1980

Oil, Employment, and the Price Level: A Monetary Approach to the Macroeconomics of Imported Intermediate Goods under Fixed and Flexible Rates

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CENTRE FOR THE STUDY OF INTERNATIONAL ECONOMIC RELATIONS

WORKING PAPER NO. 8005

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This paper contains preliminary findings from research still in progress and should not be quoted without prior approval of the author.

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OIL, EMPLOYMENT AND THE PRICE LEVEL: A MONETARY APPROACH TO THE MACROECONOMICS OF IMPORTED INTERMEDIATE GOODS UNDER FIXED AND FLEXIBLE RATES*

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November 1979

Revised Version, March 1980

Abstract

This paper investigates macroeconomic effects of a change in the real price of an imported intermediate good in an open OECD type economy with rigid nominal wages. Price level is totally determined from the cost side (labour and oil prices). A rise in the world oil price is shown to produce a stagflationary adjustment pattern, while a depreciation because of the import content of exports may become contractionary. The alleged insulation power of flexible rates in this context appears only as a remote possibility. 'Negative insulation' for price and output components of GNP occurs.

Five years after the oil crisis, facing a new round of oil price increases and bottlenecks in oil supply, macroeconomic policy in the industrial countries continues to struggle with a plethora of economic problems. Economic analysts[1] of the "economic malaise" of the 1970's cite as most critical the size and diversity of inflation rates in the major industrial countries, together with a marked decline in OECD output growth since the oil shock of 1973/74. Only Germany and Japan, by the end of 1978, had restored their inflation rates to a level below the pre-1973/74 rates, while GNP growth for the OECD as a whole receded to an annual average of 3% over the 1973-78 period, as compared to about 5% over the preceding decade. Above all, unemployment rates have remained as high as, or higher than, the levels reached shortly after the oil crisis.

Some European countries, like Germany, have recovered remarkably well from the 73/74 crisis. However, a sharp acceleration of inflation during the first half of 1979, largely attributable to the recent increase in oil prices on top of a continuing increase in raw material prices, and the strengthening of the dollar following the November 1978 rescue operation, appears to have jeopardized a successful "Stabilitatspolitik" in mid-year 1979. In Germany, a country heavily reliant on imported raw materials, the price increase for these intermediates in world markets, and particularly the oil price hike, has been viewed as a hold by OPEC over the real incomes of the raw material importing countries. Fears have been raised that, with OPEC as a new claimant, the social consensus (Sozialpartnerschaft) achieved through verbal conflict and factual cooperation of interest groups may be disrupted. Arguing that what the sheiks have already withdrawn would not be available for income distribution within the country, Bundesbank and Bundesregierung[2] have made it quite

clear to everybody that it would be economic nonsense for Tarifpartner (trade unions and employees) to attempt to escape the downward adjustment in real income by trying to pass on to the 'other side' the burden of OPEC's attack, either via unjustified increases of product prices on the one hand, or by claiming a 'second help' within the current or at the beginning of the new contract period on the other hand. At the same time the Bundesbank took steps to make its threat of non-accommodation more credible, the Bundesregierung, after some coalition struggle behind the scene, had decided that there will be no rigid bureaucratic measures to hold down prices of oil products or to save on oil consumption. Rather, market forces should be given a chance to absorb the new oil price shock. Hence, during the next months prices of gas and heating oil have shown sharp increases resulting in a doubling of the CPI in August/October to nearly 6% with employment unaffected and the trade balance exhibiting a declining tendency. To further smooth adjustment the government has enacted help to low income families subsidizing fuel consumption and establishing a program to give financial support to private households and business for investments suited to conserve energy or to switch energy use away from oil towards other energy sources respectively.

So much for a short record of the reaction of one of the oil and raw material importing industrialized economies to the most recent oil episode, endured in a rather undramatical fashion. In the search for an academic understanding of this particular set of events, which appears to have affected all industrial economies--specifically, inflation and unemployment following an unprecedented rise in raw material prices--the standard demand-oriented Keynesian model of an open economy is more or less irrelevant. To deal in an appropriate way with some subtle microeconomic aspects of allocation in the

realm of macroeconomics some suitable extension of that model is necessary. In the wake of the 73/74 oil crisis the present author in Schmid [1976] explored a minimal monetary two-country world model, where vertical trading took place between a raw material producing group of countries and a resource importing group of countries, operating as a processing plant by manufacturing a final good with the help of domestic factors of production. The final product was both domestically consumed and exchanged with the foreign country in payment for the imported raw material. By bringing together two strands of economic theorizing--namely the pure theory of intermediate goods and the monetary approach to the balance of payments--the model stressed the role of intermediate imports in the comparative statics of a fully employed world economy with fixed exchange rates.[3]

The present paper considers OECD or rather a representative European OECD country under the more reasonable assumption that downward rigidity of nominal wages[4] will prevent full employment. Firstly, aiming at a thorough understanding, we adhere to our previous minimal framework of a world of only three goods: a traded intermediate, a non-traded factor of production, and a traded final good. Most of the time we will analyze the case of a 'small country' with no quantity repercussion from abroad in the market for domestic exports. Although we assume a sufficiently large export share of the domestic country in the world market for final products such that changes in domestic export supply may influence the world market price for the exportable the small country assumption makes the domestic country a price taker in world market for raw materials. Those raw materials are neither present in the domestic country nor are they produced there; however, in world markets at the ruling price there is excess supply, i.e., the short side of the market determines transactions. We also assume

excess supply of the domestic factor of production at the ruling wage rate. Our analysis proceeds by asking the following three questions:

(1) What kind of adjustment in gross domestic production, GNP, CPI, employment, trade balance, and quantity of imported raw materials, will occur in a vertically trading small open economy if we consider the influence of a sudden increase in the world market price of raw materials under fixed exchange rates?

(2) What impact on the same set of variables do we find in an economy where exports have an import content if we consider an autonomous change in the exchange rate?

(3) Assuming for the moment a raw material price hike exerts stagflationary pressure in the domestic economy, how is the stagflationary pattern of adjustment influenced by introducing a flexible exchange rate system?

Section 2 of the paper deals with the challenge of setting up a minimal model which integrates aggregative and allocative economy analysis. We look first at the supply side of a raw material importing economy, adding later the demand side and equilibrium in the market for the final product at given parameter levels of the exchange rate and nominal wage rate. Section 3.1 looks at the effects of a raw material price increase on output, price level, and employment under fixed rates. We will argue that even with a fixed nominal wage the home economy inevitably will suffer from stagflation. In our comparative static analysis we define stagflation as declining output together with an increase in price level. Opposite to a demand-oriented theory of imported inflation a raw material price increase directly touches the supply side by exerting a cost push on the domestic price level while reducing domestic output.

As long as domestic nominal wages increase at a lower rate than the price level, the domestic economy faces a real income loss assuming a realistic low possibility of substitution between domestic factors of production and imported raw materials.[5] The squeeze in real income and a restrictive wealth effect of raising final good's price bring down domestic absorption. Simultaneously the domestic price increase has negative effects on domestic capabilities to export, hence with a falling total demand for domestic goods we get a domestic recession. Our model stresses the view that movements in the main economic aggregates like gross domestic product, gross national product, and employment are not necessarily positively correlated. Having shown a recession in real domestic product with respect to employment we present a simple condition which rules a delicate balance between the favourable substitution effect of more costly raw materials and their negative effect via the falling level of production. Dealing with exchange rate changes in Section 3.2 we show that a devaluation of the domestic currency may act like a supply shock as soon as we introduce direct cost-push effects of an exchange rate change in an open economy where indispensable raw materials are priced in foreign currency units. Traditionally, demand oriented theories of devaluation, and even the monetary approach, show stimulating demand effects of a devaluation on the domestic economy. While not denying those well-known effects, our model explains the response of output and price components of GNP upon exchange rate changes as a fine interplay between demand and supply forces. With the exchange rate considered as determining part of the cost of production a devaluation (revaluation) adds to forces pushing up (restraining) the domestic price level. On the other hand we observe two opposing effects on the demand side. Besides the well-known demand pull (demand restricting) effects which

operate via an improvement (deterioration) in competitiveness of domestic products, the cost push (cost dampening) effect of a devaluation (revaluation) operates exactly through the same channels mentioned above in connection with price increases (decreases) for raw materials. Therefore, we can present a simple condition under which a devaluation has the potential to induce an inflationary recession in the domestic economy if the reduction in domestic absorption is not sufficiently counteracted by a strong increase in exports--the foreign component of aggregate demand. Along the lines of the absorption approach we develop a modified Marshall-Lerner condition where the elasticity of factor substitution plays the role of the more familiar elasticity of demand for imported final products. We further show that recessionary effects upon domestic output following a devaluation do not spill over to domestic employment as long as our modified Marshall-Lerner condition holds true. Section 4 investigates the chances a flexible exchange rate system may have in preventing an import of cost push inflation when prices of raw materials increase relative to other prices. As a general result stagflationary adjustment induced by raw material price increases cannot be avoided by flexible rates. Depending on the size of structural parameters in our model, stagflation may become weaker, be strengthened, or we may find a dampening effect in the price component while recession is reinforced or vice versa. The paper develops conditions for the appearance of each case. Finally, in Section 5, we look at a global framework of OECD-OPEC interaction. This 'two country' version extends the analysis given in Schmid [1976] towards a world of fixed wages, unemployment, and varying exchange rates.

2. The Model[6]

We focus first on the supply side of the model. Domestic production, x, is a linear homogeneous function of domestic labour input, ℓ, and inputs of raw material, n.

$$x = x(\ell, n) \tag{1}$$

Given the price of final goods, P, the nominal wage rate, W, and the raw material price, P_n, all in domestic currency units, factor demand in domestic production is determined by short-run profit maximization

$$Px_\ell(\ell, n) = W \; ; \; Px_n(\ell, n) = P_n$$

where $x_\ell \equiv \partial x/\partial \ell$ and $x_n \equiv \partial x/\partial n$. We assume the representative production unit to be a price taker in factor markets, i.e., the model is one where the money wage rate, W, is given and labour is in perfectly elastic supply. Hence the quantity transacted in the labour market is determined by the short side of the market. The same holds true for raw material markets. World market price for raw materials, P_n^*, is taken to be fixed in foreign currency units. Given the exchange rate, E, denoted as the price of foreign currency in domestic currency units, the domestic price of imported inputs is

$$P_n = EP_n^* \quad \text{or} \quad \hat{P}_n = \hat{E} + \hat{P}_n^* \tag{2}$$

At the ruling world market price, P_n^*, the domestic economy always obtains the quantity of raw materials it has asked for. Price of domestic output, P, is set by firms in a competitive way at the level of unit costs.

$$P = a_\ell W + a_n P_n \quad \text{with} \quad a_\ell \equiv \ell/x \; ; \; a_n \equiv n/x \tag{3}$$

As a consequence of linear homogeneous technology, input coefficients $a_i (i=\ell,n)$ are functions of the relative factor price, W/P_n, alone.

$$a_\ell = a_\ell(W/P_n) \; ; \; a_n = a_n(W/P_n)$$

Making use of the well-known condition of cost minimization differentiation of (3) gives the percentage change of output price as the average mean of changes in factor prices.

$$\hat{P} = \theta_{\ell}\hat{W} + \theta_{n}\hat{P}_{n} \tag{4}$$

In (4) symbols $\theta_{\ell} \equiv (W/P)a_{\ell}$, $\theta_{n} \equiv (P_{n}/P)a_{n}$ represent shares of domestic or imported factors of production respectively in the value of domestic production. As is well known those shares sum up to unity.

$$\theta_{\ell} + \theta_{n} = 1$$

As is further known these shares appear as partial elasticities of production if we differentiate (1)

$$\hat{x} = \theta_{\ell}\hat{\ell} + \theta_{n}\hat{n} \tag{5}$$

Introducing factor intensity $\nu \equiv n/\ell$ we can rewrite the change in output (5) in two equivalent ways.

$$\hat{x} = -\theta_{\ell}\hat{\nu} + \hat{n} \quad \text{or} \quad \hat{x} = \theta_{n}\hat{\nu} + \hat{\ell} \tag{6}$$

Knowing that the definition of the elasticity of factor substitution relates changes in factor intensity to changes in relative factor price

$$\hat{\nu} = \hat{a}_{n} - \hat{a}_{\ell} = -\sigma(\hat{P}_{n} - \hat{W}) \quad \sigma > 0 \tag{7}$$

we combine (6) and (7) to find a useful relation.

$$\hat{x} = \theta_{\ell}\sigma(\hat{P}_{n} - \hat{W}) + \hat{n} \tag{8}$$

Note that, fixing the relative factor price ratio (8) exhibits constant returns to scale if we let output depend on factor use. (4) and (8) fully determine price output responses of the production side of our economy which has to be brought into line with the consumption side later. Therefore we turn now to income, spending and the role of money.

