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Suggested Citation: Siebert, Horst (1978) : Sector structure in an open economy, Weltwirtschaftliches Archiv, ISSN 0043-2636, Mohr, Tübingen, Vol. 114, Iss. 1, pp. 124-145

This Version is available at:

<https://hdl.handle.net/10419/3591>

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Sector Structure in an Open Economy

By

Horst Siebert

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In this paper the problem is studied how the sector structure of an open economy is affected by changes in foreign countries. Reference is made to a two-sector model with two factors of production¹. Section I discusses the small country case; in Section II a two-country model is developed. Section III describes sectorial adaptations in a case where the exchange rate is flexible. Section IV analyses how protecting the export sector and the sector of import-substitutes by undervaluing the home currency prevents sectorial changes and how this policy will affect the balance of trade. Sectorial adjustments under constant and flexible exchange rates are compared. The final section draws some conclusions.

I. The Small Country Case

If the home country is small and no trade policy is undertaken, the world market determines relative prices and the home country has to adapt to changes in the relative prices in the world market. Let us assume that in the world market the price ratio $p = p_1/p_2$ increases, for instance because commodity 1 is reduced in supply or because the demand for that commodity increases internationally. Then the following adaptations will take place. (1) The production of commodity 1 will increase and that of commodity 2 will fall in the home country. (2) Sectorial structure will change in favor of commodity 1, namely $d(Q_1/Q_2)/dp > 0$. (3) The movement along the production frontier will be made possible by a reallocation of the factors of production between the two sectors. Factors of pro-

Remark: I would like to thank R. Gronych and an anonymous referee for their helpful comments.

¹ For the production and demand side of the model compare Siebert [1977a]. — A similar model has been used to study the international transmission of inflation under flexible exchange rates, see Siebert, [1976]. — On the analysis of sectorial change for a closed economy compare Siebert [1977b].

duction will migrate from sector 2 to sector 1. Note that the relative decline of sector 2 is independent of how we measure sectorial structure. It may be measured in terms of relative quantitative outputs (Q_1/Q_2), relative output in value terms (pQ_1/Q_2), since p also rises, or in terms of factors used in sectors, such as labor (A_1/A_2). (4) Differences in factor intensity ($k_2 \geq k_1$) between the sectors of the home country do not reverse the adaptive processes with respect to sectorial structure and the allocation of factors. If the price for sector 1 rises, the output of sector 1 increases and it does not matter whether sector 1 is relatively more capital intensive ($k_1 > k_2$) or not ($k_1 < k_2$). For distribution effects, however, factor intensity is relevant. (5) Relative factor prices will change in favor of the factor that is intensively used in sector 1 (where demand increases) and the distribution of factor shares will shift in favor of the factor heavily used in sector 1. Define the relation of labor income to capital income as $z = lA/rK$, then for $k_2 > k_1$ the wage-interest ratio will rise for increasing p and the labor share will rise. If $k_2 < k_1$, the wage-interest-ratio will decline and z will fall.

II. A Two-Country Model

If a country is not small it has a feedback on world prices so that world prices cannot be taken as given. Abandoning the assumption of the small country allows us to study the interaction between different countries. Define excess demand functions for the home country $E_i(p_1, p_2)$ and for the foreign country $E_i^+(p_1^+, p_2^+, \alpha)$ where prices are noted in the different countries' currencies and α represents a parameter that indicates parametric changes in the foreign country. Assume that initially $p_1/p_2 < p_1^+/p_2^+$ so that country 1 exports commodity 1 ($E_1 < 0$) and imports commodity 2 ($E_2 > 0$) and vice versa for the foreign country in the two-country case¹. $\partial E_i^+/\partial \alpha$ indicates a shift in the foreign country's excess demand function, $\partial E_i^+/\partial \alpha > 0$ represents an increase in demand stemming for instance from a preference shift towards commodity i or a decline in supply, and $\partial E_i^+/\partial \alpha < 0$ denotes a decline in excess demand, demonstrating either a preference shift away from that commodity or an increase in supply due to technical progress.

Equilibrium in the world markets requires that

$$E_i(p_1, p_2) + E_i^+(p_1^+, p_2^+, \alpha) = 0 \quad (1)$$

¹ It can be shown that, with freely fluctuating exchange rates, the exchange rate will serve to transform absolute price advantages into comparative price advantages so that $p_1/p_2 > p_1^+/p_2^+$ is sufficient for the direction of trade indicated. Compare Siebert [1977a].

The balance of trade is defined as

$$Z = -(p_1 E_1 + p_2 E_2) \quad (2)$$

The relation between commodity prices and the exchange rate w is

$$p_i = p_i^+ w. \quad (3)$$

The model gives an answer to the following two questions:

(i) How do prices p_i in the home country (and p_i^+ in the foreign country) adjust to a sectorial disturbance in the foreign country in order to clear world markets, if the exchange rate is flexible (which ensures $Z = 0$)? The change in prices in the home country indicates the sectorial adjustments necessary. (ii) If the exchange rate is kept constant in order to protect the export sector and the import-competing sector, by undervaluation of the home currency, what sectorial adjustments are occurring and being prevented, and what are the economic costs of such a policy in terms of a disequilibrium in the balance of trade?

In order to keep the discussion as simple as possible we neglect the dependence of the excess demand of commodity i on the relative price of commodity j . Also the model represents a partial equilibrium approach in the sense that excess demand does not depend on income and the model is not closed with respect to income.

