Imported Intermediate Goods, Foreign Price Increases, and Domestic Monetary Policy: The IS-LM Analysis Revived*

By Horst Herberg and Ewen McCann

Until recently imports of intermediate goods have been neglected in monetary (not in real) trade theory. This paper deals with the macroeconomic consequences of such imports. The basic analytical tool is a suitably modified Hicksian IS-LM diagram. It is shown that trade in intermediate goods does have some particular implications that do not arise otherwise.

I. Introduction

For a number of years the *Fleming/Mundell* (FM) model[1] has been the corner-stone of open economy macroeconomics.[2] This model was based on a number of simplifying assumptions the main ones being:

> "To focus attention on policies affecting the level of employment, we assume unemployed resources, constant returns to scale, and fixed money wages; this means that the supply of domestic output is elastic and *its price level constant.*"[3]

Mundell mentions three conditions for a fixed domestic product price, and there is still a fourth one: absence of imported intermediate goods (raw materials, semi-finished products etc.). The recent oil-price crises, however, have reminded us that the fourth condition is untenable. In addition, since the worldwide upsurge of inflation rates money wages have become indexed in many countries and in others wage negotiations are geared at preventing a fall in real wages. Hence, the assumption of a fixed money wage should be abandoned.[4] In other words, the FM

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[1] *Fleming* (1962), *Mundell* (1963).

[2] Cf. *Chacoliades* (1978), chapt. 17, *Dornbusch* (1980), chapt. 11, *Dornbusch & Fischer* (1978), chapts. 18, 19, *Sohmen* (1969), chapt. V, *Takayama* (1972), chapts. 10, 11. (This list is far from exhaustive.)

[3] *Mundell* (1963), 476; our emphasis.

[4] The wide use of expectation-augmented Philipps curve indicates that this condition is no longer generally accepted.

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model has to be appropriately modified if it is to remain a useful analytical device.

In recent years a number of authors have studied the consequences of foreign price increases and domestic economic policy for an economy importing intermediate goods. There are, for example, papers by *Bruno* and *Sachs* (1979), *Findlay* and *Rodriguez* (1977), *Herberg* (1976), (1980), (1981), *Herberg, Hesse* and *Schuseil* (1982), *Obstfeld* (1980) and *Schmid* (1976), (1980)[5].

These authors have covered important ground and answered many questions at issue. Our main reason for nevertheless writing yet another paper is to show that the Hicksian IS-LM analysis can be easily adapted to take into account intermediate imports and the consequent variability of domestic product prices and to provide a simple method for deriving quite a number of conclusions. This method is especially suited to handle different possible conditions related, for example, to the type of trade balance reaction to exchange rate changes or to the degree of wage indexation. Since Hicksian diagrams are well-known and widely used in macroeconomics their adaption we are going to propose should help to understand more easily how intermediate imports affect the basic economic relationships and which implications this has for the working of the system.

This paper is organized as follows: In section II we state our assumptions and derive some basic relationships. Section III is devoted to establishing the properties of the equilibrium loci for the commodity market, the money market and the balance of payments, i. e. the IS, LM and BK curves. In the final section IV we present a graphical analysis of the consequences of foreign price increases under fixed or flexible exchange rates, of a devaluation of the home currency, and of monetary policy under flexible exchange rates. (With regard to fiscal policy cf. *Herberg, Hesse* and *Schuseil* (1982).)

II. Assumptions and basic equations

We shall study a two-country world with a small domestic or home economy and a large foreign economy. The domestic economy produces a single, final (composite) commodity that can be consumed and invested at home or exported. The foreign economy produces two more (com-

[5] An approach to explain domestic price variability without introducing intermediate goods has been followed by *Argy* and *Salop* (1979). They work with a price index that depends on the prices of domestic and foreign consumption goods and with varying degrees of money illusion on the part of labour.

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posite) commodities, one of them a tradeable purely intermediate good, the other one a non-tradeable final good that is a non-perfect substitute of the domestic product.

This is a minimal structure for a model for studying the consequences of intermediate imports. Assuming that the foreign tradeable commodity also serves final purposes does not change the conclusions more than marginally — cf. *Herberg/Hesse/Schuseil* (1982). And, as *Sanyal* and *Jones* (1982) have argued, almost every imported commodity has at least to be transported and retailed before it can be consumed. Moreover, taking the home economy to be the sole producer of one of the commodities is consistent with casual observations (Swiss watches, Columbian coffee, Swedish steel) and empirical evidence — cf., e.g., *Isard* (1977), *Lipsey* and *Kravis* (1977).

With regard to the home economy we make the following assumptions (A 1) - (A 9):

(A 1) *Production Function*

$$Q = F(N, R) \tag{1}$$

Q output net of depreciation, N labour input, R input of the imported intermediate good (all in physical units).

F is a neoclassical production function; it is especially linear homogeneous and strictly quasi-concave. The elasticity of substitution, σ, between N and R is non-negative and less than unity.

(A 2) *Labour Supply and Wage Formation*

Labour supply is completely elastic at the current nominal wage rate, W. This wage rate is indexed with respect to the price of the domestic product, P:[6]

$$\hat{W} = \alpha \hat{P}, \quad 0 \leq \varkappa = \text{const} \geq 0 \tag{2}$$

α will be called the degree of wage indexation. Obviously, under perfect indexation ($\alpha = 1$) the real wage rate W/P is constant, under no indexation ($\alpha = 0$) the nominal wage rate is constant, while imperfect indexation ($0 < \alpha < 1$) implies that W increases but W/P falls as P goes up.[7]

(A 3) *Price Formation*

Domestic producers mark-up their minimum variable costs:

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[6] $\hat{u}$ denotes the relative change du/u.

[7] In countries without formal wage indexation but with trade unions trying to prevent real wages to decline α could be interpreted as the unions' elasticity of price expectations.

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(3) $$P = (1 + \varkappa)\,(WN + P_R\,R)\,/\,Q, \qquad \varkappa = \text{const} \geq 0$$

P_R domestic currency price of the imported input

These three assumptions define the domestic aggregate supply function, the import function and the real income/output relationship. They will be derived in turn.

Aggregate Supply Function

This function describes the relationship between the domestic supply price P, the output level Q and the domestic price P_R of the intermediate good.