It is of strategic importance in the macroeconomic analysis of imported intermediates to distinguish the value of gross-production and domestic value added (GNP). Nominal gross national product is less than the total value of gross domestic production by the value of a country's bill of raw materials imports. Denote Px as the value of domestic production and let Y represent the value of gross national product. We then have the following relation[7]

$$Y = Px - P_n n \tag{10}$$

Recalling the terms of production given above we can say more about GNP and the value of (gross) production. We know that the value of production is exhausted by the sum of factor payments. Therefore we can identify the share of GNP in value of output as the cost share of the domestic factor of production in the value of domestic output.[8]

$$Y/Px \equiv \theta_\ell = 1 - \theta_n \qquad \text{with } \theta_n \equiv P_n n/Px$$

Using these shares we can derive from (10) another useful relation showing the relative change of GNP in value terms as a function of relative changes in all other variables.

$$\hat{Y} = \frac{1}{\theta_\ell}(\hat{P} + \hat{x}) - \frac{\theta_n}{\theta_\ell}(\hat{P}_n + \hat{n})$$

For later use we are interested in real GNP, $y \equiv Y/P$, which we measure, deflating (10) by the price level, P, as

$$\hat{y} = \frac{1}{\theta_\ell}\hat{x} - \frac{\theta_n}{\theta_\ell}(\hat{P}_n - \hat{P} + \hat{n}) \tag{11}$$

We characterize the consuming sector by imposing a budget constraint on the representative consumer.

$$Y = C + H \qquad \text{with } H \gtrless 0 \tag{12}$$

$$C = Pc \quad (c = \text{physical consumption})$$

According to (12) consumption expenditures[9] may deviate from national income by positive or negative amounts of hoarding, H. Routinely, authors of the monetary approach explain consumption behaviour in terms of a hoarding function. Hoarding appears as a linear stock adjustment process where actual cash balances, M, are adjusted continually to desired money holdings, L, which in turn are assumed to be a linear function of nominal income.

$$\dot{M} = H = \lambda[kY - M] \qquad \lambda,\ k = \text{const} > 0 \tag{13}$$

Using (13) in (12) and assuming $0 < \lambda k < 1$, nominal expenditures appear quite normally as a linear function of nominal income.

$$C = (1 - \lambda k)Y + \lambda M \tag{14}$$

First note the importance of the long-run stock equilibrium for the expenditure function (14). If $kY = M$ stock equilibrium prevails and consumers spend all their income. If $kY \neq M$ consumers spend more or less than their income, using hoarding or dishoarding to reduce disequilibrium in the stocks of money holdings. Secondly, note the property of linear homogeneity of the expenditure function in Y and M. To explore this property a bit further, let us define the following expenditure elasticities with respect to nominal income and actual cash balances evaluated at a point of long-run stock equilibrium.

$$\frac{\partial C}{\partial Y}\frac{Y}{C} \equiv \alpha = (1 - \lambda k)\ ;\ \frac{\partial C}{\partial M}\frac{M}{C} \equiv \rho = \lambda k \tag{15}$$

We can enjoy this new notation in differentiating (14) at a point of long-run stock equilibrium to get

$$\hat{C} = \alpha\,\hat{Y} + \rho\,\hat{M} \tag{16}$$

In (16) linear homogeneity imposes the following useful condition upon our spending parameters

$$\alpha + \rho = 1$$

Knowing what happens to nominal expenditures sometimes is not enough if we have to deal with an economy where prices and quantities are independent

variables. We therefore deflate (14) by the domestic price level to get

$$c = (1 - \lambda k)y + \lambda m \tag{17}$$

$$y = Y/P, \quad c = C/P, \quad m = M/P$$

The differentiated form of (17) is now

$$\hat{c} = \alpha\hat{y} + \rho\hat{m} \tag{18}$$

The real expenditure function (18) indicates differences in real consumption behaviour not obvious from the nominal expenditure function:

i) A uniform increase of price level and nominal cash balances holding real income constant raises nominal expenditures by the same percentage rate while real consumption demand remains constant.[10]

ii) A uniform increase of real income and nominal cash balances holding price level constant raises nominal expenditures by the same percentage rate. This time, however, real consumption demand has increased.

It remains to complete the exposition of our model by specifying how equilibrium is reached at the market for final products and to explain the fundamental equivalence between trade balance and hoarding even in the present context of a vertically trading open economy. For a final goods market equilibrium domestic supply and demand from domestic and foreign residents must equalize.

$$x = c + c^* \tag{19}$$

In (19) we have c^* representing foreign demand for domestic final products. Foreign demand for exports is assumed to be a decreasing function of the price of domestic goods in terms of foreign currency units.

$$c^* = c^*(P/E) \tag{20}$$

Negative and positive changes in export demand arise in this specification from a change in domestic price for exports and from exchange rate changes. That can

be seen by introducing the elasticity of export demand, η. We find[11]

$$\hat{c}^* = \eta(\hat{P} - \hat{E}) \qquad -1 \leq \eta \equiv \frac{dc^*}{dP^*}\frac{P^*}{c^*} \leq 0 \tag{21}$$

The interesting feature of our specification (21) is that in a crude way it models the idea of competitiveness of domestic exports in a perfect world market for final goods as the interplay of two factors, i.e., offering domestic exports at rising domestic prices hurts export sales while an increase in the exchange rate helps selling.

In an open economy with a vertical trading pattern the trade balance, B, contrasts exports of final products with imports of raw materials.

$$B = Pc^* - P_n n \tag{22}$$

To show the correspondence between the trade balance and domestic hoarding we multiply equilibrium condition (19) by price level, P. That gives the statement that revenues to the domestic country from selling to domestic and foreign residents equal the value of domestic production which in turn is exhausted by payments to domestic and foreign factors of production. Therefore when we subtract payments for imported raw materials from both sides we get

$$Px - P_n n = Pc + Pc^* - P_n n \tag{23}$$

The left side of (23) we recognize as domestic income, hence (23) can be rewritten in a well-known form

$$Y = C + EX + IM \qquad \text{with } EX \equiv Pc^*,\ IM \equiv P_n n \tag{24}$$

Using the budget constraint (12) in (24) we end up with the relation between trade balance and hoarding we looked for.

$$B = H \tag{25}$$

(25) illustrates a distinctive common feature of the monetary approach and the absorption approach: As long as domestic absorption is in accordance with domestic income, trade balance must be zero. This we must keep in mind while

differentiating (19) in the initial state of balanced trade to get another highly useful relation.

$$\hat{x} = \theta_{\ell}\hat{c} + \theta_{n}\hat{c}^{*} \tag{26}$$

Application of the traditional absorption approach to a vertically trading open economy underlines the lack of distinction most monetary trade models exhibit with respect to value of domestic production and value of national product (= value of national income). It is exactly that difference which matters. Hence domestic absorption has to be compared to domestic value-added, not value of production, if we make statements concerning the domestic trade balance. The simple message is that a country lives beyond its means as soon as its absorption exceeds the value-added that country contributes in the process of making final products out of raw materials in a two-tier world production process. As a consequence of its absorption behaviour such a country runs a trade deficit. The equivalence of hoarding and the trade balance can be used to explain the change in the trade balance by changes in hoarding. We find from (25) with (15)

$$dB = \lambda M[\hat{y} + \hat{P} - \hat{M}] \tag{27}$$

With fixed exchange rates this means that, as long as we have an unbalanced trade account, we have an inflow or outflow of money which is used to adjust actual to desired money balances. Only a balanced trade account halts the process of redistribution of money supply between trading countries and we refer to such a state as a long-run stock equilibrium. In the flexible exchange rate case excess demand for currencies is adjusted by changes in the exchange rate as a price for money, hence the monetary approach to the balance of trade becomes the monetary approach to the exchange rate. Before elaborating this in Section 4 we now turn to the analysis of raw material price increases in a fixed exchange rate context.

3. The Model: Fixed Exchange Rates

The equations given so far can be condensed to a model in which we can explain changes of four endogenous variables ($\hat{x}$, $\hat{P}$, $\hat{n}$, dB) taking into account changes in four exogenous variables ($\hat{P}^*_n$, $\hat{E}$, $\hat{W}$, $\hat{M}$).

The following schematic presentation is possible.

$$
\begin{aligned}
&g_1(\hat{x},\hat{P},\hat{n} \quad ; \quad \hat{P}^*_n,\hat{E}, \quad \hat{M}) = 0\\
&g_2(\hat{x}, \quad \hat{n} \quad ; \quad \hat{P}^*_n,\hat{E},\hat{W} \;) = 0\\
&g_3(\;\hat{P} \quad ; \quad \hat{P}^*_n,\hat{E},\hat{W} \;) = 0\\
&g_4(\hat{x},\hat{P},\hat{n},dB \; ; \quad \hat{P}^*_n,\hat{E}, \quad \hat{M}) = 0
\end{aligned}
\tag{28}
$$

$g_1(\cdot)$ represents the equilibrium condition of the market for final products (26) with respect to (18), (21) and (11) with (2). The explanation of domestic output (8) appears as function $g_2(\cdot)$ with regard to (2). Prive level changes (4) are given in function $g_3(\cdot)$ with regard to (2), and $g_4(\cdot)$ captures trade balance changes (27) in connection with (11) and (2). Taking into account these substitutions an explicit version of (28) can be given as follows.

$$
\begin{bmatrix}
\rho & -[\theta_n\alpha - \theta_\ell\rho + \theta_n\eta] & \alpha\theta_n & 0\\
1 & 0 & -1 & 0\\
0 & 1 & 0 & 0\\
1 & 1 & -\theta_n & -\theta_\ell/\lambda M
\end{bmatrix}
\begin{bmatrix}
\hat{x}\\ \hat{P}\\ \hat{n}\\ dB
\end{bmatrix}
=
\begin{bmatrix}
\alpha\theta_n & -[\theta_n\eta + \alpha\theta_n] & 0 & \rho\theta_\ell\\
\theta_\ell\sigma & \theta_\ell\sigma & -\theta_\ell\sigma & 0\\
\theta_n & \theta_n & \theta_\ell & 0\\
\theta_n & \theta_n & 0 & \theta_\ell
\end{bmatrix}
\begin{bmatrix}
\hat{P}^*_n\\ \hat{E}\\ \hat{W}\\ \hat{M}
\end{bmatrix}
$$

To reduce further the complexity of model (28) we will interpret $g_2(\cdot)$ as a factor demand function for imported intermediates. This gives formal expression to the idea that the domestic country reacts to an exogenous change in raw material prices first by varying the demand for those raw materials in response to price changes and secondly by an adjustment of the level of production. Substitution for $\hat{n}$ from $g_2(\cdot)$ in $g_1(\cdot)$, $g_3(\cdot)$ results in a fairly reduced model to determine variables $\hat{x}$, $\hat{P}$, and dB.

Following this design of analysis we deal first with $g_1(\cdot)$. Using (18), (21) in (26) we find

$$\hat{x} = \theta_\ell[\alpha\hat{y} + \rho\hat{m}] + \theta_n[\eta(\hat{P}-\hat{E})] \tag{29}$$

Repeating (11) for ready use

$$\hat{y} = \frac{1}{\theta_\ell}\hat{x} - \frac{\theta_n}{\theta_\ell}[\hat{P}_n - \hat{P} + \hat{n}] \tag{11}$$

we observe as a bracketed term in (11) the change in real domestic expenditures for imported raw materials, i.e., the 'real oil bill'. Substituting for $\hat{n}$ from $g_2(\cdot)$ in (11) we catch the 'direct' change of domestic real income if we raise prices of raw materials and domestic labour <u>holding constant domestic production</u>.

$$\hat{y} = \frac{1}{\theta_\ell}\hat{x} - \frac{\theta_n}{\theta_\ell}[\theta_\ell(1-\sigma)\hat{P}_n - \theta_\ell(1-\sigma)\hat{W} + \hat{x}] \tag{30}$$

Note that in (30) we have evaluated the <u>real income</u> squeeze by incorporating cost-push effects on domestic price level induced by those factor price increases, i.e., $\hat{P} = \theta_n\hat{P}_n$, $\hat{P} = \theta_\ell\hat{W}$. Assuming realistic values of $0 \leq \sigma < 1$ we can identify a negative real income effect of an increase in raw material prices and a positive income effect of a rising wage rate. Using (30) in (29) we have the first equation of our final system of equations.

$$(\rho\theta_\ell+\theta_n)\hat{x} + (\rho\theta_\ell-\eta\theta_n)\hat{P} = -\alpha\theta_\ell\theta_n(1-\sigma)\hat{P}_n + \alpha\theta_\ell\theta_n(1-\sigma)\hat{W} - \eta\theta_n\hat{E} + \rho\theta_\ell\hat{M} \tag{31}$$

The falling xx line in Figure 1 depicts goods market equilibrium in x,P space. The negative slope of the xx line indicates restrictive demand effects exerted