III. Flexible Exchange Rates and Sectorial Structure

Differentiating equations (1)–(3) with respect to α , substituting and setting initial prices equal to 1, we have

$$\begin{bmatrix} \left(\frac{dE_1}{dp_1} + \frac{\partial E_1^+}{\partial p_1^+} \right) & 0 & -\frac{\partial E_1^+}{\partial p_1^+} \\ 0 & \left(\frac{dE_2}{dp_2} + \frac{\partial E_2^+}{\partial p_2^+} \right) - \frac{\partial E_2^+}{\partial p_2^+} & 0 \\ \left(E_1 + \frac{dE_1}{dp_1} \right) & \left(E_2 + \frac{dE_2}{dp_2} \right) & 0 \end{bmatrix} \cdot \begin{bmatrix} \frac{dp_1}{d\alpha} \\ \frac{dp_2}{d\alpha} \\ \frac{dw}{d\alpha} \end{bmatrix} = \begin{bmatrix} -\frac{\partial E_1^+}{\partial \alpha} \\ -\frac{\partial E_2^+}{\partial \alpha} \\ 0 \end{bmatrix} \quad (4)$$

The solution to equation (4) is given in the appendix. The determinant Δ as defined in equation (I) of the appendix is negative, if the Robinson-condition for the normal reaction of the balance of payments with respect to exchange rate variations is given (equation (I'')). A sufficient

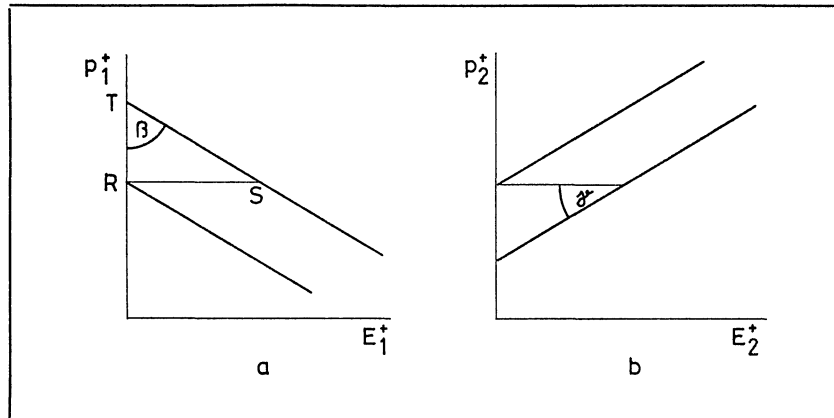
condition for $\Delta < 0$ is that the import demand of the home country is elastic, i.e. $|\eta_2| \geq 1$.¹

For the discussion of the results we have to distinguish the following three cases.

Case 1: Elastic Import Demand. — If the import demand of the home country is elastic, $|\eta_2| > 1$, we have from equation (IV) in the appendix that

$$\frac{dp}{d\alpha} \begin{matrix} > \\ < \end{matrix} 0 : \quad \frac{\frac{\partial E_1^+}{\partial \alpha}}{-\frac{\partial E_1^+}{\partial p_1}} \begin{matrix} > \\ < \end{matrix} \frac{\frac{\partial E_2^+}{\partial \alpha}}{-\frac{\partial E_2^+}{\partial p_2}} \quad (5)$$

In equation (5) $\partial E_i^+/\partial \alpha$ indicates the horizontal shifts in the excess demand curves of the foreign country. $\partial E_i^+/\partial p_i^+$ denotes the slopes of the excess demand functions. These expressions may be interpreted with the help of the Figure.



Assume the foreign country were closed. Then a shift in its excess demand (to the right or left) by RS implies a change in its autarky price by RT. Define the change in the autarky price as $(dp_1^+/d\alpha)^*$, then we have²

¹ For supply elasticities of ∞ , the Marshall-Lerner condition is sufficient for $\Delta < 0$.

² This follows from $\tan \beta = \frac{\partial E_1^+}{\partial p_1^+} = \frac{-(\partial E_1^+/\partial \alpha)}{(dp_1^+/d\alpha)^*}$

$$\left(\frac{dp_1^+}{d\alpha}\right)^* = \frac{\frac{\partial E_1^+}{\partial \alpha}}{-\frac{\partial E_1^+}{\partial p_1^+}} \quad \text{and}^1 \quad \left(\frac{dp_2^+}{d\alpha}\right)^* = \frac{\frac{\partial E_2^+}{\partial \alpha}}{-\frac{\partial E_2^+}{\partial p_2^+}}$$

so that condition (5) may be expressed as

$$\left. \left\{ \begin{array}{l} \left(\frac{dp_1^+}{d\alpha}\right)^* \geq \left(\frac{dp_2^+}{d\alpha}\right)^* \\ |\eta_2| > 1 \end{array} \right\} : \quad \frac{dp}{d\alpha} \geq 0 \right\} \quad (5')$$

In equation (5') the change in the autarky price is an indicator of sectorial change occurring in the foreign country if that country were closed.

The following cases have to be distinguished²:

¹ This follows from

$$\tan \gamma = \frac{1}{-\frac{\partial E_2^+}{\partial p_2^+}} = \frac{\left(\frac{dp_2^+}{d\alpha}\right)^*}{\frac{\partial E_2^+}{\partial \alpha}}$$

² If in the autarky situation, the price changes in the two sectors of the foreign country are identical, for instance from an increase in demand spread uniformly over the two sectors, there is no change in the relative price of the home country and consequently there is no sectorial change in the home country. The result for this limiting case is not surprising since sector structure does not change in the foreign country in the first place.

Adjustments in the exchange rate insulate the home country from changes in the foreign country. Using the definitions for the change in the autarky price and substituting into equation (V) of the appendix we have from equation (V')

$$\frac{dw}{d\alpha} = -\left(\frac{dp_1^+}{d\alpha}\right)^* = -\left(\frac{dp_2^+}{d\alpha}\right)^*$$

If prices in the foreign country rise, the currency of the home country becomes stronger. If prices in the foreign country fall, the currency of the home country is devalued. The change in the exchange rate completely offsets the price changes in the foreign country. Observe that with a fixed exchange rate, this result is not obtained and identical changes in the autarky price of the foreign country (i. e., no sectorial change in the foreign country) will affect the sectorial structure in the home country.