Define:[8]

(4)

$$\Theta_N := WN/(WN + P_R\,R) \qquad \text{cost share of labour}$$

$$\Theta_R := P_R\,R/(WN + P_R\,R) = 1 - \Theta_N \qquad \text{cost share of the imported input}$$

(5)

$$\varrho_N := E\,(Q, N) \qquad \text{output elasticity with respect to labour}$$

$$\varrho_R := E\,(Q, R) \qquad \text{output elasticity with respect to the imported input}$$

Both ϱ_i are positive and because of the linear homogeneity of F they add up to unity.

Cost minimization requires

$$W/P_R = \frac{\partial F/\partial N}{\partial F/\partial R} = (R/N)\,(\varrho_N/\varrho_R)\ .$$

Hence, $\Theta_N = \varrho_N$, $\Theta_R = \varrho_R$. From (2) - (4)

(6) $$\hat{P} = \alpha\Theta_N\,\hat{P} + \Theta_R\,\hat{P}_R + \Theta_N\,\hat{N} + \Theta_R\,\hat{R} - \hat{Q}\ .$$

Moreover, eq. (1) and the definition of σ, ϱ_N and ϱ_R imply:

$$\hat{Q} = \varrho_N\,\hat{N} + \varrho_R\,\hat{R} = \vartheta_N\,\hat{N} + \Theta_R\,\hat{R}, \quad \hat{R} - \hat{N} = \sigma\,(\hat{W} - \hat{P}_R)$$

Therefore,

(7) $$\hat{R} = \hat{Q} + \sigma\Theta_N\,(\hat{W} - \hat{P}_R), \quad \hat{N} = \hat{Q} - \sigma\Theta_R\,(\hat{W} - \hat{P}_R)\ .$$

Finally, inserting (7) into (6) we find:

(8) $$\eta := E\,(P, P_R) = \Theta_R/(1 - \alpha\Theta_N) \left\{ \begin{array}{l} > 0 \text{ generally} \\ \leqq 1 \text{ for } \alpha \leqq 1 \end{array} \right.$$

[8] $E\,(u, v)$ denotes the (partial) elasticity of u with respect to v.

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(9) $$E(P, Q) = 0$$

The last two equations imply

(i) that for given P_R the domestic supply curve is horizontal,

(ii) that a, say, one-percent increase in P_R shifts the curve upwards by η percent and causes the domestic terms of trade P/P_R to deteriorate by $1 - \eta$ percent.

Import Function

Real imports, defined as $M = P_R R/P$, are determined by the output level and the domestic price of the intermediate good: $M = M(P_R, Q)$. The partial elasticities of this function can be derived from $\hat{M} = \hat{P}_R + \hat{R} - \hat{P}$, $\hat{W} = \alpha \hat{P}$ and eqs. (7) - (9):

(10) $$\mu := E(M, P_R) = (1 - \alpha)(1 - \eta) \gtrless 0 \text{ for } \alpha \lesseqgtr 1$$

(11) $$E(M, Q) = 1$$

We recall that for $\alpha = 1$ a change in P_R leaves P_R/P and P_R/W unaffected. Since there is then no input substitution R remains constant and μ equals zero. For $\alpha < 1$, however, P_R/P and P_R/W increase as P_R goes up. Substitution leads to a fall in R but because of $\sigma < 1$ this is proportionally smaller than the rise in P_R/P. Hence, μ is positive. Moreover, since the production function is linear homogeneous in N and R and since P is independent of Q it follows that R and M change by the same percentage as Q, i. e. eq. (11) holds.

Real Income/Output Relationship

It is important, though trivial, to observe that the home economy's nominal value-added, i.e. its nominal income, $\tilde{Y}$, falls short of the output value, PQ, by the value of intermediate imports, $P_R R$. Defining real income Y as $\tilde{Y}/P$ we therefore have:

$$Y = Q - M = (1 - \bar{m}) Q \quad \text{with } \bar{m} = M/Q < 1$$

Real income is thus also a function of output and the domestic price of the imported input: $Y = Y(P_R, Q)$. More specifically,

(12) $$dY = (1 - \bar{m})\, dQ - M \mu \hat{P}_R \ .$$

(A 4) *Domestic Absorption*

Domestic real absorption A depends on real income and on the interest rate r:[9]

[9] A_Y denotes the partial derivative $\partial A/\partial Y$, and A_r etc. is similarly defined.

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(13) $$A = A(Y, r), 0 < A_Y < 1, A_r < 0$$

(A 5) *Exports*

Real exports X are a function of the ratio P/P^* of the domestic supply price and the domestic price of the foreign import-competing commodity:

(14) $$X = X(P/P^*), -\infty < \xi = E(X, P/P^*) < 0$$

(A 6) *Money Demand and Supply*

Real money demand L depends on output and the interest rate:

(15) $$L = L(Q, r), 0 < E(L, Q) < 1, L_r < 0$$

Output has been taken as a determinant of real money demand since its value PQ seems to be a better proxy for the total volume of transactions than nominal income PY.

Nominal money supply H has two sources: Domestic credit creation (H^d) and foreign reserve transactions by the domestic central bank (H^f):

(16) $$H = H^d + H^f, \dot{H}^f = Z$$

Z nominal balance of payments, $\dot{H}^f$ time derivative of H^f

(A 7) *Net Capital Imports*

Nominal net capital imports in terms of domestic currency, K, depend on the international interest differential. With the foreign interest rate given and exchange rate expectations being static:

(17) $$K = K(r), 0 \leq K' \lesseqgtr \infty$$

(A 8) *Domestic/Foreign Price Relationships*

There are no tariffs, transport costs or other trade impediments:

(18) $$P_R = e\,\Pi_R, P^* = e\,\Pi^*$$

e exchange rate (domestic currency price of a foreign currency unit), Π_R, Π^* prices of the two foreign goods in terms of foreign currency.

As mentioned earlier, we are especially interested in the consequences of increases in the price of the intermediate commodity. Therefore, we shall take the price of the other foreign good, Π^*, to remain constant, and without loss we normalize it to unity.