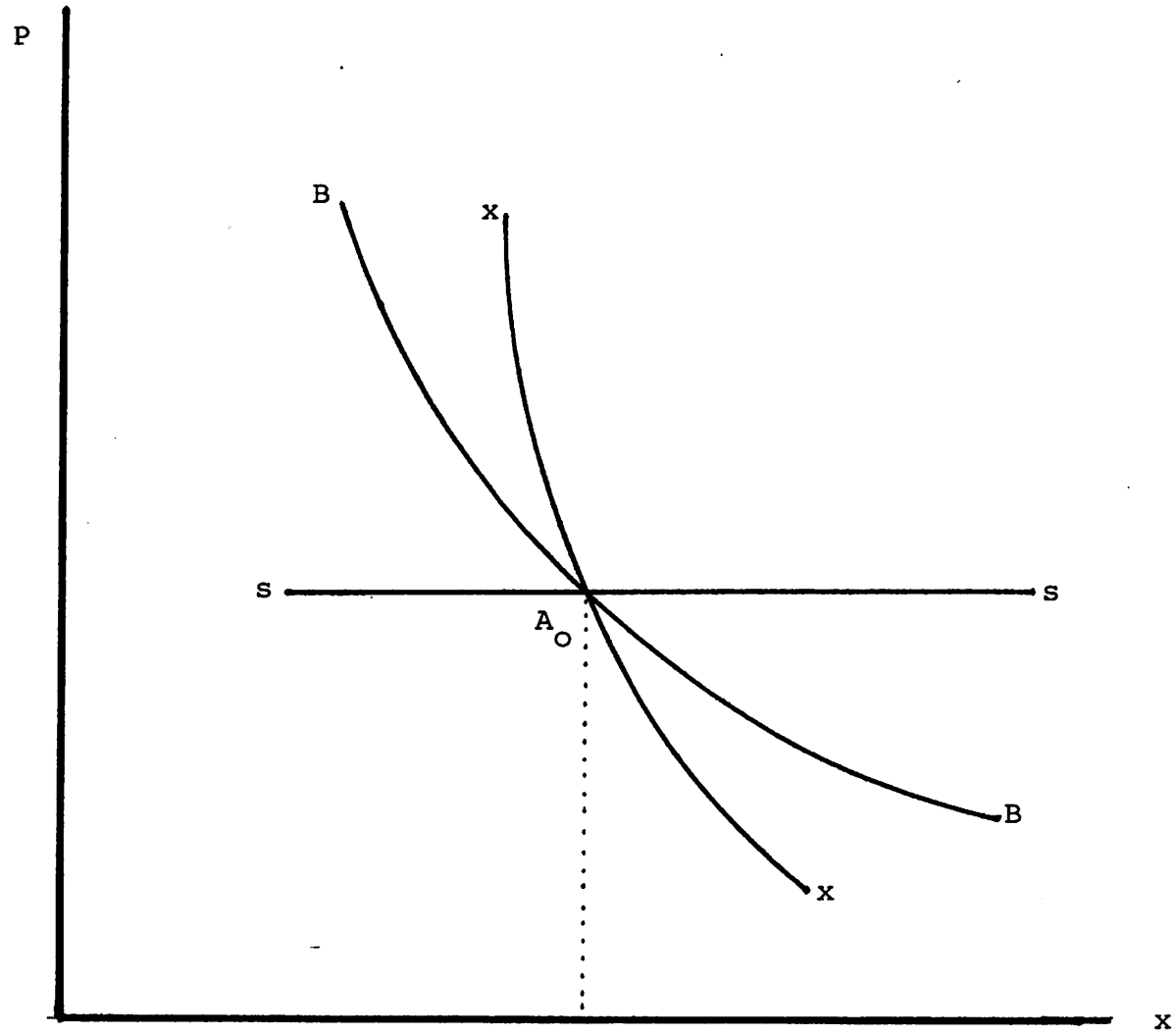


Fig. 1

by domestic price level increases operating via both a negative real balance effect and a reduction in exports. The demand shortage triggers a receding production level to establish a new goods market equilibrium. The recession of production feeds on itself via a contractionary multiplier process towards the lower level of production. The coefficient of $\hat{x}$ in (31) shows the inverse of the output multiplier in an open resource importing economy. θ_n represents the leakage corresponding to the raw materials bill and $\rho\theta_\ell$ represents the marginal propensity not to spend with respect to domestic income. Therefore the elasticity of the xx line is negative, appearing larger or equal to unity in absolute value as long as $-1 \leq \eta \leq 0$.

$$\hat{P}/\hat{x}\Big|_{xx} = -\frac{\rho\theta_\ell + \theta_n}{\rho\theta_\ell - \eta\theta_n} < 0$$

On the right hand of (31) we track down the tax-like effect of a raw material price if and only if $0 \leq \sigma < 1$. Note that an increase in the nominal wage rate correspondingly works in the contrary, producing a demand stimulus if $0 \leq \sigma < 1$.[12] The impact of a devaluation can now be shown to be subjected to conflicting forces if we consider (2) in (31). We find

$$-[\alpha\theta_\ell\theta_n(1-\sigma) + \eta\theta_n]\hat{e} \gtrless 0 \qquad (32)$$

On the one hand we realize the advantageous impact a devaluation has in improving competitiveness of domestic products, while on the other hand a rising exchange rate raises production costs in a resource importing open economy and induces the same contractionary real income squeeze we have mentioned above in connection with growing prices of raw materials.

Next we have portrayed in Figure 1 a horizontal ss curve. This curve delineates cost determinedness of the final product price. Simultaneously it can be looked at as a macroeconomic supply function, if we vary the output level

holding factor prices constant with a linear homogeneous technology. Properties of the ss curve can be realized by combining (4) and (2) to get

$$\hat{P} = \theta_n(\hat{P}^*_n + \hat{E}) + \theta_\ell \hat{W} \tag{33}$$

Obviously price elasticity of output is infinity at the cost determined price level. Increases in factor prices shift the ss curve upwards, the percentage change being given by the cost share of the factor of production whose price has risen.

Finally Figure 1 shows the BB curve as a falling line. This locus is determined by combinations of price and output levels compatible with trade balance equilibrium. Using (11) in (27) we get

$$dB = \lambda M[\frac{1}{\theta_\ell}\hat{x} - \frac{\theta_n}{\theta_\ell}(\hat{P}_n - \hat{P} + \hat{n}) + \hat{P} - \hat{M}]$$

Substitution of $\hat{n}$ from (8) results in

$$dB = \lambda M[\hat{x} + \hat{P} - \theta_n(1-\sigma)\hat{P}_n + \theta_n(1-\sigma)\hat{W} - \hat{M}] \tag{34}$$

where the elasticity of the BB curve can be seen as

$$\hat{P}/\hat{x}\Big|_{BB} = -1$$

Given the domestic money supply and factor prices as in (34) we need an inverse relationship between real income and price level if the trade balance is to be preserved. This is necessary because an isolated increase of each of these variables produces excess demand for cash balances by increasing demand or decreasing supply of real cash balances, respectively. Hence points to the right or above the BB curve represent a trade balance surplus. Similarly, we can argue that increases in the money supply and raw material price and a declining wage rate are related to excess cash balances if $0 \leq \sigma < 1$. Given x,P, this results in trade balance deficits because the BB curve shifts to the right.

The model we were looking for is given now as equations (31), (33), and (34). By rewriting these in a compact matrix version we realize its ability to determine $\hat{x}$, $\hat{P}$, dB.

$$\begin{bmatrix} [\rho\theta_\ell + \theta_n] & [\rho\theta_\ell - \eta\theta_n] & 0 \\ 0 & 1 & 0 \\ 1 & 1 & -(1/\lambda M) \end{bmatrix} \begin{bmatrix} \hat{x} \\ \hat{P} \\ dB \end{bmatrix} \tag{35}$$

$$= \begin{bmatrix} -\alpha\theta_\ell\theta_n(1-\sigma) & \alpha\theta_\ell\theta_n(1-\sigma) \\ \theta_n & \theta_\ell \\ \theta_n(1-\sigma) & -\theta_n(1-\sigma) \end{bmatrix} \begin{bmatrix} \hat{P}_n^* \\ \hat{W} \end{bmatrix} + \begin{bmatrix} -[\alpha\theta_\ell\theta_n(1-\sigma) + \eta\theta_n] & \rho\theta_\ell \\ \theta_n & 0 \\ \theta_n(1-\sigma) & 1 \end{bmatrix} \begin{bmatrix} \hat{E} \\ \hat{M} \end{bmatrix}$$

The determinant of (35) is

$$D = -\frac{1}{\lambda M}\Delta < 0$$

$$\Delta = \rho\theta_\ell + \theta_n > 0$$

In dealing next with raw material price increases we use (35) to calculate exact results although we will take great pains to explain these algebraic results.

3.1 Increases in intermediate goods prices

The model yields the following solutions for the output and price variables

$$\hat{x}/\hat{P}_n^* = \frac{-\theta_n[(1-\rho)\theta_\ell(1-\sigma) + (\rho\theta_\ell - \eta\theta_n)]}{\Delta} < 0 \tag{36}$$

$$\hat{P}/\hat{P}_n^* = \theta_n > 0 \tag{37}$$

Demand for raw materials and domestic employment are given by (8) and (6) with regard to (7) respectively.

$$\hat{n} = - \Theta_\ell \sigma \hat{P}_n^* + \hat{x} \tag{38}$$

$$\hat{\ell} = \Theta_n \sigma \hat{P}_n^* + \hat{x} \tag{39}$$

The factor demand functions distinguish clearly between substitution effects and the influence of the level of production. We find the total effect of an increase in raw materials price if we feed back the output impact (36) in (38), (39).

$$\hat{n}/\hat{P}_n^* = - \frac{[\rho\Theta_\ell\sigma + \Theta_n(\Theta_\ell - \Theta_n\eta)]}{\Delta} < 0 \tag{40}$$

$$\hat{\ell}/\hat{P}_n^* = - \frac{\Theta_n[(1-\sigma) - \Theta_n(1+\eta)]}{\Delta} \gtrless 0 \tag{41}$$

Recalling a specific feature of our model namely the identity between domestic real income and real wage payments in producing GDP yields the following relations.

$$y = W\ell/P \quad \text{or} \quad \hat{y} = \hat{\ell} - \hat{P} \tag{42}$$

Holding constand the nominal wage rate we easily find a solution for domestic real income if we use (37) and (41) in (42).

$$\hat{y}/\hat{P}_n^* = - \frac{\Theta_n[(1-\sigma) + (\rho\Theta_\ell - \eta\Theta_n)]}{\Delta} < 0 \tag{43}$$

(42) is also of strategic importance in estimating trade balance reaction. With reference to (27) and (42) we get the change of trade balance

$$dB = \lambda M(\hat{\ell} - \hat{M}) \tag{44}$$

Apparently, as long as we fix the nominal wage rate, employment and the trade balance move in the same direction.

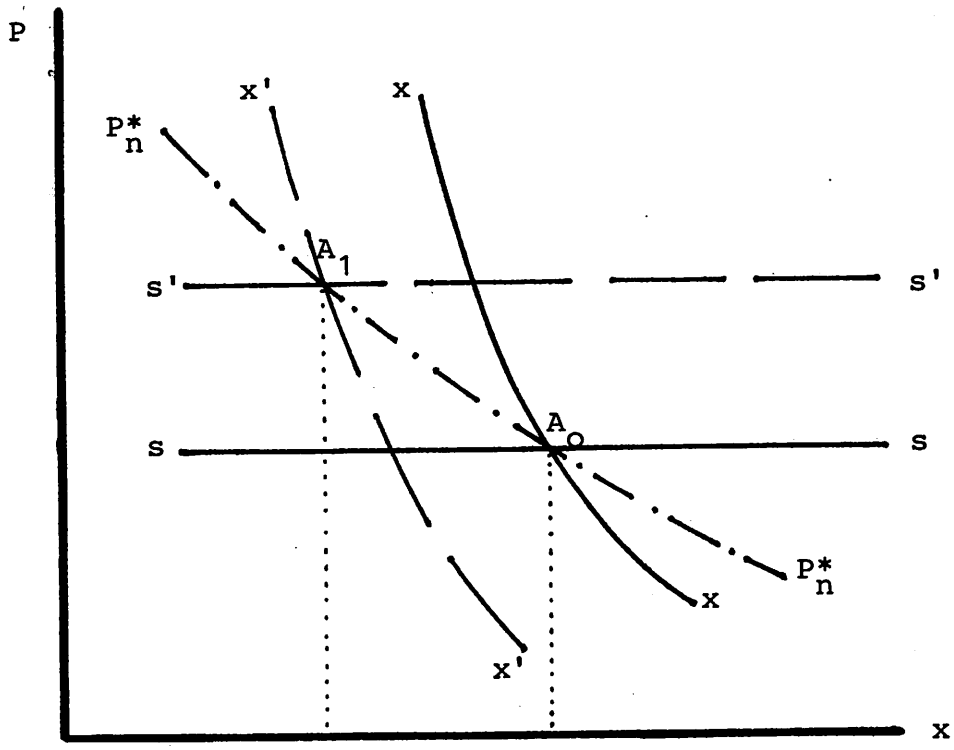
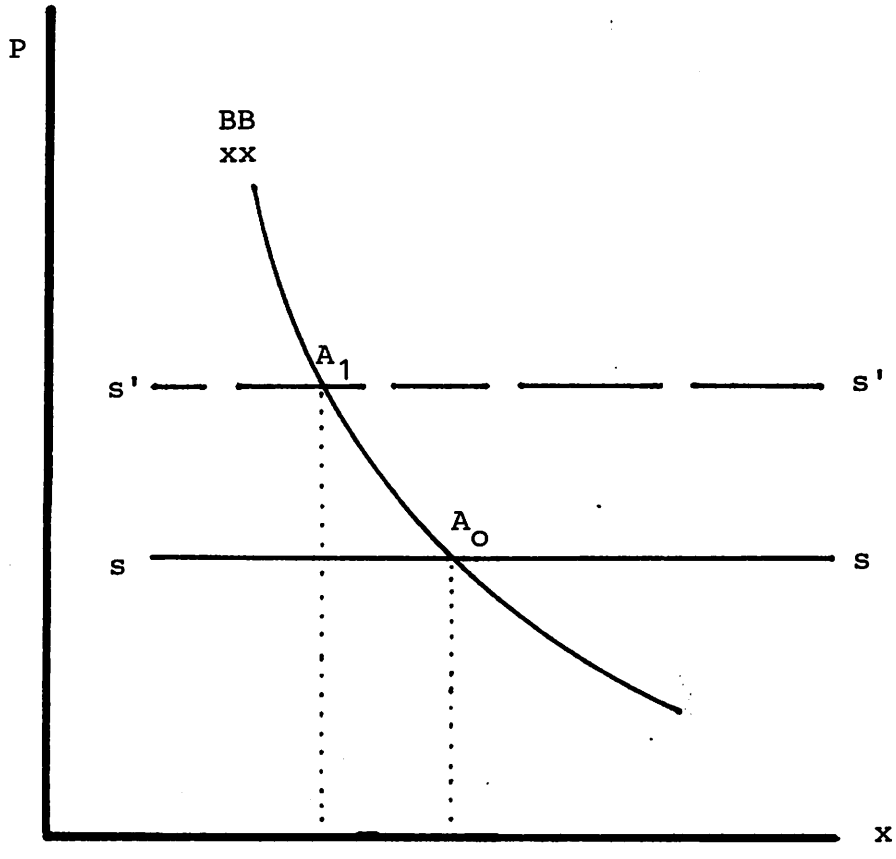