After trade takes place we must have

$$\frac{p_1}{p_2} = w = \frac{p_1^+}{p_2^+}$$

Since in the case discussed prices in the home country do not change (compare equations (II) and (III) in the appendix), changes only occur in the prices of the foreign country and in the exchange rate. From equation (3) we have

$$\frac{dp_1^+}{d\alpha} = -\frac{dw}{d\alpha}$$

so that prices in the foreign country rise exactly with the appreciation of the home currency.

(a) Sector structure in the home country will change in favor of the exporting sector, i.e., the relative price of commodity 1 will rise in the following cases (compare Table 1).

- (i) There is an increase in excess demand for both commodities in the foreign country, but the increase in demand for commodity 1 is stronger so that its autarky price rises more than the autarky price of commodity 2.
- (ii) There is a decrease in excess demand for both commodities, but the decrease is not as strong for commodity 1 as for commodity 2.
- (iii) The autarky price of commodity 1 rises whereas the autarky price of commodity 2 falls due to a shift in demand away from commodity 2 or due to improved production conditions of commodity 2.¹

In these cases where there is a change in sector structure in the foreign country the flexible exchange rate does not completely insulate the home country from sectorial changes in the foreign country. Using the definitions for the changes in the autarky prices and substituting into equation (V) of the appendix, we have

$$\frac{dw}{d\alpha} = \frac{-\left(\frac{dp_1^+}{d\alpha}\right)^* G - \left(\frac{dp_2^+}{d\alpha}\right)^* F}{G + F} \quad (6)$$

where G and F are the two terms in the determinant. Since G and F are negative, the home currency is revalued in case (i) and devalued in case (ii). (Case (iii) is ambiguous.) The extent of the exchange rate variation is determined by demand and supply conditions in the two countries and by the extent of the parametric shifts in the excess demand functions of the foreign country.

Define $\rho = \frac{(dp_2^+/d\alpha)^*}{(dp_1^+/d\alpha)^*}$, then we have

$$\frac{dw}{d\alpha} = - \frac{dp_1^+}{d\alpha} \frac{(G + \rho F)}{G + F} \quad (6')$$

Consider the case of a decrease in demand for both commodities in the foreign country. The more equal the decrease in demand is between the two sectors, i.e., the closer ρ is to 1, the greater are the chances that

¹ Observe that the reduction in relative price p^+ is limited by the assumption $p < p^+$ which ensures $E_1 < 0$ and $E_2 > 0$. If p^+ falls so much that the condition $p < p^+$ no longer holds, the direction of trade flows is reversed.

the exchange rate variation will completely offset the price changes. The more (less) divergent the original price changes are, i.e., if ρ is substantially smaller (bigger) than 1, the smaller (bigger) is the extent of the exchange rate variation. This shows that flexible exchange rates can be expected to transfer changes in sector structure from one country to the other and serve as price signals for necessary sectorial adjustments.

Observe that in the foreign country the relative price has to change by the same amount as in the home country. This follows from the fact that in the initial situation relative prices must be equal due to Jevons law of indifference for the world market (no trade barriers), and after the shifts in the excess demand functions of the foreign country have occurred, relative prices must be equal again. Using equation (3) we have

$$\frac{dp^+}{d\alpha} = \frac{dp_1^+}{d\alpha} - \frac{dp_2^+}{d\alpha} = \frac{dp_1}{d\alpha} - \frac{dw}{d\alpha} - \frac{dp_2}{d\alpha} + \frac{dw}{d\alpha} = \frac{dp}{d\alpha} \quad (6'')$$

Observe that $dp^+/d\alpha$ will be different from the change in the relative autarky price so that trade affects relative price.

(b) Sector structure in the home country will change in favor of the import-competing sector, i.e., the relative price p in the home country will fall

- (i) if, in the case of demand increases, autarky prices rise more for sector 2 than sector 1 in the foreign country,
- (ii) if, in the case of a decline of demand, the autarky price of commodity 2 falls less than that of commodity 1 in the foreign country,
- (iii) if the autarky price of commodity 1 falls, and if the price of commodity 2 increases in the foreign country.

Observe from equation (6') that in case 1.b.(i) with increasing demand the currency of the home country is revalued (as in 1.a.(i)), but since $\rho > 1$, the revaluation is larger than in case 1.a.(i). This stems from the fact that with the home country's elastic demand for imports, the demand for foreign currency decreases, whereas the foreign country's demand for the home currency rises.

Case 2: Elasticity of Import Demand of 1. — A limiting case occurs if $|\eta_2| = 1$. In this case we have $dp_1/d\alpha = 0$. The absolute price of commodity 1 in the home country does not change with

$$\frac{dw}{d\alpha} = - \left(\frac{dp_1^+}{d\alpha} \right)^* \quad (7)$$

so that the price change of commodity 1 is completely offset by changes in the exchange rate. For the relative price we have

$$\frac{dp}{d\alpha} = \frac{B}{\frac{\partial E_1^+}{\partial p_1} \left(\frac{dE_2}{dp_2} + \frac{\partial E_2^+}{\partial p_2} \right)} \quad (7')$$

so that the results of equations (5) and (5') also hold in this special case (with B as defined in the appendix).