Let us summarize. The home economy is described by the following 5 equations:

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supply function:

$$P = P\,(e\,\Pi_R) \tag{19}$$

real income/output relationship:

$$Y = Q - M\,(e\,\Pi_R, Q) \tag{20}$$

commodity market equilibrium:

$$Q = A\,(Y, r) + X\,(P/e) \tag{21}$$

money market equilibrium:

$$PL\,(Q, r) = H,\ H = H^d + H^f,\ \dot{H}^f = Z \tag{22}$$

balance of payments:

$$Z = P\,[X\,(P/e) - M\,(e\,\Pi_R, Q)] + K\,(r) \tag{23}$$

III. Properties of the IS, LM and BK curves

The graphical analysis will be based on a suitable adaption of the Hicksian diagram in (Y, r)-space. Obviously, we could also use similar diagrams in (Q, r)-space or like *Argy* and *Salop* (1979) in (Y, P)-space but then the implications of our model would not stand out as clearly against those of the FM model.

Three equilibrium loci are of importance. They are defined now as follows:

IS curve: commodity market equilibrium (eq. (21)),

LM curve: money market equilibrium (eq. (22)),

BK curve: balance-of-payments equilibrium (eq. (23) with $Z = 0$),

each subject to the aggregate supply function (eq. (19)) and the real income/output relationship (eq. (20)).

To establish the properties of these loci we first form the total differentials of the last 5 equations:

$$\begin{pmatrix} 0 & 0 & 1 \\ 1 & -(1-\bar{m}) & 0 \\ -A_Y & 1 & -X\xi \\ 0 & L_Q & L \\ 0 & \bar{m} & -X\xi - X + M \end{pmatrix} \begin{pmatrix} dY \\ dQ \\ \hat{P} \end{pmatrix} \tag{24}$$

$$= \begin{pmatrix} 0 & 0 & \eta & \eta \\ 0 & 0 & -M\mu & -M\mu \\ A_r & 0 & 0 & -X\xi \\ -L_r & 1 & 0 & 0 \\ K'/P & 0 & -M\mu & -X\xi - M\mu \end{pmatrix} \begin{pmatrix} dr \\ dH \\ \hat{\Pi}_R \\ \hat{e} \end{pmatrix}$$

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1. IS Curve

Solving the first three equations of (24) for dY yields:

$$[1-(1-\bar{m})\,A_Y]\,dY=(1-\bar{m})\,A_r\,dr+[(1-\bar{m})\,\eta\,X\,\xi-M\,\mu]\,\hat{\Pi}_R+\hat{\Gamma}\,\hat{e} \tag{25}$$

with

$$\Gamma:=-(1-\bar{m})\,(1-\eta)\,X\,\xi-M\,\mu=-(1-\eta)\,[(1-\bar{m})\,X\,\xi+(1-\sigma)\,M] \tag{26}$$

The coefficient of dY is positive and those of dr and $\hat{\Pi}_R$ are negative while Γ may be of either sign. Therefore,

$$\partial Y/\partial r<0: \quad \text{negative slope} \tag{27a}$$

$$\partial Y/\partial \Pi_R<0: \quad \text{leftward shift if } d\Pi_R>0 \tag{27b}$$

$$\partial Y/\partial e \begin{cases} >0 \text{ if } \Gamma>0: & \text{rightward shift} \\ =0 \text{ if } \Gamma=0, & \text{especially } \alpha=1\text{: } no\ shift \\ <0 \text{ if } \Gamma<0: & \textit{leftward shift} \end{cases} \text{ if } de>0 \tag{27c}$$

Clearly, Γ should be related to the Marshall-Lerner (ML) condition, and it is easy to see that this is indeed the case.

From (8) - (11),

$$dX=X\,\xi\,(\hat{P}-\hat{e})=-(1-\eta)\,X\,\xi\ , \quad dM=M\hat{Q}+\hat{M}\,\mu\,\hat{e} \tag{28}$$

As the ML condition usually requires real income to be still unchanged we impose this restriction here as well. (12) implies that then $\hat{Q}=\bar{m}\,\mu\,\hat{e}/(1-\bar{m})$, and inserting this equation into (28) yields:

$$dX-dM\Big|_{Y=\text{const}}=\Gamma\,\hat{e}/(1-\bar{m}) \tag{29}$$

Hence, the LM condition is satisfied if $\Gamma>0$ and is strictly violated if $\Gamma<0$.

It is important to note that Γ is related to the change in the real trade balance following an exchange rate change *with the price of the domestic product adjusting.* Therefore, Γ must be zero if wages are perfectly indexed since then a variation in e leaves real exports and real imports unaffected. This is indeed borne out by the RHS of the definition of Γ (remember that $\alpha=1$ implies $\eta=1$).

In the FM model the ML condition is necessary and sufficient for stability. This is no longer true for the present model, and hence we may, and will, study the consequences of $\Gamma<0$.

The last observation is of some importance for at least two reasons:

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(i) The recent debate about J-curve effects has reminded us that demand elasticities usually are rather small in the short run and only increase as time goes by.

(ii) Intermediate imports tend to make an anomalous trade balance reaction more likely. In the FM model the ML condition is met if the sum of the domestic and foreign elasticities of demand for imported final goods exceeds unity. In case of an initial trade equilibrium ($X = M$) it presently requires $|\xi| > (1 - \sigma)/(1 - \bar{m})$. Hence the foreign demand elasticity alone has to exceed unity by a sufficient margin if the elasticity of substitution is smaller than the share of imported inputs in the total value of output, i.e. $\sigma < \bar{m}$.

2. LM Curve

The properties of the LM curve can be derived from the first two and the fourth equation in (24). They imply:

(30) $L_Q\, dY = -(1 - \bar{m})\, L_r\, dr + (1 - \bar{m})\, dH - [(1 - \bar{m})\, L\, \eta + ML_Q\, \mu]\, (\hat{\Pi}_R + \hat{e})$

and therefore

(31a) $\partial Y/\partial r > 0$: positive slope

(31b) $\partial Y/\partial H > 0$: rightward shift if $dH > 0$

(31c) $\partial Y/\partial e < 0$, $\partial Y/\partial \Pi_R < 0$: *leftward shift* if $de > 0$ or $d\Pi_R > 0$

The last shift results from the fact that an increase in either e or Π_R raises the domestic price and hence lowers *real* money supply.