Fig. 2



$|\eta| = 1, \sigma = 1$

Fig. 3

Several general observations suggest themselves. First, our raw materials price-ridden economy adjusts by a stagflationary pattern, if we define stagflation in the present comparative static analysis as an output-recession coupled with an increase in output price. Secondly, in an open economy with imported intermediates, employment is independent from development of either domestic production or domestic income. Domestic employment depends on the structural parameters of our model because a positive substitution effect of more expensive raw materials works against a negative scale of production effect. The basic stagflationary adjustment pattern is grasped by the dotted-dashed $P^*_n P^*_n$ line in Figure 2. That line is the locus of all combinations [x,P] generated by variations in the price of raw materials. The elasticity of this curve can be determined from (36) and (37).

$$\hat{P}/\hat{x}\Big|_{\hat{P}^*_n \gtrless 0} = -\frac{\rho\theta_\ell + \theta_n}{(1-\rho)\theta_\ell(1-\sigma) + \rho\theta_\ell - \theta_n\eta} < 0 \qquad (45)$$

Except for the marginal propensity to spend $(1-\rho)$ and the factor shares θ_ℓ, θ_n, the elasticity of substitution $0 \leq \sigma \leq 1$ and the elasticity of export demand $-1 \leq \eta \leq 0$ primarily govern the economy's adjustment.

To aid our understanding of the events following an autonomous rise in raw materials price, it is rewarding to consider first an unrealistic borderline case: $|\eta| = \sigma = 1$. Raising prices for imported intermediates push up the price level of domestically produced goods. This, on the one hand, has a damaging influence on export sales while export values stay constant. On the other hand, domestic absoprtion is going to be restricted by a real balance effect. Hence domestic production recedes, simultaneously forcing down domestic real income because, if $\sigma = 1$, domestic real income is proportionate to domestic production. The reduction of domestic real income reinforces falling

demand by domestic residents, so that in the final stage demand by domestic and foreign residents shrinks by the same percentage rate. This amounts to a falling production with a constant export share. Employment is unchanged in this border line case because the positive substitution effect of more expensive raw materials is compensated exactly by receding production. Also we find that price and quantity effects compensate each other in the value of imports, hence the trade account is not changed. The specific results of this thought experiment can be checked from our results (36)-(43).

$$\hat{x}/\hat{P}^*_n = -\theta_n \; ; \; \hat{P}/\hat{P}^*_n = \theta_n \; ; \; \hat{n}/\hat{P}^*_n = -1 \; ; \; \hat{\ell}/\hat{P}^*_n = 0$$

$$\hat{y}/\hat{P}^*_n = -\theta_n \; ; dB/\hat{P}^*_n = 0$$

Figure 3 portrays the specific adjustment. Note that, in accordance to our construction, the xx and BB curves must coincide if $\sigma = 1$, and in this case, according to (35), only the ss curve is shifted upwards by θ_n.

This experiment is unrealistic in particular because the difficulties in adjusting to a sudden increase in raw material prices are seen as stemming from a rather low elasticity of substitution. Therefore, if $0 \leq \sigma < 1$, rising prices of raw materials immediately impose a real income loss upon net importers of these intermediate products, forcing down the share of domestic value-added in the value of total production. The direct real income squeeze becomes larger the smaller is σ and, in accordance with (35), shows up in Figure 4 both as a movement of BB to the right and a movement of xx to the left. Figure 4 shows clearly how the direct real income effect reinforces the recessionary trend, creating a $P^*_n P^*_n$ curve (not shown) less steep than the original xx curve. The direct income effect also destroys the delicate balance between substitution and scale effects with respect to domestic employment. The smaller is σ the more a growing recession dominates a weakening

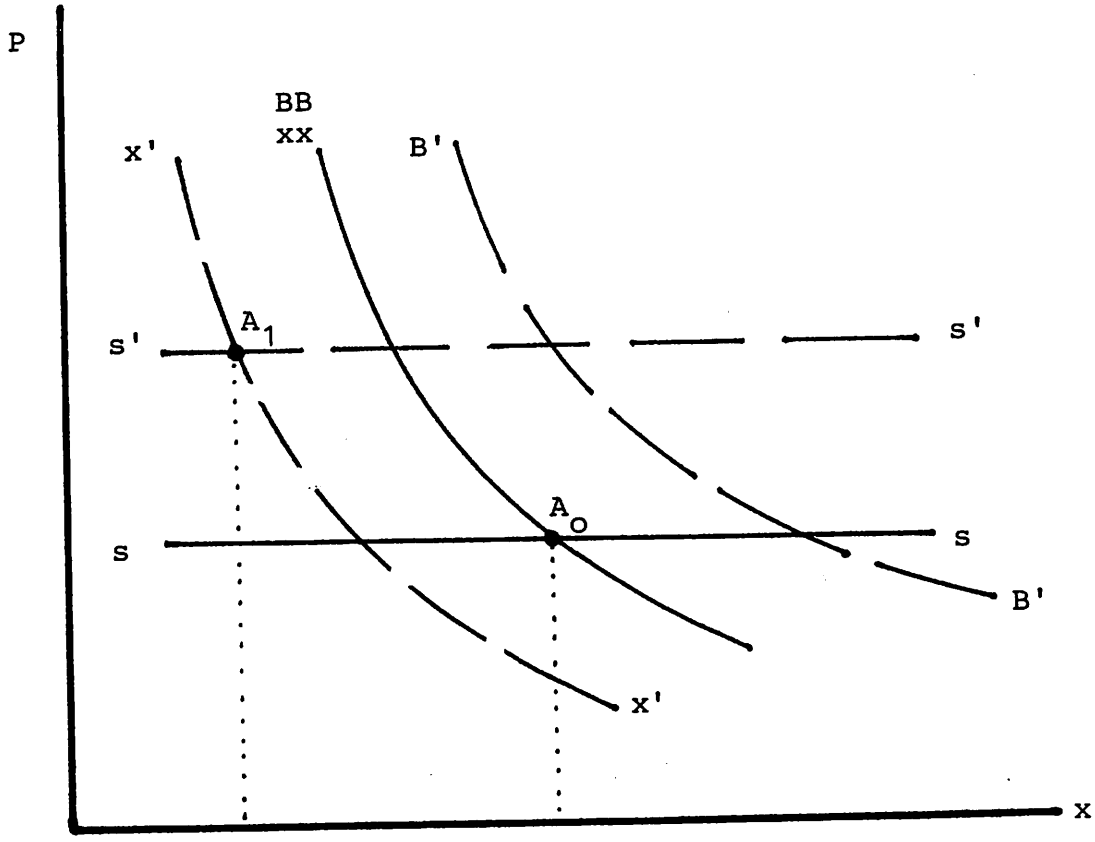


Fig. 4

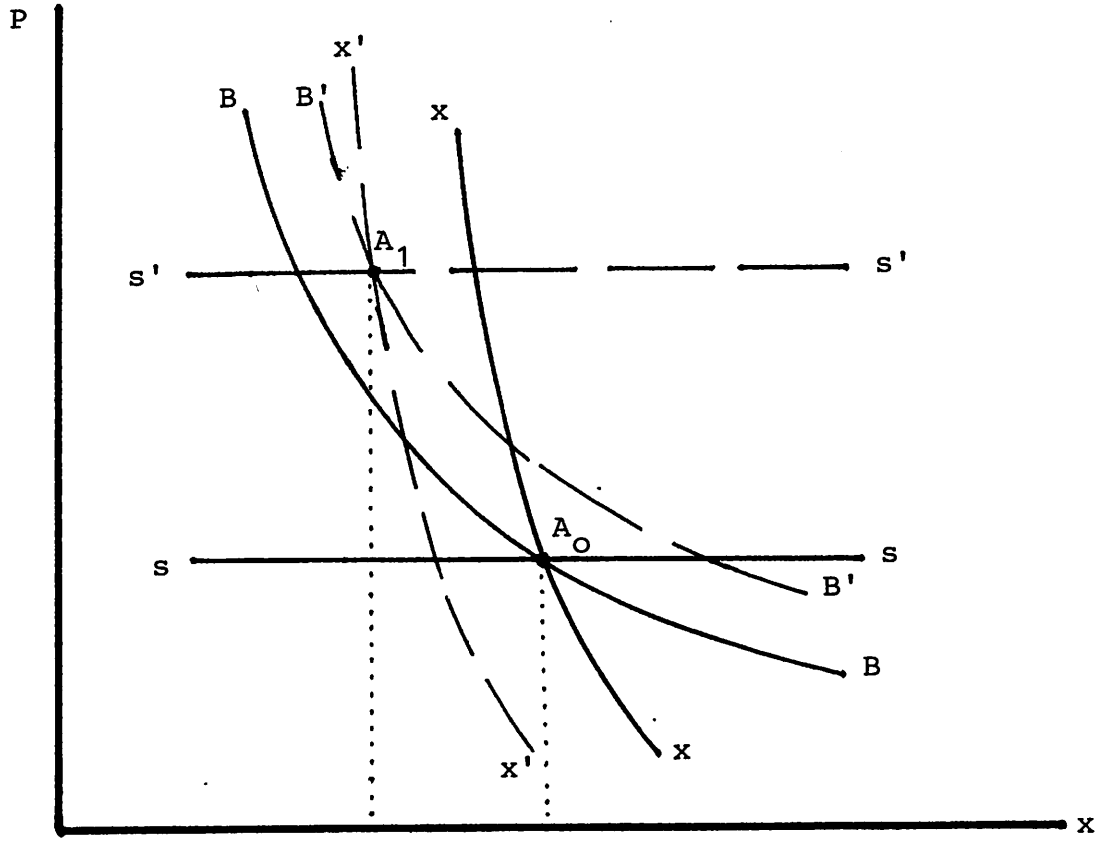


Fig. 5

favourable substitution effect. Employment tends to fall and pulls down the trade balance, too, in accordance with (44). Finally Figure 5 emphasizes the strategic importance of the elasticity of export demand given by the steepness of the xx curve relatively to the BB curve. A smaller $|\eta|$, by increasing the slope of xx, explains geometrically the following: The more price inelastic is export demand with respect to the growing domestic price level, the more a domestic recession is diminished and the more chances improve that trade surpluses are induced together with growing employment. In summary, while a lower σ tends to deteriorate the trade balance, a lower $|\eta|$ tends to improve it. Figure 5 depicts the border line case of a relatively low σ and a $|\eta|$ such that trade is balanced and employment is neutral after an increase in raw material prices even when the direct real income effect is at work. In accordance with (41) the condition for that result is

$$(\sigma-1) + \theta_n(1+\eta) = 0 \qquad (46)$$

3.2 Devaluation

It makes sense before studying the impact of raising raw material prices in the context of a flexible exchange rate system in section 4 to have a closer look at a once-and-for-all change in the exchange rate. This holds the more because the theory of devaluation neglects widely import content of exports. As a consequence Keynesian open economy models, as well as monetary approach models, tend to overestimate the demand response of a devaluation. The present model gives an unbiased view of the exchange rate impact showing an impact of the rate on the demand side as well as on the supply side of an open economy. Our view takes away much of the demand stimulus traditional theory claims with regard to a devaluation while at the same time it stresses a particularly strong form of interaction between price level and exchange rate changes neither present in Keynesian models nor modelled in context of the monetary approach with or without unemployment.