Case 3: Inelastic Import Demand. — If import demand is inelastic ($|\eta_2| < 1$) and if $\Delta < 0^1$, the result for the change in relative price is of the same sign as in the elastic case². Assume $(dp_1^+/d\alpha)^* > 0$ and compare the case of elastic (1.a.(i)) and inelastic import demand (3.a.(i)). In both cases the relative price increases in the home country and sector 1 expands. Also it follows from equation (6) that the home currency will be revalued, with the revaluation being weaker in the inelastic case³. Observe that in the elastic case the absolute price of commodity 1 in the home country rises and the absolute price of commodity 2 falls. In the inelastic case, the absolute price of both commodities falls(!), but the price of commodity 2 falls more than that of commodity 1, so that the relative price p rises. The fall in prices is due to the revaluation of the home currency that reduces export demand.

More interesting is a comparison of cases 1.b.(i) and 3.b.(i). In both cases the relative price p falls so that sector 1 contracts and sector 2 expands. In the elastic case (1.b.(i)) the absolute price of commodity 1 falls and that of commodity 2 rises. The home currency is revalued. In

¹ Two cases have to be distinguished. Since the second term in the determinant Δ is positive, the denominator can be negative or positive. If $\Delta > 0$, the Robinson-condition is violated, and the balance of trade does not react normally to changes in the exchange rate. From the definition of excess demand in the foreign currency market (E^*) we have

$$Z = -(pE_1 + E_2) = -E^*, \text{ so that}$$

$$\frac{dZ}{dw} > 0 \iff \frac{d(-E^*)}{dw} > 0 \iff \frac{dE^*}{dw} < 0$$

This shows that if the Robinson-condition does not hold, the stability condition of the foreign currency market is not satisfied. Equation (3) of our approach, however, presupposes that the exchange rate is determined in the foreign currency market. Consequently, $\Delta > 0$ must be ruled out for our analysis and we assume that the Robinson-condition holds ($\Delta < 0$).

² For $|\eta_2| > 1$, the term $\left(E_2 + \frac{dE_2}{dp_2}\right) + \left(E_1 + \frac{dE_1}{dp_1}\right) = E_1(-\eta_2 + \epsilon_1)$ is always negative under the assumption $E_1 < 0$.

³ Observe that for $\rho < 1$ the result with respect to the exchange rate is ambiguous.

Table 1 — *Effects of Foreign Price Changes on the Home Country Prices by Flexible Exchange Rates*

Changes in autarky prices	Adjustment in the home country	
	$ \eta_2 \geq 1$ (cases 1 and 2)	$ \eta_2 < 1$ and $\Delta < 0$ (case 3)
(a) $\left(\frac{dp_1^+}{d\alpha}\right)^* > \left(\frac{dp_2^+}{d\alpha}\right)^*$ (i) $\left(\frac{dp_1^+}{d\alpha}\right)^* > 0$ (ii) $\left(\frac{dp_1^+}{d\alpha}\right)^* < 0$	$\left\{ \begin{array}{l} \frac{dp}{d\alpha} > 0 \\ \frac{dw}{d\alpha} < 0 \text{ revaluation} \\ \frac{dw}{d\alpha} > 0 \text{ devaluation} \end{array} \right.$	$\left\{ \begin{array}{l} \frac{dp}{d\alpha} > 0 \\ \frac{dw}{d\alpha} < 0 \text{ revaluation} \\ \frac{dw}{d\alpha} \leq 0 \text{ ambiguous} \end{array} \right.$
(b) $\left(\frac{dp_1^+}{d\alpha}\right)^* < \left(\frac{dp_2^+}{d\alpha}\right)^*$ (i) $\left(\frac{dp_1^+}{d\alpha}\right)^* > 0$ (ii) $\left(\frac{dp_1^+}{d\alpha}\right)^* < 0$	$\left\{ \begin{array}{l} \frac{dp}{d\alpha} < 0 \\ \frac{dw}{d\alpha} < 0 \text{ revaluation} \\ \frac{dw}{d\alpha} > 0 \text{ devaluation} \end{array} \right.$	$\left\{ \begin{array}{l} \frac{dp}{d\alpha} < 0 \\ \frac{dw}{d\alpha} \leq 0 \text{ ambiguous} \\ \frac{dw}{d\alpha} > 0 \text{ devaluation} \end{array} \right.$

the inelastic case 3.b.(i) both absolute prices rise, but the price of commodity 2 rises more than that of commodity 1 ensuring a fall in the relative price p . In the inelastic case, the home currency may be revalued as in the elastic case or it may be devalued. The more inelastic the import demand of the home country, the more likely it is that the home currency will be devalued. In the inelastic case, we have from equation (3)

$$\frac{dp_i^+}{d\alpha} = \frac{dp_i}{d\alpha} - \frac{dw}{d\alpha}.$$

Since absolute prices rise for both commodities in the home country, absolute prices also rise in the foreign country, if the home currency is revalued. If, however, the home currency is devalued, the price of one or even of both commodities in the foreign country may fall (with p_2 falling less than p_1 so that p falls). Here the interesting case arises that in the foreign country, where the autarky prices were assumed to rise, the prices fall due to trade. In this case the home country is so dependent on the imported commodity that its demand for foreign currency rises more than its foreign currency earnings from exports. The devaluation of its currency does not, however, insulate the country against the import of inflation, but, on the contrary, it further stimulates inflation [Siebert, 1976]. Also in this case it is possible for the foreign country to "export inflation."

Some of the results are summarized in Table 1.

IV. Sectorial Change and Fixed Exchange Rates

In the previous section, the transformation of sectorial changes from the foreign country to the home country in the case of flexible exchange rates was analyzed. Assume now that the exchange rate is fixed. This case is of considerable political relevance since countries have tried in the past to influence economic processes at home by setting the exchange rate as a political price (i.e., undervaluation of the home currency to stimulate exports). This case may be also typical for a scenario of macro-level investment planning where the different political groups will exercise pressure in the political process to fix the exchange rate. It can be expected that the export sector and trade unions will ask for an undervaluation (employment effects) to the detriment of consumers who prefer an overvaluation.