3. BK Curve

Solving the first two and the last equation in (24) for dY and denoting the real trade balance $X - M$ by B we find:

(32) $$\bar{m}dY = (1 - \bar{m})\, (K'/P)\, dr + [(1 - \bar{m})\, (B + X\, \xi)\, \eta - M\, \mu]\, \hat{\Pi}_R + [(1 - \bar{m})\, B\, \eta + \Gamma]\, \hat{e}$$

To preserve the usual slope of the BK curve we assume:

(A 9) $$B + X\, \xi = X - M + X\, \xi < 0$$

This assumption holds if, for example, the trade balance was initially balanced, in deficit or not too large a surplus or, alternatively, if foreign import demand is elastic ($|\xi| \geq 1$).

All coefficient in (32) except the last one are sign determinate. Therefore,

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$$\text{(33a)}\quad \partial Y/\partial r \begin{cases} = 0 & \text{if } K' = 0\text{:} \quad \text{vertical curve} \\ > 0, < \infty & \text{if } 0 < K' < \infty\text{:} \quad \text{positive slope} \\ = \infty & \text{if } K' = \infty\text{:} \quad \text{horizontal curve} \end{cases}$$

$$\text{(33b)}\quad \partial Y/\partial \Pi_R < 0\text{: leftward shift if } d\Pi_R > 0 \text{ and } K' < \infty$$

$$\text{(33c)}\quad \partial Y/\partial e \begin{cases} > 0 \text{ if } (1-\bar{m})B\eta + \Gamma > 0\text{:} & \text{rightward shift} \\ = 0 \text{ if } (1-\bar{m})B\eta + \Gamma = 0\text{:} & \textit{no shift} \\ < 0 \text{ if } (1-\bar{m})B\eta + \Gamma < 0\text{:} & \textit{leftward shift} \end{cases} \Bigg\} \begin{array}{l} \text{if } de > 0 \\ \text{and} \\ K' < \infty \end{array}$$

Clearly, for $K' = \infty$ changes in Π_R or e leave the BK curve unperturbed.

It might be surprising that the properties of the BK curve depend, *inter alia*, on the initial trade balance situation. This is due to the fact that in the present model the domestic product price can be expected to vary and that, consequently, the nominal trade balance is subject to pure price effects equal to $B\dot{P}$. These effects will, of course, alter the balance of payments, and to bring it back into equilibrium some additional change in, say, real income is required.

The basic reason for such purely nominal effects is that by assumption (A 7) it is *nominal* capital flows that depend on the interest rate and that, therefore, the balance of payments is not linear homogeneous in P. These effects would disappear under the alternative assumption:

(A 7 a) *Real* net capital imports depend on the interest rate:

$$\text{(20a)}\qquad K = Pk(r),\ 0 \leq k' \leq \infty$$

The implications of (A 7 a) are covered by our formulae with $B \equiv 0$ in eq. (32).

Rather than these two extreme alternatives the intermediate one $K = K(P, r)$, $0 < E(K, P) < 1$, $0 \leq K_r \leq \infty$, should be closer to reality. But then again pure price effects on the nominal trade balance exist and the initial trade situation matters, although to a lesser degree.

4. Some General Conclusions

In spite of major changes in assumptions the IS, LM and BK curves in the FM model and the present one have most properties in common. But there are also important differences that are due to the existence of imported inputs:

(i) In the FM model a devaluation of the home currency induces a rightward shift of the IS and BK curves since stability requires the

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ML condition to be satisfied. In our model a leftward shift is also possible since we need not impose this condition.

(ii) In the FM model a devaluation or an increase in the foreign price of the imported commodity leave the domestic supply price and thus real money supply and the LM curve unchanged. In our model they raise P, lower H/P and shift the LM curve to the left.

IV. Graphical analysis

We distinguish between two types of general equilibria, one with the commodity and the money market cleared (to be called *short-run equilibrium*), the other one with the balance of payments balanced as well (to be called *quasi-long-run equilibrium*). Obviously, a short-run equilibrium is characterized by a point of intersection of the IS and LM curves and a quasi-long-run equilibrium is represented by a point of intersection of all three curves (if such a point exists at all).

Assume that initially the home economy is in a quasi-long-run equilibrium. Under flexible exchange rates it moves, after there has been an exogeneous disturbance, directly to another such an equilibrium since the balance of payments remains at zero level. But under fixed exchange rates an outside shock will normally cause a payments surplus or deficit and hence lead to a new short-run equilibrium only. The domestic central bank could try to neutralize completely the impact of the consequent inflow or outflow of foreign reserves on nominal money supply ($dH^l = -dH^d$). Then the once attained short-run equilibrium would persist as long as there is no policy change and no further disturbance. If, on the other hand, balance-of-payments induced changes in money supply are allowed to occur the home economy will go through a series of short-run equilibria and, provided stability prevails, finally reach a new quasi-long-run equilibrium. The latter is characterized, *inter alia*, by a new level of nominal money supply.

1. Foreign Price Increases

Suppose the foreign price Π_R of the imported intermediate good has gone up. This shifts, as shown in *Figure 1*, the three curves from positions IS, LM, BK to IS′, LM′, BK′. The new short-run equilibrium under fixed exchange rates is at point U where IS′ and LM′ intersect. U is obviously associated with a lower level of real income than the initial equilibrium point T. Simultaneously the cost-push effects of the higher Π_R and possibly also higher nominal wages have raised the domestic product price. The fall in real absorption and in real exports

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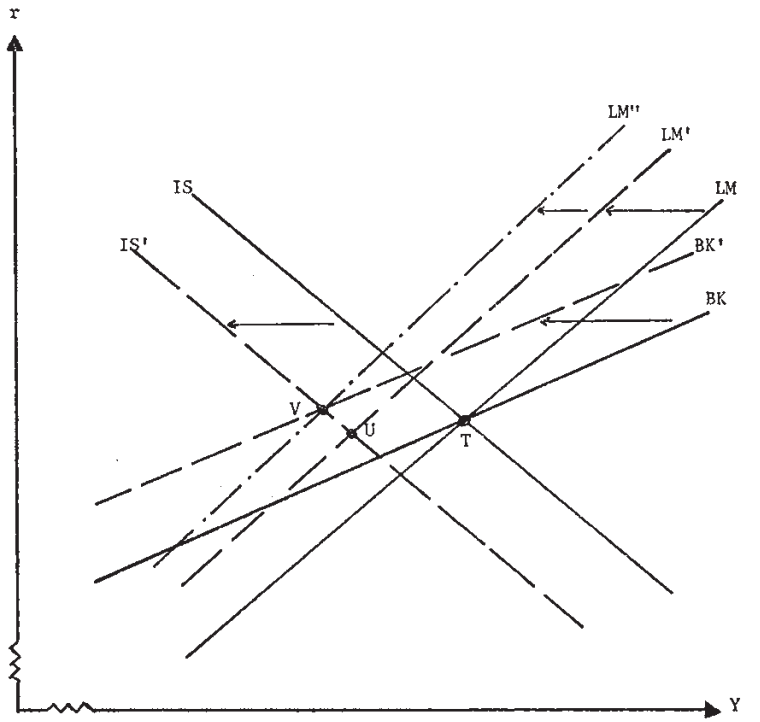