It is easy to calculate for a devaluation from (35).

$$\hat{x}/\hat{E} = -\frac{\theta_n[\theta_\ell(\eta-\sigma+1) + \sigma\rho\theta_\ell]}{\Delta} \gtrless 0 \tag{47}$$

$$\hat{P}/\hat{E} = \theta_n > 0 \tag{48}$$

Using (47) in (38) and (39) yields

$$\begin{aligned}\hat{n}/\hat{E} &= -\frac{\theta_\ell[\theta_n(\eta-\sigma+1) + \sigma(\rho+\theta_n)]}{\Delta} \\ &= -\frac{\theta_\ell[\theta_n(1+\eta) + \sigma\rho]}{\Delta} < 0\end{aligned} \tag{49}$$

$$\begin{aligned}\hat{\ell}/\hat{E} &= -\frac{\theta_n[\theta_\ell(\eta-\sigma+1) - \sigma\theta_n]}{\Delta} \\ &= -\frac{\theta_n[\theta_\ell(1+\eta) - \sigma]}{\Delta} > 0\end{aligned} \tag{50}$$

Domestic real income is determined by (42) with regard to (48) and (50).

$$\hat{y}/\hat{E} = - \frac{\theta_n [\theta_\ell(\eta-\sigma+1) + \rho\theta_\ell + \theta_n(1-\sigma)]}{\Delta} \gtrless 0 \qquad (51)$$

Overlooking results (47)-(51) we realize a common term $\theta_1(\eta-\sigma+1)$ which appears in nearly all our results. We point out next the importance of this expression in connection with the so-called 'primary reactions' of the trade balance. We repeat the definition of the trade balance (22).

$$B = P^*c - P_n n$$

Differentiation of (22), in a state of initially balanced trade yields, with respect to (21), (8), (4) and (2)

$$dB = - Pc^*[\theta_\ell(\eta-\sigma+1)\hat{E} + \hat{x}]. \qquad (53)$$

Holding production constant, we can say that we find a 'normal' reaction of the trade balance if the following condition is valid

$$(\eta-\sigma+1) < 0 \qquad (54)$$

Recalling σ as our elasticity of import demand, we look upon (54) as a modified Marshall-Lerner condition, the validity of which we always assumed as we evaluated the signs of our results (47)-(51). We can express the total impact of a devaluation upon the domestic trade balance if we insert (47) in (53).

$$dB/\hat{E} = \frac{-Y\rho\theta_n [\theta_\ell(\eta-\sigma+1) - \sigma\theta_n]}{\Delta} > 0 \qquad (55)$$

Comparison of (55) with (50) again indicates the strong connection in trends of both the trade balance and the employment variables.

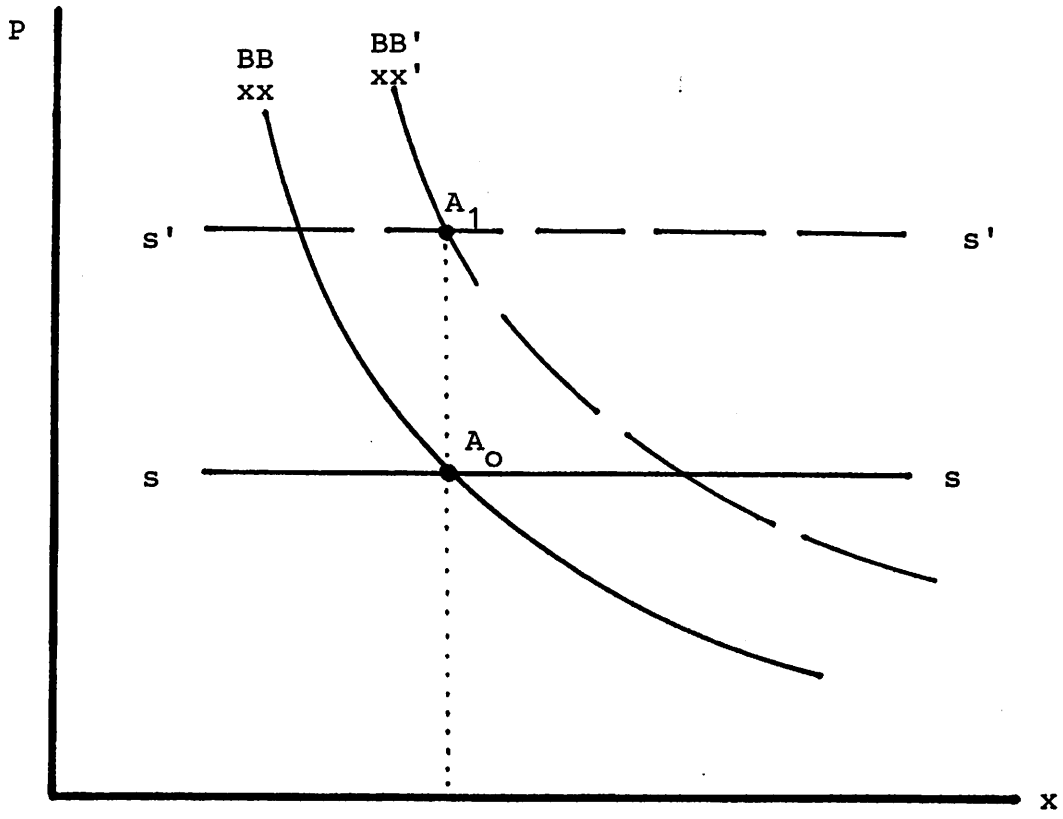
In a resource importing country a devaluation acts like a supply shock. However, this is not the whole story. On the demand side two opposing effects

manifest themselves in the coefficient of $\hat{E}$ in (35).[13]

$$-[\theta_n \eta + \alpha\theta_\ell \theta_n (1-\sigma)] \gtrless 0 \tag{56}$$

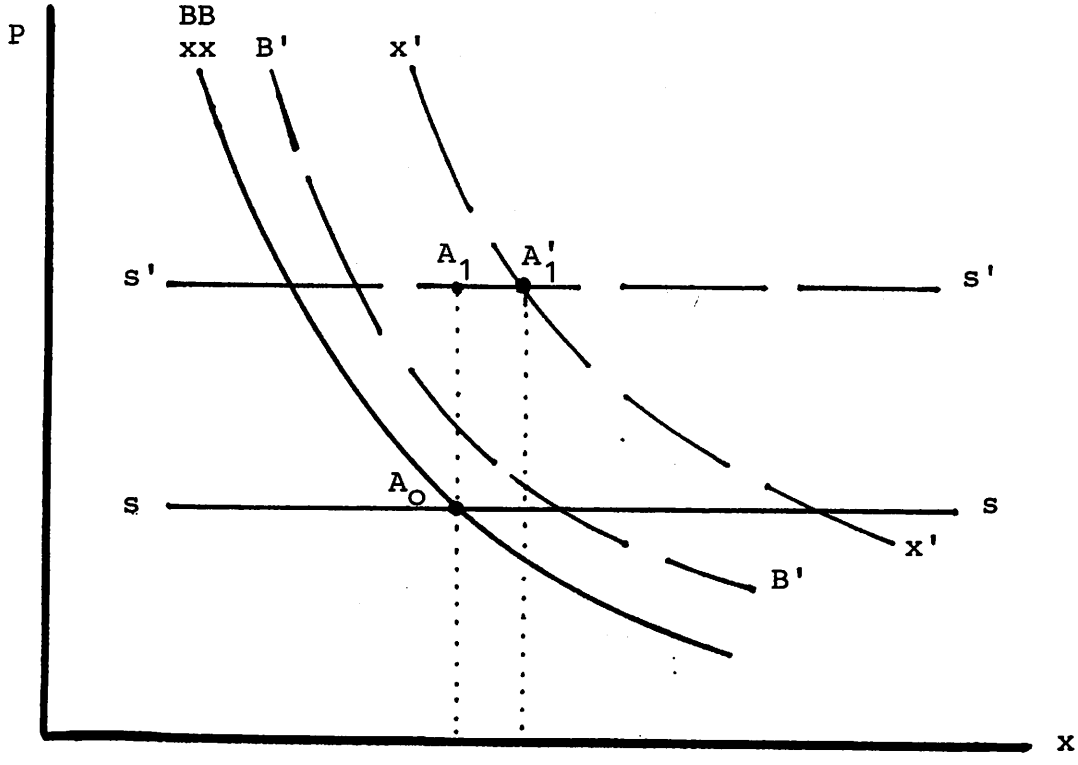
The first term shows the well-known demand stimulating effect because a devaluation improves competitiveness of domestic exports. The second term characterizes the fall of demand for domestic goods induced by the direct real income loss if $0 \leq \sigma < 1$.

To fix ideas and to understand better the total result of interacting forces it is worthwhile to consider again a theoretical border line case: $|\eta| = 1$, $\sigma = 0$. Despite the general indeterminancy of (56) in this special case we find a clear-cut increase in total demand given the price level. This appears as a rightwards shift of the xx curve in Figure 6.[14] Further, we observe the cost effect of a devaluation pushing upwards the ss curve in Figure 6. This demonstrates two more dampening factors in total demand for domestic goods, namely a negative real balance effect in goods demand of domestic residents and a negative effect in export sales because of rising domestic prices. Figure 6 presents a situation where the loss in demand of domestic residents is exactly compensated by a (net) increase in demand of foreign residents. Thus domestic output and factor demand remain constant. Domestic income and absorption also remain constant in nominal terms ensuring that the trade balance stays balanced. As export value has increased by the percentage of the exchange rate change if $|\eta| = 1$, import value must have risen via a price increase by the same percentage. Note that domestic real income must fall because nominal domestic income has not kept up with the rising price level. The precise outcomes of this thought experiment result from



$|\eta| = 1, \sigma = 0$

Fig. 6



$|\eta| = 1, 0 < \sigma < 1$

Fig. 7

$$\hat{x}/\hat{E} = 0;\ \hat{P}/\hat{E} = \theta_n;\ \hat{\ell}/\hat{E} = \hat{n}/\hat{E} = 0;\ \hat{y}/\hat{E} = -\theta_n$$

These findings are summed up in a new equilibrium point A_1 in Figure 6. However, as soon as σ approaches higher values the direct real income effect is weakened, therefore the demand loss from domestic residents falls short of the demand increase resulting from export gains. Now a devaluation unambiguously raises domestic output and employment. These findings show up in Figure 7 if $|\eta| = 1$ and $0 < \sigma < 1$. Points of a new equilibrium as A_1' must be located to the right of A_1 if $0 < \sigma < 1$. Note that the BB curve is shifted to the right the less the increase in σ; hence for a growing σ trade balance surpluses become larger.

It appears that the implications of a reduction in $|\eta|$, the export elasticity, are uncertain. On the one hand export aid by devaluation is diminished the greater the minimum absolute values of the elasticity of export demand. From (56) we can conclude if $|\eta|$ falls below some critical value, the (net) demand effect of a devaluation will become negative even when the price level is given.[15] On the other hand the cost-push effect of a rising exchange rate on the price of domestic goods hurts exports less, the more inelastic is the export demand of the domestic country. This effect shows up as a greater steepness of the xx curve. In total, a reduction of $|\eta|$ causes a decline of the expansive power normally attributed to devaluation by lifting the export component of total demand for domestic goods. Corresponding to each value of $0 \leq \sigma < 1$ there exists a critical value of $|\eta|$ below which export support is weakened so far that it is unable to exceed demand losses on the part of domestic residents. In such an event a devaluation brings stagflation to the devaluing country. The exact condition for that unusual result is given in (47). We have

$$\hat{x}/\hat{E} \gtrless 0 \quad \text{if} \quad \sigma(1-\rho) - (1+\eta) \gtrless 0 \tag{57}$$

Formula (50) shows another most interesting result in proving that the recession of domestic production takes place without affecting domestic employment as long as we are prepared to assume a 'normal' reaction of the trade balance after a devaluation.[16] In this case (55) tells us that the total effect of a devaluation on the trade balance is unambiguously positive. Figure 8 sums up such a course of events demonstrating stagflation and a trade surplus as a result of domestic devaluation. A sufficient condition for the stagflationary result is $|\eta| < \rho$ if $0 < \sigma < 1$. In general we can say the occurrence of stagflation is assisted by a small elasticity of substitution between domestic and imported factors of production and a small elasticity of export demand.

4. The Model: Flexible Exchange Rates

The framework given so far employs a very simple version of the monetary approach where wealth takes the form of cash balances only. A trade balance surplus therefore is equivalent to domestic hoarding which in turn is related to excess demand for domestic currency. While the gap in money holdings in a fixed exchange rate system can be closed only in a time consuming adjustment process in which the domestic monetary authority creates money by acquiring exchange reserves, in a flexible exchange rate system the exchange rate, being the price of a currency, adjusts such that the excess money demand disappears. In this way the monetary approach to the balance of payments becomes the monetary approach to exchange rate determination. Therefore our algebraic apparatus requires little change to cope with a flexible exchange rate system. All we need to do is postulate $dB = 0$ in (35) and switch the exchange rate variable from the exogenous to the endogenous side of the model.