With fixed exchange rates the balance of trade may not be balanced so that Z cannot be set equal to zero. Differentiating equations (1)–(3) with respect to α yields¹

¹ Initial prices are set equal to 1. The effect of trade balances on the money supply and indirectly on commodity prices is not taken into account. A sterilization policy of the central bank is assumed.

$$\begin{bmatrix} \left(\frac{dE_1}{dp_1} + \frac{\partial E_1^+}{\partial p_1^+} \right) & 0 & 0 \\ 0 & \left(\frac{dE_2}{dp_2} + \frac{\partial E_2^+}{\partial p_2^+} \right) & 0 \\ \left(E_1 + \frac{dE_1}{dp_1} \right) & \left(E_2 + \frac{dE_2}{dp_2} \right) & 1 \end{bmatrix} \cdot \begin{bmatrix} \frac{dp_1}{d\alpha} \\ \frac{dp_2}{d\alpha} \\ \frac{dZ}{d\alpha} \end{bmatrix} = \begin{bmatrix} -\frac{\partial E_1^+}{\partial \alpha} \\ -\frac{\partial E_2^+}{\partial \alpha} \\ 0 \end{bmatrix} \quad (8)$$

In order to keep the size of this paper small, we concentrate on the rise of autarky prices in the foreign country (cases (i)). Assuming positive autarky price changes in the foreign country we have as results from equation (IX'') in the appendix

$$\left. \begin{array}{l} (\beta) \quad \frac{\eta_1^+ \eta_2}{\varepsilon_1 \varepsilon_2^+} \frac{\left(\frac{dp_1^+}{d\alpha} \right)^*}{\left(\frac{dp_2^+}{d\alpha} \right)^*} \begin{matrix} > \\ < \end{matrix} 1 \\ (\beta') \quad \frac{\left(\frac{dp_1^+}{d\alpha} \right)^*}{\left(\frac{dp_2^+}{d\alpha} \right)^*} \begin{matrix} > \\ < \end{matrix} 1 \end{array} \right\} : \left(\frac{dp}{d\alpha} \right)_{\bar{w}} \begin{matrix} > \\ < \end{matrix} 0 \quad (8')$$

with $(dp/d\alpha)_{\bar{w}}$ defining the change of the relative price under fixed exchange rates. For the change in the balance of trade (as sufficient conditions) we have from equation (X') in the appendix

$$\frac{dZ}{d\alpha} \begin{matrix} > \\ < \end{matrix} 0 : \quad \left(\frac{dp_1^+}{d\alpha} \right)^* G + \left(\frac{dp_2^+}{d\alpha} \right)^* F \begin{matrix} > \\ < \end{matrix} 0$$

using elasticities

$$\left. \begin{array}{l} (\gamma) \quad \eta_2 \eta_1^+ \left[(1 + \varepsilon_1) \left(\frac{dp_1^+}{d\alpha} \right)^* + \varepsilon_2^+ \left(\frac{dp_2^+}{d\alpha} \right)^* \right] \begin{matrix} > \\ < \end{matrix} \\ \varepsilon_1 \varepsilon_2^+ \left[(1 + \eta_2) \left(\frac{dp_2^+}{d\alpha} \right)^* + \eta_1^+ \left(\frac{dp_1^+}{d\alpha} \right)^* \right] \\ (\gamma') \quad - \eta_1^+ \varepsilon_2^+ \left[\left(\frac{dp_1^+}{d\alpha} \right)^* - \left(\frac{dp_2^+}{d\alpha} \right)^* \right] \begin{matrix} > \\ < \end{matrix} 0 \end{array} \right\} : \frac{dZ}{d\alpha} \begin{matrix} > \\ < \end{matrix} 0 \quad (8'')$$

To simplify the interpretation, the extreme cases where elasticities are either 0 or infinite are not discussed.

The condition for the change in relative price and consequently in sectorial structure differs considerably from the case of flexible exchange rates¹. Whereas in the case of flexible exchange rates it is sufficient for p to rise in the home country (and sector 1 to expand) for the autarky price of sector 1 to rise more than that of sector 2 in the foreign country (assuming $|\eta_2| > 1$), with fixed exchange rates, condition (8' β) is also required. The first part of condition (8' β) is the well-known condition for an improvement of the terms of trade with respect to an exchange rate variation.

Condition (8'' γ) is similar, but not identical to the Robinson-condition for the normal reaction of the balance of trade. If (5') holds with $|\eta_2| > 1$, the balance of trade will have a surplus for positive autarky price changes in the foreign country (and a deficit for negative price changes).

Comparing the results of the case of flexible and constant exchange rates one realizes that constant exchange rates distort sectorial structure at the cost of balance of trade problems. If a balance of trade problem then has to be solved by way of revaluation or devaluation, abrupt changes in sectorial structure become necessary, as was the case when West Germany gave up its policy of undervaluing the German mark².

Define $dp/d\alpha$ as the price change in the case of flexible exchange rates and $(dp/d\alpha)_{\bar{w}}$ as the price change in the case of constant exchange rates, then we have from equation (XII') in the appendix

$$\frac{dp}{d\alpha} - \left(\frac{dp}{d\alpha}\right)_{\bar{w}} \geq 0 : \quad \frac{\eta_2 \eta_1^+}{\epsilon_1 \epsilon_2^+} \leq 1 \quad (9)$$

Table 2 summarizes the results for flexible and fixed exchange rates for the case of increasing autarky prices in the foreign country. Table 2 corresponds to cases (i) of Table 1. Consider the following cases:

Elastic Import Demand (case (1.a)).— If the import demand of the home country is elastic, $\eta_1^+ \eta_2 > \epsilon_1 \epsilon_2^+$ (case (aa)) is sufficient for $(dp/d\alpha)_{\bar{w}}$ to be positive. We have from equation (XII') in the appendix that the relative price changes more under constant exchange rates than under flexible exchange rates. This means that adjustments in volume substitute for changes in the exchange rate and that the export sector will expand more than necessary. Sector structure is distorted in favor of the export sector due to the fixed exchange rate. The undervaluation of the

¹ The conditions stated are sufficient conditions.