Fig. 1

that results from the decline in Y and the increase in P, respectively, means lower total demand for the home product and hence reduces output as well. If the domestic central bank pegged the exchange rate and also kept the nominal money supply constant or if the new quasi-long-run equilibrium happened to be at U these would be already the permanent changes. Otherwise, however, there are further effects.

Under fixed exchange rates nominal money supply will normally change over time. In Figure 1 we have depicted the case that, as U lies above BK′, payments have turned into deficit. The consequent fall in H leads to a secondary leftward shift of the LM curve until it reaches position LM″ and then passes through the point of intersection V of IS′ and BK′. This transition to the new quasi-long-run equilibrium is accompanied by an additional fall in real income and output but no further price changes.

If instead the balance of payments first turns into surplus, i.e. if the U lies to the left of BK′, then the induced increase in H will partly, but not completely, reverse the decline in Y and Q (see *Figure 2*).

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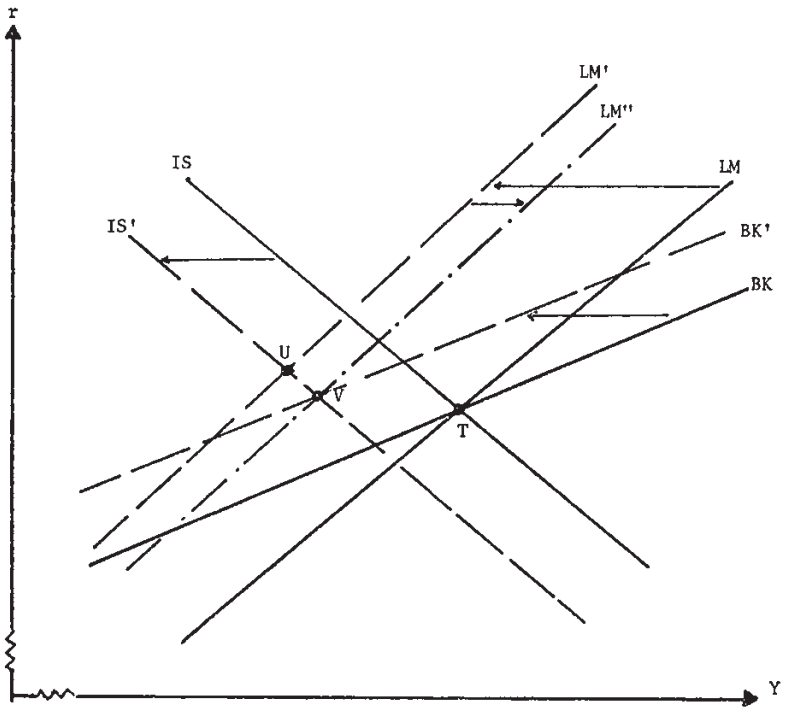

Fig. 2

Thus we have a first result: *Suppose domestic commodity supply is completely elastic. Under fixed exchange rates a rise of the foreign price of the imported input leads in the short run as well as in the quasi-long-run to stagflation or, more precisely, to inflation-cum-recession at home: the domestic product price goes up, real income and to a lesser extent also output decline. The permanent effects are stronger (weaker) than the transitory ones if initially the balance of payments went into deficit (surplus) and thus causes the money supply to shrink (expand).*

Let the exchange rate be flexible. In a situation as shown in Figure 1 and reproduced in *Figure 3* the home currency will be devalued causing some additional increase in P_R and P. Hence the LM curve moves further to the left while the IS and BK curve may shift into either direction depending on whether or not the ML condition holds and whether the trade balance was initially in surplus or deficit. Figure 3 covers the case $\Gamma < 0$ and $B \leq 0$. The new equilibrium is at

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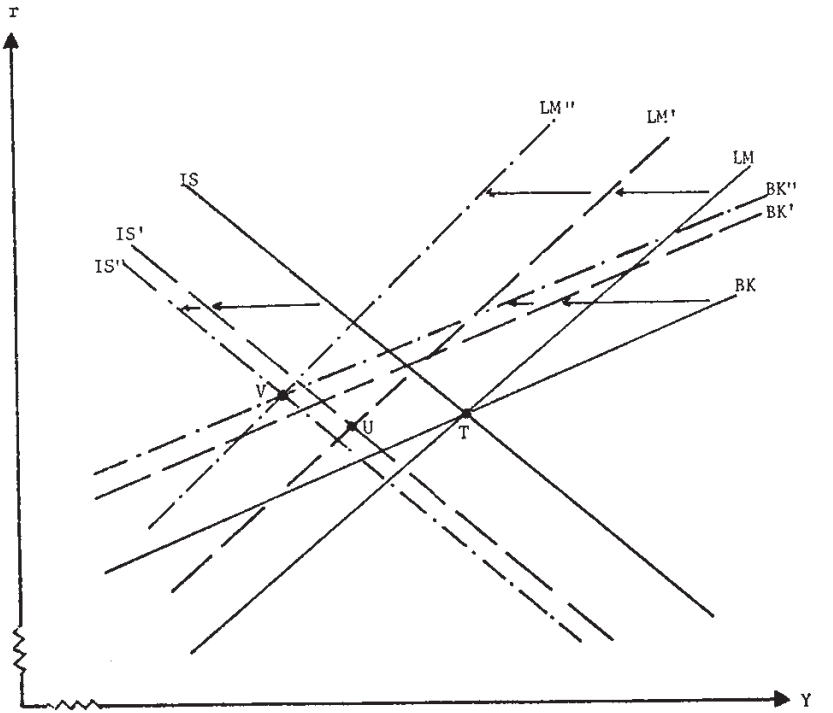

Fig. 3

point V.[10] Real income and output decline even more than under fixed exchange rates in the short run or the quasi-long run. However, it is also possible that Y and Q fall relatively less than in the other two cases. A sufficient condition is $\Gamma > 0$ and $B \geq 0$ since then the devaluation shifts the IS and BK curves somewhat back to the right instead of further to the left.