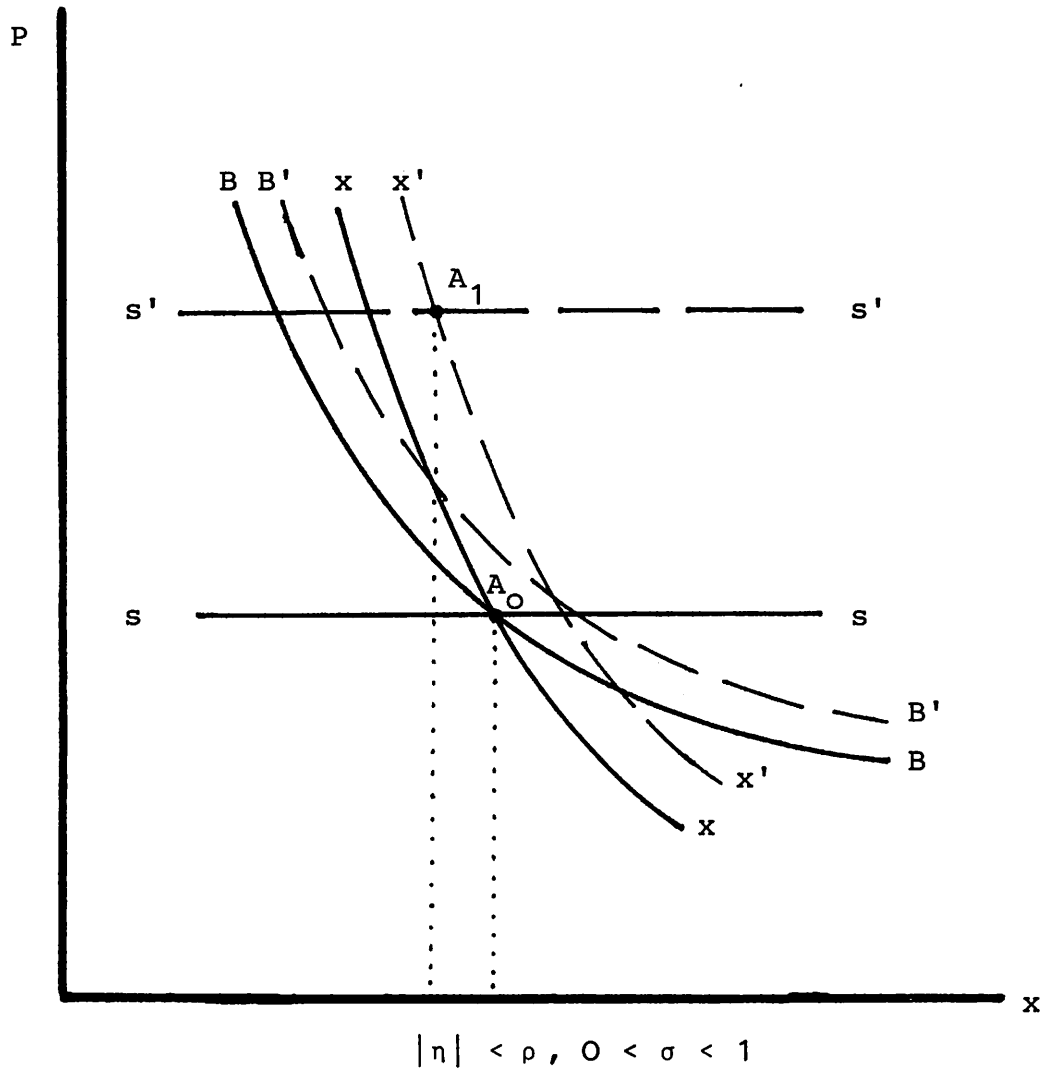


Fig. 8

That gives us the following flexible exchange rate model.

$$\begin{bmatrix} [\rho\theta_\ell + \theta_n] & [\rho\theta_\ell - \eta\theta_n] & \theta_n[\eta + \alpha\theta_\ell(1-\sigma)] \\ 0 & 1 & -\theta_n \\ 1 & 1 & -\theta_n(1-\sigma) \end{bmatrix} \begin{bmatrix} \hat{x} \\ \hat{P} \\ \hat{E} \end{bmatrix} \tag{58}$$

$$\begin{bmatrix} -\alpha\theta_\ell\theta_n(1-\sigma) & \alpha\theta_\ell\theta_n(1-\sigma) & \rho\theta_\ell \\ \theta_n & \theta_\ell & 0 \\ \theta_n(1-\sigma) & -\theta_n(1-\sigma) & 1 \end{bmatrix} \begin{bmatrix} \hat{P}^*_n \\ \hat{W} \\ \hat{M} \end{bmatrix}$$

The determinant of (58) is

$$D' = \theta_n\Delta' > 0$$

$$\Delta' = \sigma - \theta_\ell(1+\eta) = [\sigma\theta_n - (\eta - \sigma + 1)\theta_\ell] > 0$$

Assuming a 'normal' reaction of the trade balance we can easily determine a positive sign of Δ'. The impact of an increase in raw material price can be calculated from (58)

$$\hat{x}/\hat{P}^*_n = \frac{\theta_n\eta\sigma}{\Delta'} < 0 \tag{59}$$

$$\hat{P}/\hat{P}^*_n = \frac{-\theta_n\eta}{\Delta'} > 0 \tag{60}$$

$$\hat{E}/\hat{P}^*_n = \frac{(1-\sigma) - \theta_n(1+\eta)}{\Delta'} \gtrless 0 \tag{61}$$

$$= \frac{-[(\sigma - \theta_\ell(1+\eta)) + \eta]}{\Delta'} = \frac{-[\Delta' + \eta]}{\Delta'} \gtrless 0$$

Of further interest are the demand for imported intermediates and domestic employment. To this end it is useful to determine first the change in price of raw materials denoted in domestic currency. From (2) with regard to (61) it follows

$$\hat{P}_n/\hat{P}^*_n = \frac{-\eta}{\Delta'} > 0 \tag{62}$$

(8) with regard to (59) and (62) explain demand for raw materials as

$$\hat{n}/\hat{P}^*_n = \frac{\sigma\eta}{\Delta'} < 0 \tag{63}$$

From (6) and (7) we find the change in domestic employment.

$$\hat{\ell} = \theta_n \sigma \hat{P}_n + \hat{x}$$

Using (59) and (62) we can conclude that domestic employment is not affected by an increase in raw material price under a flexible rate system.

$$\hat{\ell}/\hat{P}^*_n = 0 \tag{64}$$

Finally (42) tells us that the change of domestic real income is negative.

$$\hat{y}/\hat{P}^*_n = \frac{\theta_n \eta}{\Delta'} < 0 \tag{65}$$

As a general observation we first note that the stagflationary adjustment pattern has survived the introduction of a flexible exchange rate system. Interestingly enough, under flexible rates the price-output response pattern is completely dominated by σ, a technological characteristic of our model. This can be seen from (59) and (60) if we determine again the elasticity of the locus of all x,P combinations for a varying raw material price.

$$\hat{P}/\hat{x}\Big|_{\substack{\text{flex.} \\ \hat{P}^*_n \gtrless 0}} = -\frac{1}{\sigma} \tag{66}$$

Accepting the fact that flexible rates have helped the domestic country to insulate domestic employment although it could not prevent stagflation, we carry on our analysis by asking if flexible rates at least assisted in curbing stagflation. To learn about this property we have to compare price

and output components of GDP. Comparisons of (37) to (60) and of (36) to (59) results in the following important inequalities:

$$\hat{P}/\hat{P}^*_n\Big|_{\text{flex.}} \gtrless \hat{P}/\hat{P}^*_n\Big|_{\text{fix.}} \quad \text{if } \sigma - 1 + \theta_n(1+\eta) \lesseqgtr 0 \tag{67}$$

$$\hat{x}/\hat{P}^*_n\Big|_{\text{flex.}} \lesseqgtr \hat{x}/\hat{P}^*_n\Big|_{\text{fix.}} \quad \text{if } [\sigma(1-\rho) - (1+\eta)][\sigma - 1 + \theta_n(1+\eta)] \gtreqless 0 \tag{68}$$

A closer inspection of (67) and (68) reveals a full range of possibilities of a different adjustment under flexible rates compared to fixed rates:

I reinforcement of stagflation

II strengthening of price increase together with dampening of output recession

III strengthening of output recession together with dampening of price increase

IV curbing of stagflation

V no difference in adjustment between both exchange rate systems.

These possibilities can be visualized in Figure 9 if we represent inequalities (67) and (68) in a σ, $1+\eta$ coordinate system.

To clarify only cases I and II, we recall from (41) that an increase in raw material price results in a more immediate deterioration of the trade balance, the less the elasticity of substitution, σ, and the larger the elasticity of export demand, $|\eta|$. The same condition which governs the deterioration of the trade balance in a fixed exchange rate system will determine the increase in the exchange rate (compare (61) to (41)) in a flexible rate system. Therefore a devaluation of the domestic currency occurs which adds a second round of price increase. As we have seen in (57) assuming a sufficiently large (absolute) value of export elasticity is enough to secure a positive output effect of the devaluation and we end up

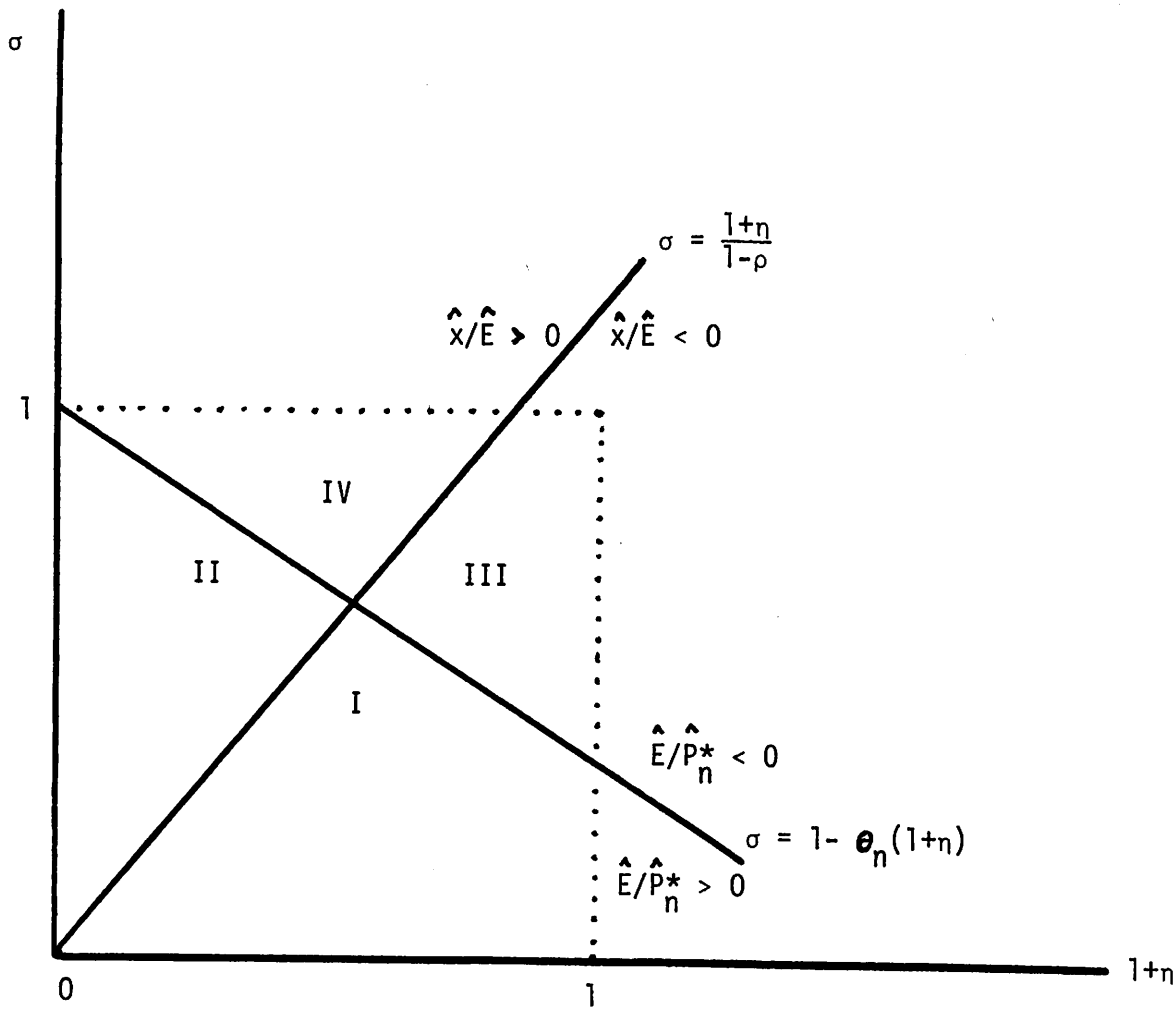


Fig. 9

with a case where the original recessionary effect of a rising raw material price is diminished by the exchange rate adjustment (case II). If the elasticity of export demand remains under that critical value, however, the resulting negative output effect of the devaluation comes on top of the original raw material price induced recession (case I). Summarizing, we can say that under certain circumstances a flexible rate system may worsen the stagflationary adjustments a raw material price-ridden economy must undergo. This holds true if raw materials are priced in foreign currency units. Therefore the most striking feature of our analysis is that we must recommend a wait-and-see attitude towards the alleged insulation power of flexible rates.[17] Depending on structural parameters of the system, whose values have to be measured at least if it comes to the question of protection against raw material induced cost push inflation, a flexible rate system may have some insulation power. Alternatively, under another set of values for our critical parameters, the same flexible rate system pushes the domestic economy in a circle of price increases and devaluations while domestic production is falling. Our present model emphasizes, however, that this 'vicious circle' does not affect employment. Domestic employment plays the part of the insulated variable. This view is confirmed if we subject the system to an internal disturbance. Using an exogenous change in the money supply the present model gives $\hat{\ell} = \hat{M}$, i.e., we can observe the usual 'corking effect' of flexible rates which results in an amplified influence of internal disturbances.