² Capital movements are not considered here.

Table 2 — Sectorial Change with Flexible and Fixed Exchange Rates $\left[\text{for } \left(\frac{dp_i^+}{d\alpha} \right)^* > 0 \right]$

Conditions		Flexible ex- change rates	$\frac{dw}{d\alpha}$	Fixed exchange rates	$\frac{dp}{d\alpha} - \left(\frac{dp}{d\alpha} \right)_{\bar{w}}$	$\frac{dZ}{d\alpha}$
Case 1: $ \eta_2 > 1$	(a) $\left(\frac{dp_1^+}{d\alpha} \right)^* > \left(\frac{dp_2^+}{d\alpha} \right)^*$	$\frac{dp}{d\alpha} > 0$	< 0	(aa) $\frac{\eta_1^+ \eta_2}{\varepsilon_1 \varepsilon_2^+} > 1: \left(\frac{dp}{d\alpha} \right)_{\bar{w}} > 0$	< 0	> 0
				(aa') $\frac{\eta_1^+ \eta_2}{\varepsilon_1 \varepsilon_2^+} < 1: \left(\frac{dp}{d\alpha} \right)_{\bar{w}} < 0$	> 0	> 0
Case 3: $ \eta_2 < 1$ $\Delta < 0$	(a) $\left(\frac{dp_1^+}{d\alpha} \right)^* > \left(\frac{dp_2^+}{d\alpha} \right)^*$	$\frac{dp}{d\alpha} > 0$	< 0	(aa) $\frac{\eta_1^+ \eta_2}{\varepsilon_1 \varepsilon_2^+} > 1: \left(\frac{dp}{d\alpha} \right)_{\bar{w}} > 0$	< 0	> 0
				(aa') $\frac{\eta_1^+ \eta_2}{\varepsilon_1 \varepsilon_2^+} < 1: \left(\frac{dp}{d\alpha} \right)_{\bar{w}} < 0$	> 0	> 0
	(b) $\left(\frac{dp_2^+}{d\alpha} \right)^* > \left(\frac{dp_1^+}{d\alpha} \right)^*$	$\frac{dp}{d\alpha} < 0$	< 0 > 0	(bb) $\frac{\eta_1^+ \eta_2}{\varepsilon_1 \varepsilon_2^+} < 1: \left(\frac{dp}{d\alpha} \right)_{\bar{w}} < 0$	< 0 > 0	> 0 < 0

currency of the home country not only is followed by a distortion in sectorial structure, but by a trade surplus. If the surplus in the balance of trade is corrected by a revaluation of the currency of the home country, the excessive expansion of the export sector is reduced with high costs of reallocating factors.

With elastic import demand of the home country and $\eta_1^+ \eta_2 < \varepsilon_1 \varepsilon_2^+$ (case aa')) two subcases may be distinguished: The relative price p rises, but not as much as in the case of flexible exchange rates, i.e., sector 1 does not expand as much as it should compared to the case of flexible exchange rates, or to put it in another way, the fixed exchange rate represents a distortion in favor of sector 2. In the second subcase this bias for sector 2 is even stronger. Now sector 2 expands under fixed exchange rates whereas it would contract under flexible exchange rates. In case (aa') the undervaluation of the currency of the home country acts as an artificial price advantage for the sector of the import-substitutes. There is a surplus in the balance of trade.

As a result, compared to the case of flexible exchange rates, constant rates stimulate sectorial changes in the wrong direction, either too strong an expansion of the export sector or of the sector producing import-substitutes (in the case of elastic import demand). Going along with this undesired sectorial change are surpluses in the balance of trade. If these surpluses are corrected by revaluating the currency, high costs of changing sectorial structure are incurred.

Since constant exchange rates give the wrong price signals for sectorial structure and since the balance of payments problems will eventually require a correction in the exchange rate and in sectorial structure, constant exchange rates require a larger quantity of factors to be reallocated, compared to a situation with flexible exchange rate. Since labor is not completely mobile intersectorially in the short run due to a number of reasons, the policy of fixed exchange rates is one underlying cause of sectorial (or structural) unemployment.

Inelastic Import Demand. — If the import demand of the home country is inelastic, if the Robinson-condition holds ($\Delta < 0$)¹, and if the

¹ Further analysis of the case where the Robinson-condition does not hold, i.e. $\Delta > 0$, is necessary. Neglecting the instability problem of the foreign exchange market, the result (5') would be reversed and we would have

$$\left(\frac{dp_1^+}{d\alpha}\right)^* < \left(\frac{dp_2^+}{d\alpha}\right)^* : \frac{dp}{d\alpha} > 0 \quad \Delta < 0$$

If the autarky prices rise in the foreign country and if the price of commodity 1 rises more than of commodity 2 (sector structure changes in favor of commodity 1 in the foreign

change in the autarky price of sector 1 is greater than of sector 2, (case (3.a)), we have a perfect analogy to case (1.a), namely: For $\eta_1^+ \eta_2 > \epsilon_1 \epsilon_2^+$ (case (3.aa)), relative price p rises more under constant than under flexible exchange rates and we have an excessive expansion of the export sector. If $\eta_1^+ \eta_2 < \epsilon_1 \epsilon_2^+$ (case (3.aa')), two subcases have to be distinguished. Either the change in relative price is not as strong as in the case of flexible exchange rates, which implies a distortion in favor of sector 2 (sector 2 does not have to be reduced as much as under constant exchange rates), or the relative price falls under constant exchange rates, whereas it would rise under flexible exchange rates. Sector 2 expands under fixed rates whereas it would have to contract under flexible rates.

