of a future devaluation. In the bad news case the response is the opposite. Before we summarize the results valid under perfect capital mobility, it should be noted that a tax financed fiscal expansion has a long-run crowding in effect in this case.

Under perfect capital mobility we showed that devaluation expands output and the stock of capital in the long run. The trade-balance effect is uncertain, although most likely positive. While the long run employment effect under zero capital mobility is uncertain, it was shown that employment under perfect capital mobility unambiguously increases in the short- and the long run. Thus

in contrast to the zero-capital mobility case, a devaluation is not only an effective instrument for correcting internal imbalance, but it is also most likely an effective instrument for correcting external imbalance. With respect to fiscal policy, the analysis showed that the long-run balanced budget multiplier exceeds one. The positive effect on output of expansionary fiscal policy arises, however, at the cost of a worsened trade balance. Thus, the results obtained under perfect capital mobility concerning the scope of devaluation policy and fiscal policy for correcting external - and internal balance extend the conclusion drawn from short-run Keynesian analysis to be valid also in a longer-run time perspective.

Finally, we should mention that the model can be extended to deal with the monetary implications of balance-of-payments disequilibria. This requires only minor changes in the specification of the portfolio sector and the sources for asset accumulation. However, this modification implies the introduction of a third state-variable which increases the complexity of the dynamic analysis. Another interesting extension of the analysis would be to incorporate an imported raw material input into the model. This requires a three factor production function approach à la Bruno and Sachs (1982). The last qualification we should mention concerns the assumption of rigid money-wages. Although it was demonstrated that the real product wage is unaffected by devaluation in the long run under perfect capital mobility, it will be interesting to consider the role of devaluation policy under conditions where future recontracting is possible. I plan to deal with these issues in the future.

APPENDIX A

The slope of the stable and unstable path and the initial jump in q in response to devaluation news.

The General solution of the model can be written as:

$$(A1) \begin{bmatrix} K(t) \\ q(t) \end{bmatrix} = \begin{bmatrix} f_1^{(1)} & f_1^{(2)} \\ f_2^{(1)} & f_2^{(2)} \end{bmatrix} \cdot \begin{bmatrix} c_1 e^{w_1 t} \\ c_2 e^{w_2 t} \end{bmatrix} + \begin{bmatrix} \bar{K} \\ \bar{q} \end{bmatrix}$$

where $\begin{bmatrix} f_1^{(1)} \\ f_2^{(1)} \end{bmatrix}$ and $\begin{bmatrix} f_1^{(2)} \\ f_2^{(2)} \end{bmatrix}$ are the r.h.s. column eigenvectors

associated with respectively the eigenvalues w_1 and w_2 . $\begin{bmatrix} \bar{K} \\ \bar{q} \end{bmatrix}$ denotes the new steady state value of $\begin{bmatrix} K \\ q \end{bmatrix}$. Given that we already have assumed $\Delta < 0$ (the saddle point assumption) we know that the system is driven by one unstable and one stable eigenvalue. To ensure convergence of the system, we must choose initial conditions such that the system is driven only by the single stable root. Let us label the stable root w_S . The eigenvector associated with w_S fulfills by definition the following matrix equation:

$$(A2) \begin{bmatrix} 0 - w_S & f'(q)K \\ a_{21} & a_{22} - w_S \end{bmatrix} \begin{bmatrix} v_1^{(S)} \\ v_2^{(S)} \end{bmatrix} = \begin{bmatrix} 0 \\ 0 \end{bmatrix}$$

where $[v_1^{(S)}, v_2^{(S)}]$ denotes the eigenvector. Normalizing the eigenvector by setting $v_2^{(S)} = 1$ and solving for $v_1^{(S)}$ gives two identical expressions for $v_1^{(S)}$:

$$(A3) \quad v_1^{(S)} = - \frac{(a_{22} - w_S)}{a_{21}} \quad \text{and} \quad v_1^{(S)} = \frac{f'(q) \cdot K}{w_S}$$

We choose to work with the equation: $V_1^S = -\frac{(a_{22} - w_S)}{a_{21}}$. The dynamics of the system along the staple path (saddle path) may therefore be written as:

$$(A4) \begin{bmatrix} K(t) \\ q(t) \end{bmatrix} = \begin{bmatrix} -\left(\frac{a_{22} - w_S}{a_{21}}\right) \\ 1 \end{bmatrix} (pe^{w_S t}) + \begin{bmatrix} \bar{K} \\ \bar{q} \end{bmatrix}$$

where p (the initial condition) is to be determined by $K(0) = K_0$.