5. OPEC vs. OECD - The Two Country Framework

In this final section we consdier the 'rest of the world' as OPEC and the 'home country' represents OECD using OPEC's production of intermediates. Thus export demand for domestic goods is no longer exogenously given, but rather depends on OPEC's real income. We assume further that OPEC's final goods prices are denominated in the same currency, say US $, with which it denominates the price of its sole export, the intermediate good. Let P* denote the final goods price in 'foreign' currency units. Then OPEC's expenditures, C*, and income, Y*, are represented by

$$C^* = P^*c^* \quad \text{and} \quad Y^* = P_n^*x^* \tag{69}$$

Note that in (69) we made a convenient switch in notation substituting n, previously the domestic country's demand for importables, by x*, OPEC's production level. Knowing OPEC's income we can easily establish OPEC's expenditures. That gives us

$$C^* = \alpha^*Y^* + \rho^*M^* \tag{70}$$

Obviously in (70) we measure OPEC's money stock in U.S. currency units. OPEC's physical demand for OECD goods can now be shown to depend on OPEC's real income $y^* = Y^*/P^*$ and the purchasing power of its cash balances M^*/P^*. We derive from (70)

$$c^* = \alpha^*y^* + \rho^*Em^* \tag{71}$$

$$y^* = (P_n/P)x^* \; ; \; m^* = M^*/P$$

(71) establishes one tie in the connection between both trading blocs the other one being OECD's demand for OPEC's output.

$$\hat{x}^* = \theta_\ell\sigma(\hat{P}_n - \hat{W}) + \hat{x} \tag{72}$$

This completes the description of our global world framework. Substituting

demand functions (18) and (71) in (26) the equilibrium condition of the world market for final goods yields

$$\hat{x} = \theta_\ell[\alpha\hat{y} + \rho(\hat{M}-\hat{P})] + \theta_n[\alpha^*\hat{y}^* + \rho^*(\hat{E}+\hat{M}^*-\hat{P})] \tag{73}$$

From the definition of y and y* we can substitute for their percentage change in (73). As previously shown using (72) we then can evaluate the change in real income of both countries following an increase in factor prices $\hat{P}_n$, $\hat{W}$. Once we know the coefficient of $\hat{P}_n$ we can finally collect terms for exchange rate change $\hat{E}$ with regard to (2). These calculations result in the following equation

$$\begin{aligned}&[1-\alpha\theta_\ell - \alpha^*\theta_n]\hat{x} + [\rho\theta_\ell + \rho^*\theta_n]\hat{P} \\ &= \theta_\ell\theta_n(1-\sigma)(\alpha^*-\alpha)[\hat{P}_n^*-\hat{W}] + \theta_n[\rho^* + \theta_\ell(1-\sigma)(\alpha^*-\alpha)]\hat{E} + \rho\theta_\ell\hat{M} + \rho^*\theta_n\hat{M}^*\end{aligned} \tag{74}$$

The second equation of our world model is the price equation (4) repeated here for convenience.

$$\hat{P} = \theta_n(\hat{P}_n^* + \hat{E}) + \theta_\ell\hat{W} \tag{75}$$

The third equation is also well known from (34) and gives OECD's trade balance.

$$dB = \lambda M[\hat{x} + \hat{P} - \theta_n(1-\sigma)(\hat{P}_n^*-\hat{W}) - \theta_n(1-\sigma)\hat{E} - \hat{M}] \tag{76}$$

Equations (74)-(76) determine the change in world output of final goods, $\hat{x}$, the price level of these goods, $\hat{P}$, and the OECD trade balance, dB. Now it is easy to find the impact of a change in the dollar price of raw materials from (74) and (75).

$$\begin{aligned}\hat{x}/\hat{P}_n^* &= \frac{\theta_n[(\alpha^*-\alpha)\theta_\ell(1-\sigma) - \rho\theta_\ell - \rho^*\theta_n]}{[1-\alpha\theta_\ell - \alpha^*\theta_n]} \\ &= \frac{\theta_n[(\rho^*-\rho)\theta_\ell\sigma - \rho^*]}{\rho\theta_\ell + \rho^*\theta_n} < 0\end{aligned} \tag{77}$$

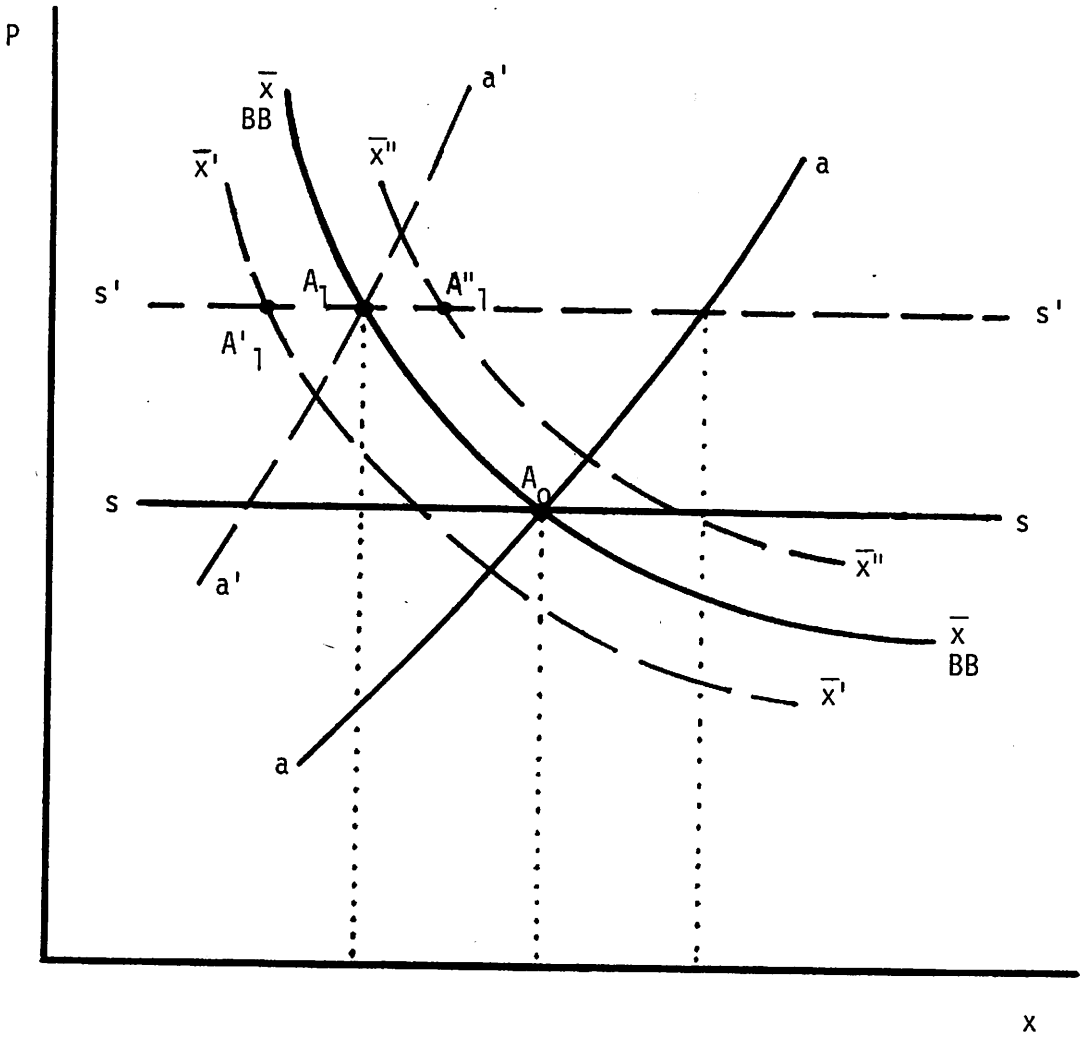


Fig. 10

The change in OECD's employment and OPEC's production of intermediates is

$$\hat{\ell}/\hat{P}^*_n = -\frac{\theta_n \rho^*(1-\sigma)}{\rho\theta_\ell + \rho^*\theta_n} \leq 0 \tag{78}$$

$$\hat{x}^*/\hat{P}^*_n = -\frac{[\theta_n \rho^* + \theta_\ell \sigma\rho]}{\rho\theta_\ell + \rho^*\theta_n} < 0 \tag{79}$$

It is possible to design a graphical description of these adjustments along familiar lines of an aggregate demand and aggregate supply analysis. In Figure 10 the demand curve can be drawn as a falling xx line. From (74) the price elasticity of the aggregate demand curve is negative and equal to unity. Note that the coefficient of $\hat{x}$ in (74) represents a world income multiplier while the coefficient of $\hat{P}$ catches the real balance effect for the world as a whole. The ss line expresses cost-determinedness of the final goods price. We further show a short-run aggregate supply curve aa, the foundation of which requires some explanation. The aa curve is the marginal cost curve resulting from variations in labour utilization holding constant OECD use of OPEC's intermediates. Further, the nominal wage, W, is a constant parameter if we move along aa. The elasticity of aa can be found from (8) and (4) for $\hat{W} = 0$.

$$\hat{x} = (\theta_\ell \sigma/\theta_n)\hat{P} + \hat{x}^* \tag{80}$$

Note that $\hat{P}_n > 0$ if we move along aa in an upward direction. Turned around aa explains price and output response of the OECD production sector following an increase in price of intermediates if we hold constant the use of intermediates and the nominal wage rate. From (8) it is also clear that holding P constant if we reduce the quantity of intermediates used by OECD aa shifts to the left. Thus the basic idea of how the world economy works in our model is obvious. An increase in the price of intermediates pushes up ss to s′s′.

Output of final goods then is determined by world aggregate demand influenced in turn by the increase in raw materials price. To find the new equilibrium point on $s's'$, the problem we have to discuss next is simply how to conclude the shift of the $\bar{x}\bar{x}$ line induced by a rising price of intermediates. Suppose we had found that the new equilibrium short-run supply curve aa will shift leftwards until it passes through the new equilibrium point. This indicates how the adjustment burden is divided among employment of OECD's domestic or OPEC's intermediate factor of production, respectively.

Consider now an exogenous increase in dollar price of intermediates. Assume first no difference in spending behaviour between both trading blocs ($\alpha=\alpha^*$) and let $\sigma = 1$. The cost push effect of raising intermediate goods prices on the final goods price level exerts a worldwide real balance effect. However, an immediate fall of real incomes in both trading areas of the world equal in size to the reduction in production of final goods, and therefore equal in size to each other, has simultaneously reduced the desire to hold money in both areas. Hence we end up with an immediate reduction in absorption, of the same percentage in both trading areas exactly matching the real income loss. The trade balance remains in equilibrium if it was balanced in the beginning. The shrunken world economy is shown as A_1 in Figure 10.[18] If we assume more realistically that $0 \leq \sigma < 1$ and $\alpha = \alpha^*$, we observe a redistribution of real world income in favour of OPEC, the producer of raw materials. Because of equal propensities to spend, total world demand for final goods will not be influenced by this change in the distribution of real world income. However, distribution of real absorption will shift in favour of OPEC and, more important, OPEC will start hoarding out of its relatively increased real income. Hence this time OPEC finds itself emerging out of the overall world recession with a trade balance surplus.[19]

Given this trade surplus, it is not clear whether OPEC has acted rationally in pushing the world economy into a recession, if its aim was simply an improved standard of living in terms of current consumption. As soon as $0 \leq \sigma < 1$, OECD cannot avoid a collapse of domestic employment, the size of employment reduction depending on the size of σ. Finally we investigate the case $0 \leq \sigma < 1$ and $\alpha \neq \alpha^*$. Discussants of the oil crisis have often assumed that OPEC's propensity to spend is smaller than OECD's, i.e., $\alpha > \alpha^*$. Income redistribution is now in favour of the smaller spender and this fact adds a world demand shortage to an already troubled economy. The demand deficiency is represented by a shift of $\bar{\bar{xx}}$ to the left and this clearly shows an aggravation of world recession (see A_1'). We can conclude from (78), (79) that an increase in α also worsens the fall in employment for both factors of production. Alternately if $\alpha < \alpha^*$ world recession is dampened by the positive demand effect of world income redistribution in favour of the bigger spender (see A_1''). However, that effect is not strong enough to change the basic recessionary adjustment pattern.