The situation depicted in Figure 2 is reproduced in *Figure 4*. The prevailing tendency for a payments surplus results in a revaluation of

[10] In principle, this case poses a stability problem. A new quasi-long equilibrium does not exist if an increase of the exchange rate widens instead of shortens the distance between the *IS-LM* intersection and the *BK* curve. Such a development occurs if the foreign exchange market is unstable, i. e. if a devaluation and the concomitant changes in P, Q and r raise the balance-of-payments deficit. Obviously, it requires sufficiently pronounced leftward shifts of the *IS* and the *BK* curves, i. e. sufficiently large negative values of Γ and B. Otherwise, however, stability prevails and a point like V exists. (Hence it is indeed admissible, as we asserted earlier, to deal with cases in which the *ML* condition is violated or the trade balance was initially in deficit if only Γ and B remain close enough to zero.)

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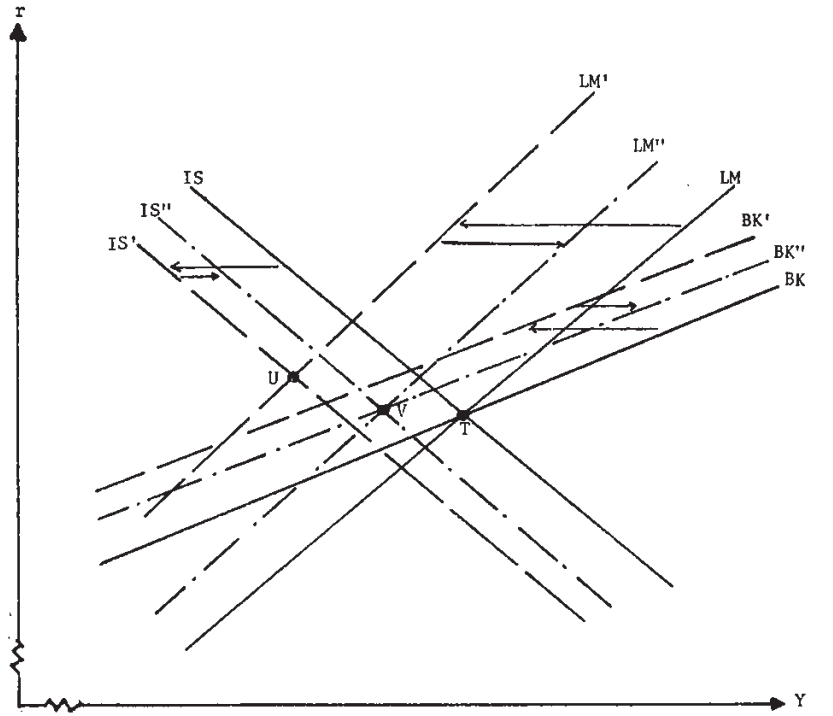

Fig. 4

the home currency and some reduction in the increase of P_R and P and the decrease of H/P. Allowing for the now most favourable circumstances, viz. $\Gamma < 0$ and $B \leq 0$, not only the LM curve but also the IS and BK curves move back to the right to positions LM″, IS″ and BK″. The new equilibrium at point V is associated with a higher domestic product price and lower levels of real income and output but these changes are smaller than under fixed exchange rates in the short run as well as in the quasi-long run.

To prove that the last conclusion is generally valid we have to show that all three curves must finally lie to the left of their initial positions. Suppose for the moment the exchange rate had fallen to such an extent that $-\hat{e} = \hat{\Pi}_R$ and hence $\hat{P}_R = \hat{P} = 0$. Then the new equilibrium seems to be associated with the old levels of Y, Q, r etc. However, the relative price P/e of the domestic product, relevant for foreigners, has risen, so that real exports have declined. Since this would imply a payments deficit the exchange rate can in fact not fall as much as just assumed. To put it differently, $-\hat{e} > \hat{\Pi}_R$, $\hat{P}_R > 0$ and $\hat{P} > 0$ must al-

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ways hold. Consequently, IS″, LM″ and BK″ are indeed positioned to the left of IS, LM and BK, respectively.

Clearly, $\Gamma > 0$ and $B \geq 0$ *ceteris paribus* now imply a more pronounced fall in Y and Q than in the previous case when there was a devaluation.

Thus we have a second result: *Suppose again domestic commodity supply is completely elastic. Exchange rates flexibility then does not prevent a rise of the foreign price of the imported input to cause inflation-cum-recession at home. In fact, as the external value of the domestic currency need not increase but may decline these adverse effects can even be stronger than under pegged exchange rates.*

Most of our arguments did not depend on the degree of wage indexation. The only exception is that some of the secondary changes in case of a devaluation cannot occur if $\alpha = 1$ since then $\Gamma = 0$. But that is of minor consequence. Therefore, the two results reported above are valid for $0 \leq \alpha \leq 1$.

It should be taken into account that in reality countries import a whole array of intermediate goods. If the foreign price of one of them, even if it is an important raw material like crude oil, goes up it will raise domestic product prices only by a smaller percentage although wages may be fully indexed. The reason is that some input costs remain the same. As a similar "retardation effect" follows from less-than-full wage indexation, we should in the present case take α to be less than unity.

At the same time it is tempting to look into the question how the extent to which curves shift and therefore equilibria change varies with the degree of indexation. This would require to study the relationships of the various coefficients in eqs. (26), (30) and (32) on the one hand and α on the other hand. A quick inspection, however, reveals that one cannot hope for sweeping, clear-cut findings.

So far we have not discussed changes in employment. It will be recalled that, unlike the FM assumptions, our assumptions do not imply that output and employment, let alone real income and employment, always change in the same direction. The reason, of course, is the presence of substitution effects in production.