From (A4) we obtain

$$(A5) \quad pe^{w_S t} = - (K(t) - \bar{K}) \frac{a_{21}}{a_{22} - w_S}$$

so we may write:

$$(A6) \quad q(t) = - (K(t) - \bar{K}) \frac{a_{21}}{a_{22} - w_S} + \bar{q}$$

Hence,

$$(A7) \quad \left. \frac{\partial q(t)}{\partial K(t)} \right|_{SS} = \frac{-a_{21}}{a_{22} - w_S}.$$

In the "bad-news" case $a_{22} > 0$, hence

$$(A8) \quad \left. \frac{\partial q(t)}{\partial K(t)} \right|_{SS}^{\text{bad news}} = - \frac{(+) }{ (+) - (\div) } < 0,$$

which proves that the saddle path is negatively sloped in the bad news case. In the "good-news" case pictured in diagram 2, $a_{22} < 0$, which seems to imply that the slope of the saddle path in this case is indeterminate. The property that $TR(A)$ equals the sum of the eigenvalues solves this ambiguity: $w_S + w_u = a_{22}$, hence $a_{22} - w_S = w_u > 0$, thus the saddle path in the "good-news" case is

unambiguously downward sloping:

$$(A9) \quad \left. \frac{\partial q(t)}{\partial K(t)} \right|_{\substack{\text{good} \\ \text{news} \\ \text{SS}}} = - \frac{(+)}{(+)} < 0 .$$

Let us now determine the initial jump in q assuming that q in response to devaluation news will jump on the new saddle path. By the property that $K(t)$ at every given instant is predetermined we know that $(K(t) - \bar{K})$ at $t = 0$ equals

$$\div \left[\frac{f'(q)K}{\Delta} \left(\frac{\gamma' h_Y + \lambda' - \Gamma_P h_Y}{D} \right) (X' + C_2') de \right]$$

as calculated in the text. At $t = 0$, the saddle path equation given by (6) may therefore be written as:

$$(A11) \quad q(0) - \bar{q} = + \left[\frac{f'(q) \cdot K}{\Delta} \left(\frac{\gamma' h_Y + \lambda' - \Gamma_P h_Y}{D} \right) (X' + C_2') de \right] \frac{a_{21}}{a_{22} - w_S}$$

or equivalently as:

$$(A12) \quad \frac{dq}{de} = \frac{f'(q) \cdot K}{\Delta} \left(\frac{\gamma' h_Y + \lambda' - \Gamma_P h_Y}{D} \right) (X' + C_2') \left(\frac{a_{21}}{a_{22} - w_S} \right)$$

This expression gives the jump in q in response to devaluation news arrived at time $t = 0$. Given that the last term already has been shown to be positive and given that $\Delta < 0$ we conclude

$$\text{that } \left. \frac{dq}{de} \right|_{\text{news}}^{\text{bad}} < 0 \quad \text{and} \quad \left. \frac{dq}{de} \right|_{\text{news}}^{\text{good}} > 0$$

as argued in the text.

Finally, what remains to show is that the slope of the unstable path (UU) in both cases is positive. The dynamics of the homogeneous part of the system in case the model is driven by the unstable root, w_u , can be written as:

$$(A13) \quad \begin{bmatrix} K(t) \\ q(t) \end{bmatrix} = \begin{bmatrix} - \left(\frac{a_{22} - w_u}{a_{21}} \right) \\ 1 \end{bmatrix} \begin{pmatrix} w_u t \\ v e^{\cdot} \end{pmatrix}$$

From (A13) we obtain the equation for the unstable path:

$$(A14) \quad q(t) = - \left(\frac{a_{21}}{a_{22} - w_u} \right) K(t)$$

Given that $a_{22} - w_u = w_s < 0$, we observe that in both cases $\left. \frac{\partial q(t)}{\partial K(t)} \right|_{uu} > 0$. In the good news case, it can further be shown that

$$(A15) \quad \left. \frac{\partial q(t)}{\partial K(t)} \right|_{\dot{q}=0} = - \frac{a_{21}}{a_{22}} > \left. \frac{\partial q(t)}{\partial K(t)} \right|_{uu} = - \frac{a_{21}}{a_{22} - w_u} > 0 .$$

(A15) tells us that the slope of the locus of stationary values for q in the good news case is steeper than the uu -curve.