In cases (1.a) and (3.a), if we have flexible exchange rates, a revaluation of the home currency occurs, or — with exchange rates fixed — we have a surplus in the balance of payments. For $|\eta_2| < 1$, $\Delta < 0$ and the autarky price change of sector 2 greater than that of sector 1 (case (3.b)), an interesting, but complex casuistry of potential outcomes arises. Under flexible rates, the relative price falls and sector 1 contracts. Under a system of fixed exchange rates, an expansion of sector 1 cannot be ruled out (compare equation (IX'')). As a sufficient condition for the relative price p to fall (and sector 2 to expand) we have $\eta_1^+ \eta_2 < \epsilon_2^+ \epsilon_1$. Assume this condition is given. Then from equation (XII) two cases have to be distinguished. If

$$\left(\frac{dp_1^+}{d\alpha}\right)^* G + \left(\frac{dp_2^+}{d\alpha}\right)^* F < 0, \quad (10)$$

p does not fall as much as under flexible rates, which implies sector 1 is not reduced as much (and sector 2 not expanded as much) as under flexible rates, we have a revaluation under flexible rates and a surplus under constant rates. The wrong price signal is set.

If expression (10), however, is positive, we have $\frac{dp}{d\alpha} - \left(\frac{dp}{d\alpha}\right)_w > 0$ which means that under constant exchange rates p falls more than under flexible ones. Under constant exchange rates, the incentive to reduce sector 1 and expand sector 2 is stronger. We have a deficit in the trade

country) one would expect — as is the result in the normal case — that p rises and sector 1 will also expand in the home country. With $\Delta > 0$, however, p falls and sector 2 would expand in the home country. In this case we would have an asymmetric picture of sectorial development in the two economies. In this case the exchange rate seems to have the function to transform a rise in the relative price in the foreign country into a decline in the relative price in the home country.

balance (constant rates). Under flexible rates, the importation of inflation would be even magnified by a devaluation, and the foreign country would successfully "export" inflation. It will be left open here, whether, in this extreme case, the stronger change in favor of sector 2 represents a misallocation of resources or whether flexible exchange rates make sure that an ideal allocation signal is given. From the point of view of short-run price level stabilization (if expression (10) is positive), constant exchange rates seem to have the advantage of having a weaker impact on the price level, with the disadvantage, however, of a deficit in the trade balance.

V. Conclusions and Extensions

In the two-sector-two-country model presented, the effects of sectorial changes in the foreign country on sector structure in the home country are studied under flexible and fixed exchange rates. Sectorial changes in the foreign country are identified by changes in the foreign country's autarky prices.

1. Under flexible exchange rates for the transformation of sectorial changes from the foreign country to the home country elasticity of import demand is relevant. With an elastic import demand and sector structure changing originally in favor of sector 1 in the foreign country, the flexible exchange rate will bring about the same direction of sectorial change in the home country. The diffusion of sectorial change from the foreign country to the home country will be brought about by a change in the exchange rate and in relative price, i. e., if the autarky price rises for both commodities, the home currency will be revalued.

2. If the import demand of the home currency is inelastic and if the Robinson-condition holds, the inelastic import demand does not change the sign of the change of relative price and of the direction of sectorial change under flexible exchange rates. However, either the revaluation will be smaller than in the elastic case, or the case may arise where the home currency is devalued. Here the limiting case arises where in the foreign country, with absolute autarky prices assumed to be rising, absolute prices after trade will fall. In this case, the devaluation does not insulate the home currency against the importation of inflation; on the contrary, inflation is further aggravated. This extreme case allows the foreign country to "export" inflation.

3. Under fixed exchange rates, the price mechanism transforming sectorial changes abroad into sectorial adjustments at home is distorted. Constant exchange rates consequently may be viewed by political groups (export industry, import-substitute-sector, trade unions) as a political means to at least partly "protect" an economy against world-wide changes

in sectorial structure. In a scenario of macro-level investment planning for instance, the political pressure for an undervaluation of the home currency can be expected to be strong.

4. Such a policy not only will lead to balance of trade problems. It is shown that a policy of fixed exchange rates will lead to an excessive expansion of the export sector and/or to an excessive expansion of the sector of import-substitutes¹. As a result fixed exchange rates stimulate sectorial changes in the wrong direction. Going along with these undesired sectorial changes are balance of trade problems that eventually have to be corrected. Eventually the exchange rate has to be adjusted and new price signals have to be set. However, high costs of changing the given sectorial structure then occur. Fixed exchange rates consequently lead to a misallocation of resources in the long run.

5. Correcting the exchange rate from time to time requires a greater reallocation of resources at a given moment of time than under flexible exchange rates. Since resources and especially labor are immobile in reality, at least in the short run, the policy of fixed exchange rates is one underlying cause of sectorial (or structural) unemployment. Also any macro-level investment planning which is likely to use fixed exchange rates will tend to increase unemployment for that reason.

6. The model presented should be extended in several directions. (i) it is a partial equilibrium approach and the model should be closed in the sense that the excess demand functions include both income and the price of the "other" commodity (cross price relationships). (ii) With the model representing the link between some real variables (sectorial structure) and a monetary variable (exchange rate), an extension should include the money supply of both countries and should include money or wealth in the excess demand functions. Also the underlying assumption of sterilization policy should be abandoned. (iii) Introducing a partial intersectorial immobility of resources may yield interesting results. (iv) Finally, a dynamic analysis of sectorial change should study the incentive effects of price changes on technical progress, i.e., have an endogenous technical progress function.