But these effects are small if σ is close to zero so that the two inputs are poor substitutes or if α is close to unity so that the input-price ratio does not change much, and they are nil for $\sigma = 0$ or $\alpha = 1$.

Our third result is: *Higher costs of the imported input reduce employment under both exchange rate regimes if the elasticity of input sub-*

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stitution is nil or small or if wages are (nearly) perfectly indexed. Otherwise employment may increase although output and real income decline.

That higher prices of imported inputs will have a stagflationary impact on the domestic economy has formerly been shown by *Bruno* and *Sachs* (1979), *Findlay* and *Rodriguez* (1977), *Herberg* (1980), (1981) and *Schmid* (1980). *Herberg* and *Schmid* also observed that exchange rate flexibility may worsen the situation, and *Herberg* has studied the implications of the degree of wage indexation.

2. Devaluation of the Home Currency

Implicitly, the consequences of a devaluation of the home currency have already been dealt with in the previous subsection. As we have seen, an increase of the exchange rate need not, as in the FM world, raise real income and output, and that for two reasons:

(i) The trade balance may deteriorate ($\Gamma < 0$).

(ii) The competitiveness of domestic producers need not improve ($\alpha = 1$)[11].

Figure 2 can be reinterpreted to cover the first of these possibilities. The transition from IS, LM, BK to IS′, LM′, BK′ is now due to the devaluation. The new short-run equilibrium at U is associated with lower real income and output and with a higher domestic product price. As discussed in note 10, stability requires that the balance of payments has turned into surplus, i.e. that U lies to the left of BK′. Hence, nominal money supply increases and partly, but not completely, reverses the decline in Y and Q. Only if in time foreign import demand becomes sufficiently elastic to render the LM condition satisfied the devaluation will finally result in an expansion.

Consider the second case and, to highlight the implications of perfect wage indexation, suppose that trade was initially balanced. *Figure 5* applies. An increase of the exchange rate shifts the LM curve to the left to position LM′. Since $\Gamma = 0$ the IS curve remains unaffected. Moreover, since points on the BK curve to the upper right (lower left) of T are associated with a trade deficit (surplus), this curve rotates counter-clockwise around T. The short-run effect of a devaluation is again a fall in real income and output (cf. point U). The balance-of-payments induced increase in nominal money supply, however, shifts the LM curve back until it once more passes through T. Hence, a deval-

[11] In the present case $\alpha = 1$ is not subject to the same objections as discussed above with regard to changes in Π_R since a devaluation affects the domestic prices of *all* imported intermediate goods.

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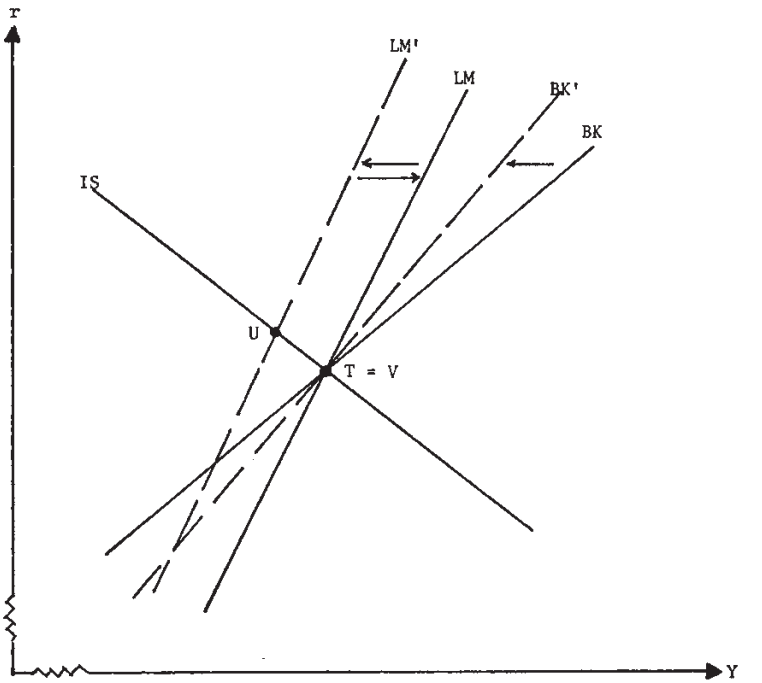

Fig. 5

uation has no permanent real effects; it only raises the domestic product price by the same percentage by which the exchange rate has gone up.

Thus we have a fourth result: *Under perfect wage indexation a devaluation of the home currency has an adverse transitory, but no permanent impact on real income, output and employment. If, however, the ML condition is strictly violated, the same policy is recessionary in the short run as well as in the quasi-long run.*

Finally we observe that even if a devaluation does work as expected its expansionary effect is the weaker the larger α. This is due to the fact that a higher degree of wage indexation means, *ceteris paribus*, more pronounced domestic price increases which erode part of the possible improvement of the home producers' competitiveness.

3. Monetary Policy

The consequences of monetary policy have also implicitly been derived in subsection IV 1. We have seen there that under fixed exchange rates its effects are qualitatively the same as in the FM model.

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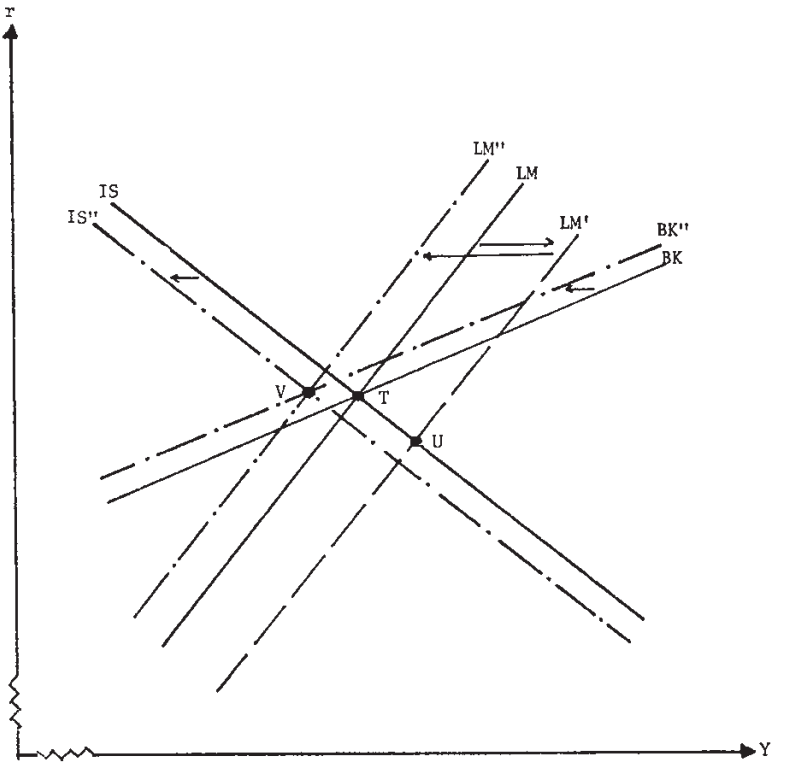