Restrictions Implied by the Marshall-Lerner Condition:

Disposable income in units of domestic output is defined as:

$$(A16) \quad Y - T = C(Y - T, \frac{e}{p}) + \frac{e}{p} M(Y - T, \frac{e}{p}) + S(Y - T, \frac{e}{p})$$

The partial derivative of (A16) with respect to e is given as follows:

$$(A17) \quad \frac{\partial(Y - T)}{\partial e} = C'_2 + \frac{M}{\bar{p}} + \frac{\bar{e}}{\bar{p}} M'_2 + S'_2 = 0$$

Suppose next that domestic residents total aggregate consumption expenditure is independent of e (or in general the terms of trade). Thus

$$(A18) \quad C'_2 + \bar{M} + M'_2 = 0 \quad \text{or} \quad S'_2 = 0,$$

where we have used the normalisation $\bar{e} = \bar{p} = 1$. (A18) gives rise to the following relationship:

$$(A19) \quad C'_2 = -M'_2 - \bar{M} = (-M'_2 \frac{\bar{e}}{\bar{M}} - 1)\bar{M} = (\eta_M - 1)\bar{M},$$

where η_M is the import elasticity. We observe that C'_2 may be positive or negative. Let us next assume that the Marshall-Lerner condition holds true:

$$(A20) \quad \eta_X + \eta_M - 1 > 0,$$

where η_X is the export elasticity. Upon substitution of (A19) into

(A20) we obtain:

$$(A21) \quad \eta_X + \frac{C'_2}{\bar{M}} > 0$$

or equivalently:

$$(A22) \quad X' \frac{\bar{e}}{\bar{X}} + \frac{C'_2}{\bar{M}} > 0.$$

The assumption of balanced trade initially and $\bar{e} = 1$ gives

$$(A23) \quad X' + C_2' > 0.$$

Thus, the Marshall-Lerner condition ensures together with $S_2' = 0$ that $X' + C_2' > 0$.

Appendix B

Linearization of the arbitrage condition

The arbitrage condition:

$$(B1) \quad \frac{\dot{q}}{q} + \frac{F_K - f(q) + q(f(q) - \theta)}{q} = r - \frac{\dot{p}}{p}$$

Multiplying through by q and substituting in for $\frac{\dot{p}}{p}$ (see (18g)) gives:

$$(B.2) \quad \dot{q} = r q - [F_K - f(q) + q(f(q) - \theta)] \\ - \frac{q[h_Y f'(q) \bar{q} + (h_Y \theta - h_K(1 - C'_1))(f(q)K - \theta K)]}{p(1 - C'_1 + h_Y(C'_2 + X'))}$$

where we also have made use of (18f). So,

$$(B.3) \quad \dot{q} \left[1 + \frac{q h_Y f'(q) \bar{q}}{p(1 - C'_1 + h_Y(X' + C'_2))} \right] = r q - [F_K - f(q) + q(f(q) - \theta)] \\ - \frac{q[(h_Y \theta - h_K(1 - C'_1))(f(q)K - \theta K)]}{p(1 - C'_1 + h_Y(C'_2 + X'))}$$

Hence,

$$(B.4) \quad \dot{q} = \frac{p(1 - C'_1 + h_Y(X' + C'_2))[r q - (F_K - f(q) + q(f(q) - \theta))]}{p(1 - C'_1 + h_Y(X' + C'_2)) + q h_Y f'(q) \bar{q}} \\ - \frac{q[(h_Y \theta - h_K(1 - C'_1))(f(q)K - \theta K)]}{p(1 - C'_1 + h_Y(X' + C'_2)) + q h_Y f'(q) \bar{q}}$$

Let us now linearize $\dot{q}$ around the initial equilibrium, where the following relationships hold true:

$$\begin{aligned}
\bar{r} \cdot \bar{q} - (\bar{F}_K - \theta) &= 0 \\
(B.5) \quad f(\bar{q}) - \theta &= 0 \\
\bar{p} = \bar{q} &= 1
\end{aligned}$$

We also define the following constants:

$$\begin{aligned}
Z_1 &= 1 - C'_1 + h_Y(X' + C'_2) \\
(B.6) \quad Z_2 &= h_Y f'(q) \bar{K} \\
Z_3 &= h_Y \theta - h_K(1 - C'_1)
\end{aligned}$$

We obtain upon linearization:

$$\begin{aligned}
\dot{\bar{q}} &\approx 0 + d\left(\frac{pZ_1}{pZ_1 + qZ_2}\right)[\bar{r} \cdot \bar{q} - (\bar{F}_K - \theta)] \\
&+ (dr \cdot \bar{q} + dq \cdot \bar{r} - dF_K) \frac{\bar{p}Z_1}{\bar{p}Z_1 + \bar{q}Z_2} \\
(B.7) \quad &- d\left(\frac{qZ_3}{pZ_1 + qZ_2}\right)[f(\bar{q})\bar{K} - \theta\bar{K}] \\
&- \frac{\bar{q}Z_3}{\bar{p}Z_1 + \bar{q}Z_2} [f'(q)dq\bar{K} + dKf(\bar{q}) - \theta dK] \\
&= \\
&(dr + dq \cdot \bar{r} - dF_K) \frac{Z_1}{Z_1 + Z_2} \\
(B.8) \quad &- \frac{Z_3}{Z_1 + Z_2} (f'(q)dq \cdot \bar{K})
\end{aligned}$$

which is the expression in the text.

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