While the spending parameters are more of a quantitative impact than of a qualitative importance in connection with an autonomous increase in prices for intermediates, they are critical in connection with an autonomous exchange rates change. We find from (74) and (75)

$$\hat{x}/\hat{E} = \frac{\theta_n[(\rho^*-\rho)\theta_\ell\sigma]}{\rho\theta_\ell + \rho^*\theta_n} \gtrless 0 \tag{81}$$

$$\hat{\ell}/\hat{E} = \frac{\theta_n\rho^*\sigma}{\rho\theta_\ell + \rho^*\theta_n} > 0 \tag{82}$$

$$\hat{x}^*/\hat{E} = -\frac{\theta_\ell\rho\sigma}{\rho\theta_\ell + \rho^*\theta_n} < 0 \tag{83}$$

Consider again the border line case $\alpha = \alpha^*$, $\sigma = 1$. Assuming for the sake of argument that P remains constant, then $\hat{P}^* = -\hat{E}$. This increases OPEC's real income and real cash balances by the same percentage hence OPEC's increased absorption causes excess demand in the world's final goods market, shifting the $\bar{x}\bar{x}$ curve to the right by the factor θ_n. Recalling the cost push effect of an exchange rate change on the final goods price level, rather than being constant P must obviously increase such that $\hat{P} = \theta_n \hat{E}$. A rising P will reduce OECD's real income and real balances by the same percentage. This brings some relief to the excess demand situation in the world market for final goods while simultaneously reducing P* to $\hat{P}^* = -\theta_\ell \hat{E}$. At the new price level total world demand for final goods remains constant because the fall in OECD demand is compensated by an equivalent increase in OPEC demand. Hence production of final products remains constant, requiring only a substitution of OECD labour force for the more expensive intermediates. The reader can convince himself that the price and quantity reactions take place without influencing either OECD's or OPEC's real income. Therefore in the final stage we are left only with negative (positive) real balance effects on OECD's (OPEC's) final goods demand. That explains the algebraic equivalence of our formulas (82) and (83) with the domestic and foreign price effects of a devaluation for a fully employed two country world as first presented by Dornbusch (1973). This simple picture is blurred somewhat if $0 < \sigma < 1$ because now a devaluation influences world income distribution by squeezing OECD real income while improving the real income of OPEC. The change in income distribution does not affect world goods demand, as $\alpha = \alpha^*$, hence OECD output remains constant. Positive and negative effects on factor use are shortened by a falling σ

until factor substitution ceases completely at $\sigma = 0$. Although changes in σ are more of a quantitative influence, equality of spending parameters is critical. If we assume $\alpha > \alpha^*$ OECD output must increase. That may come as a surprise to an attentive reader because we have noted above that normally devaluation changes world income distribution towards OPEC which is the smaller spender. We can overcome our paradoxical result by referring to the following distinction: If $\alpha > \alpha^*$ the negative impact of the exchange rate change working via income redistribution is obviously exceeded by the positive impact of a larger world income multiplier, if we assume that α has increased. An alternative way of arguing is to start with the case $\sigma = 1$ and $\alpha = \alpha^*$. We know already that world output of final goods and real income in both trading areas remain constant. Consequently OPEC's higher absorption is effected by crowding out OECD real consumption. The equilibrating mechanism is a negative real balance effect of a rising final goods price in domestic currency units and a positive real balance effect of a falling final goods price in U.S. currency units. Now, an increase in α such that $\alpha > \alpha^*$ lowers ρ such that $\rho^* > \rho$, and this is to say that demand is released in the OECD area less than it rises in the OPEC area, hence world demand for final goods increases and so does world output of final goods. It is interesting to realize that a devaluation under these circumstances is not a beggar my neighbour policy, but rather pulls up real incomes in both trading areas. This can be seen by evaluating the following formulas for real income changes in the special case under investigation.

$$\hat{y}/\hat{E} = \frac{-\theta_n[\rho\theta_\ell + \rho^*(\theta_n - \sigma)]}{\rho\theta_\ell + \rho^*\theta_n} \gtrless 0; \quad \hat{y}^*/\hat{E} = \frac{\theta_\ell[\rho(\theta_\ell - \sigma) + \rho^*\theta_n]}{\rho\theta_\ell + \rho^*\theta_n} \gtrless 0$$

Closer inspection of these formulas reveals, that in general a devaluation may or may not have a 'normal' two-country impact, i.e., $\hat{y} > 0$ and $\hat{y}^* < 0$.

However a necessary and sufficient condition can be given which yields a 'normal' result

$$\rho\theta_{\ell} + \rho^*\theta_n \lesseqgtr \sigma \Rightarrow \left\{\begin{matrix} \hat{y} > 0, \ \hat{y}^* < 0 \\ \hat{y} < 0, \ \hat{y}^* > 0 \end{matrix}\right\}$$

subject to $\rho \neq \rho^*$ and $\sigma \neq 1$.

6. Qualifications

This paper has examined effects of an oil-price shock on a small open OECD type economy. Under fixed exchange rates and with a given nominal wage the main conclusion has been that a stagflationary adjustment pattern seems inevitable. We would like to mention four reasons why this scenario may be a too pessimistic one: (1) Rising oil prices have a demand-contractionary impact on the domestic component of total demand for domestic goods. There may be matching foreign demand coming either from other also oil price ridden OECD countries, which have lost their competitiveness by a poor adjustment to rising oil prices, or from OPEC as the recipient of the income transfer. Section 5 has shown that, independent from the relative size of the marginal propensity to spend of both parts of the world economy involved in this transfer, in the present model there is no hope that recycling of petro-dollars could avoid the output recession. On the other hand Schmid (1980) shows that under certain circumstances an individual OECD country may escape output recession at the expense of other countries. (2) Throughout the paper we assumed a one-sector economy. Dornbusch (1979) shows that even with no substitution possibilities between oil and domestic factors of production in a two-sector economy there could be a positive employment effect of rising oil prices. This follows from the cost-determined change in relative prices in favour of the less oil intensive good. Demand will switch

therefore towards the goods produced in labour intensive sectors of the economy. In the end this substitution effect may overpower a clearly adverse employment effect stemming from the general demand contraction. (3) To keep analytical difficulties at a low level we employed a linear homogeneous technology throughout the paper. In consequence price determination comes from the supply side alone. This may be a refreshing feature in view of new and old monetarist orthodoxy claiming that inflation never comes from the cost-side, we think however that the model belittles demand side effects on the price level too much. In Schmid (1980) a constant third factor of production results in an upward sloping aggregate supply curve. Then an oil price increase initially has a positive price level effect which later however may or may not be corrected by the forces of aggregate demand in an upward or downward direction. (4) We have employed a fairly standard monetary approach, which we extended to cope with a varying real income. Nevertheless consumers preoccupied with reestablishing their real wealth position after an unanticipated price level increase reduced their spending out of a given real income with rising prices. Anticipation of price increases may result in a strengthening of domestic demand. Here the paper suffers from its comparative static method of analysis, which should be substituted by a more dynamic model of output, employment and the inflation rate.

The interesting feature of our analysis certainly is the direct feed-through effect of exchange rate changes when there is an input of imported factors of production in domestic production. We have seen that a devaluation under these conditions is equivalent to a simultaneous demand and supply shock. Depending upon the magnitude of a few critical parameters an exchange rate change in this way can become a contractionary policy tool. By the same token a system of flexible exchange rates can provide 'negative insulation' for the price and output components of domestic GNP in case of a foreign price disturbance.

Footnotes

*This work was made possible by a Heisenberg fellowship of Deutsche Forschungsgemeinschaft, whose aid is gratefully acknowledged. The paper presents a revised and extended version of a talk given at the annual conference of Verein für Socialpolitik on "Erschöpfbare Ressourcen", Mannheim, September 24-26, 1976. A preliminary German version is available as "Ressourcenimport, Preisniveau und Beschäftigung," Universität Mannheim, Discussion Paper No. 127, July 1979. Without implication I would like to thank Horst Herberg and members of the Money and Trade Workshop at the University of Western Ontario for their comments.

[1]See papers given at the Kiel Conference on Macroeconomic Policies for Growth and Price Stability -- The European Perspective, June 1979, especially the paper by Kouri and Macedo, "Perspectives on the Stagflation of the 1970's".

[2]See Deutsche Bundesbank, Auszüge aus Presseartikeln, several issues since January 1979, especially Nr. 45, June 1979.

[3]Theoretical work in this field has since been done under varying aspects and assumptions by Herberg (1976), Findlay and Rodriguez (1977), Buiter (1978), Bruno and Sachs (1979b), Herberg (1979), Obstfeld (1979), Scarth (1979).

[4]While the model in the present paper is set up in a sufficiently general way to deal with the case of a flexible nominal wage either by assuming a wage indexation rule or some other sort of wage constraint, here we do not intend to do so. The reader is referred to work by Bruno and Sachs (1979b), Buiter (1978), Obstfeld (1979), Scarth (1979) and Herberg (1979) where occasionally he may find economies with all sorts of 'rational agents' be it labour, oil suppliers or wealth holders. In case of wages the political process in European countries shows clearly that wage flexibility according to the assumptions of a classical labour market is not valid and wage indexation rules in the face of oil price hikes are not well established.

[5]This assumes the home country being a net importer of intermediate raw materials. For a relaxation of this assumption in case of domestic production of raw materials see Bruno and Sachs (1979b).

[6]Notation: Small letters are used to denote quantity variables and capital letters represent nominal variables. Relative change of a variable x is given as $\hat{x} = dx/x$. Sometimes we will write an equation in normal form and will add without further comments its 'hat'-form assuming familiarity with the rules of the so-called 'hat calculus'.

[7]If we assume, as Bruno and Sachs (1979b) do, that the domestic country would produce a quantity, h, of raw materials itself, then it is the value of net imports of the intermediate good which determines the difference between output and GNP. To see this, note that value added in the two industries of the economy is $Px - P_n n$ and $P_n h$ respectively. Total value added is the sum of sectoral value added $Y = Px - P_n(n-h)$.

[8]Within the context of the world model developed in Section 5 below, domestic GNP measures value added contributed by the domestic country to value of world production. The description of this two-tier world production process is given in Schmid (1976).

[9]We suppress investment expenditure, thereby using consumption expenditures and absorption as synonymous expressions.

[10]As a corollary; if we hold nominal cash balances constant and increase nominal income and price level by the same rate real income stays constant. However, real consumption declines because of a negative real balance effect working via the parameter ρ. Note that nominal expenditures increase in that case at a lower rate than the increase in nominal income.

[11]Implicit in our specification of the export demand function we have the assumption $-1 \leq \eta \leq 0$. In a world with only one final product the rest of the world either produces the same good or it specializes in the production of the intermediate good. In both cases foreign export demand is closely related to the difference between income and expenditures in the 'foreign' country and their dependence on the foreign price level. As the reader will probably see better in Section 5 price elasticity of foreign hoarding is ρ^* which itself has to be a number between zero and unity.

[12]A reader used to thinking that stagflation is the standard result from a nominal wage increase exceeding productivity progress (see Schmid (1979)) may find this surprising. He is invited to reflect upon the fact that, if resource exporters can impose a real income loss upon resource consumers, then in the case of low substitution-possibilities, resource importing countries must be able to regain some of the direct income loss by raising the price of domestic factors of production. Because of this positive effect on domestic real income a nominal wage increase in the present model may even stimulate domestic output while raising the domestic price level if the positive real income effect is sufficiently strong.

[13]This coefficient yields demand effects for a given price level except that we took into consideration price level increases when we evaluated the direct real income effect.

[14]Note that the xx and BB curves coincide if $|\eta| = 1$. We further can see from (35) that xx and BB curves shift to the right by the same percentage rate if $\sigma = 0$.

[15]That value for $|\eta|$ is sufficient for a stagflationary adjustment, because the xx curve shifts to the left when the domestic country devaluates.

[16]Note that $|\eta| < 1$ is a sufficient condition for stagflation if $\sigma = 0$. However, this parameter constellation violates condition (54) for a 'normal' trade balance reaction.

[17]In Schmid (1979) the present author has shown the perfect isolation power of flexible rates against price and quantity disturbances in a model of the monetary approach variety without imported intermediates.

[18]Note that OECD's employment is unharmed by this world recession while physical output falls in the OPEC area.

[19]This conclusion is confirmed by our geometrical apparatus in Figure 10. From (76) with $dB = 0$ we can derive a balanced trade locus in P,x space which coincides with the $\bar{x}\bar{x}$ line. The BB curve shifts to the right if $0 \leq \sigma < 1$ producing trade deficits for OECD.

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