Fig. 6

Under flexible rates, however, they can be drastically different, and this is, of course, due to the concomitant exchange rate changes. To support the statement let us look into the same two special cases as above: The basic feature is that a higher nominal money supply causes a devaluation of the home currency. *Figures 6 and 7* shown the combined implications of these changes for $\Gamma < 0$ or for $\alpha = 1$, $B = 0$, respectively.

This establishes a fifth and final result: *Let exchange rates be flexible. Under perfect wage indexation and with trade initially balanced an increase in nominal money supply raises the domestic product price by the same percentage and leaves real income, output and employment completely unaffected. If, on the other hand, the ML condition is strictly violated the same policy leads to an even higher price increase and to a decline in real income etc. These outcomes are independent of the degree of international capital mobility.*

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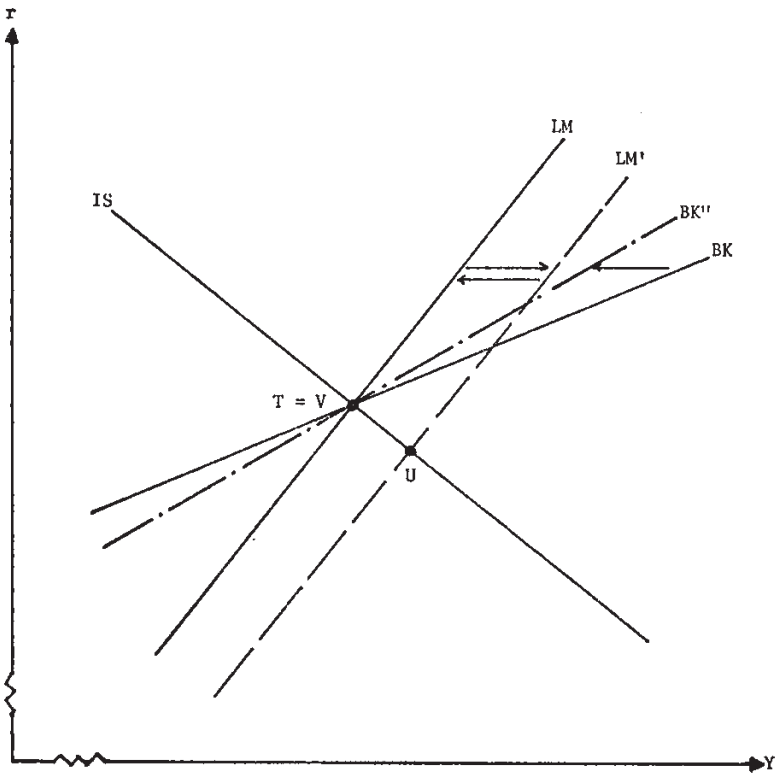

Fig. 7

Obviously, these findings are alien to a FM world, and they shed some new light on the old question of the efficacy of monetary policy[12]. The second one has also been reported, although based on quite different reasoning, by *Niehans* (1975). And the first one is a rather common conclusion, at least with regard to the "long run", of the monetary approach to the balance of payments (cf., e.g., *Dornbusch* (1980), chapt. 11/II) and references given there). But it will be noted that it has been derived here without relying on the concept of a full employment level of income or a natural rate of unemployment from which the home economy can at most temporarily deviate. Instead it follows from the fact that, although nominal money supply and absolute prices rise, real money supply and relative prices remain unchanged.

[12] *Herberg, Hesse* and *Schuseil* (1982) have shown that on the other hand under flexible exchange rates and perfect wage indexation fiscal policy tends to be the more effective the higher the degree of international capital mobility.

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4. Some Extensions

Closer inspection reveals that the fundamental condition for the last two findings is an inverse relationship between the exchange rate and real money supply. Such a relationship would also exist in the absence of imported intermediate goods, but with the domestic price level incorporating foreign consumption goods and with wage indexation. Consequently, similar results apply.

Moreover, we wish to report that all our findings carry over to the case of declining labour productivity and hence an upward sloping domestic supply curve since the IS, LM and BK curves retain their basic properties. (For a detailed proof interested readers should contact the authors.)

Summary

Allowing for imports of intermediate goods and for wage indexation of various degrees the paper deals with the macroeconomic consequences of foreign price increases, a devaluation of the home currency or an expansionary domestic monetary policy for a small open economy. Based on suitably modified Hicksian IS-LM diagrams the analysis yields a number of clear-cut results that partly differ from the implications of the Fleming-Mundell model. E. g., higher prices for imported inputs can be expected to cause inflation-cum-recession at home and the same might even be true for an increase of domestic money supply.

Zusammenfassung

In dieser Arbeit werden für eine kleine offene Volkswirtschaft, die Zwischenprodukte importiert und in der der Nominallohnsatz vollkommen oder teilweise indexiert ist, die makroökonomischen Auswirkungen ausländischer Preissteigerungen, einer Abwertung der heimischen Währung oder einer expansiven inländischen Geldpolitik untersucht. Grundlage der Analyse ist ein geeignet modifiziertes Hicks'sches IS-LM-Diagramm. Es wird eine Reihe klarer Ergebnisse abgeleitet, die z. T. von den Implikationen des Fleming-Mundell-Modells abweichen. Beispielsweise werden steigende Kosten für importierte Inputs in der Regel zu Inflation und Rezension führen, und gleiches kann sogar die Folge einer Ausweitung der inländischen Geldmenge sein.

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