¹ This statement has been left open for case (3.b).

Appendix

1. The determinant of equation (4) is

$$\Delta = \frac{\partial E_1^+}{\partial p_1^+} \left(E_1 + \frac{dE_1}{dp_1} \right) \left(\frac{dE_2}{dp_2} + \frac{\partial E_2^+}{\partial p_2^+} \right) + \frac{\partial E_2^+}{\partial p_2^+} \left(E_2 + \frac{dE_2}{dp_2} \right) \left(\frac{dE_1}{dp_1} + \frac{\partial E_1^+}{\partial p_1^+} \right) \quad (I)$$

using G for the first and F for the second term

$$\Delta = G + F \quad (I')$$

by rearranging into elasticities:

$$\Delta = -E_1 E_1^+ E_2 \eta_1^+ (1 + \epsilon_1) (\epsilon_2^+ - \eta_2) - E_1 E_1^+ E_2 \epsilon_2^+ (1 + \eta_2) (\epsilon_1 - \eta_1^+) \quad (I'')$$

where the first term is identical to G and the second identical to F with ϵ indicating supply and η denoting demand elasticities. Alternatively equation (I'') may be written as

$$\Delta = E_1 E_1^+ E_2 [\eta_2 \eta_1^+ (1 + \epsilon_1 + \epsilon_2^+) - \epsilon_1 \epsilon_2^+ (1 + \eta_2 + \eta_1^+)] \quad (I''')$$

with the bracketed term representing the Robinson-condition. Define B as

$$B = -\frac{\partial E_1^+}{\partial \alpha} \frac{\partial E_2^+}{\partial p_2^+} + \frac{\partial E_2^+}{\partial \alpha} \frac{\partial E_1^+}{\partial p_1^+}$$

Then

$$\frac{dp_1}{d\alpha} = \frac{1}{\Delta} \left(E_2 + \frac{dE_2}{dp_2} \right) B \quad (II)$$

$$\frac{dp_2}{d\alpha} = -\frac{1}{\Delta} \left(E_1 + \frac{dE_1}{dp_1} \right) B \quad (III)$$

$$\frac{dp}{d\alpha} = \frac{d(p_1/p_2)}{d\alpha} = \frac{B}{\Delta} \left[\left(E_2 + \frac{dE_2}{dp_2} \right) + \left(E_1 + \frac{dE_1}{dp_1} \right) \right] \quad (IV)$$

$$\begin{aligned} \frac{dw}{d\alpha} = \frac{1}{\Delta} \left\{ \frac{\partial E_1^+}{\partial \alpha} \left(E_1 + \frac{dE_1}{dp_1} \right) \left(\frac{dE_2}{dp_2} + \frac{\partial E_2^+}{\partial p_2^+} \right) + \right. \\ \left. + \frac{\partial E_2^+}{\partial \alpha} \left(E_2 + \frac{dE_2}{dp_2} \right) \left(\frac{dE_1}{dp_1} + \frac{\partial E_1^+}{\partial p_1^+} \right) \right\} \quad (V) \end{aligned}$$

or by substitution

$$\frac{dw}{d\alpha} = - \frac{\left(\frac{dp_1^+}{d\alpha}\right)^* G + \left(\frac{dp_2^+}{d\alpha}\right)^* F}{G + F} \quad (V')$$

2. For the determinant of equation (10) we have

$$D = \left(\frac{dE_1}{dp_1} + \frac{\partial E_1^+}{\partial p_1^+}\right) \left(\frac{dE_2}{dp_2} + \frac{\partial E_2^+}{\partial p_2^+}\right) > 0 \quad (VI)$$

The results are

$$\left(\frac{dp_1}{d\alpha}\right)_{\bar{w}} = \frac{-\frac{\partial E_1^+}{\partial \alpha}}{\frac{dE_1}{dp_1} + \frac{\partial E_1^+}{\partial p_1^+}} \quad (VII)$$

$$\left(\frac{dp_2}{d\alpha}\right)_{\bar{w}} = \frac{-\frac{\partial E_2^+}{\partial \alpha}}{\left(\frac{dE_2}{dp_2} + \frac{\partial E_2^+}{\partial p_2^+}\right)} \quad (VIII)$$

For the change in relative price we have

$$\left(\frac{dp}{d\alpha}\right)_{\bar{w}} = \frac{-\frac{\partial E_1^+}{\partial \alpha} \left(\frac{dE_2}{dp_2} + \frac{\partial E_2^+}{\partial p_2^+}\right) + \frac{\partial E_2^+}{\partial \alpha} \left(\frac{dE_1}{dp_1} + \frac{\partial E_1^+}{\partial p_1^+}\right)}{\left(\frac{dE_1}{dp_1} + \frac{\partial E_1^+}{\partial p_1^+}\right) \left(\frac{dE_2}{dp_2} + \frac{\partial E_2^+}{\partial p_2^+}\right)} \quad (IX)$$

or in terms of elasticities

$$\left(\frac{dp}{d\alpha}\right)_{\bar{w}} = \frac{-\left(\frac{dp_1^+}{d\alpha}\right)^* \eta_1^+ (-\eta_2 + \varepsilon_2^+) - \left(\frac{dp_2^+}{d\alpha}\right)^* \varepsilon_2^+ (\varepsilon_1 - \eta_1^+)}{(\varepsilon_1 - \eta_1^+) (-\eta_2 + \varepsilon_2^+)} \quad (IX')$$

with

$$\begin{aligned} \left(\frac{dp}{d\alpha}\right)_{\bar{w}} \leq 0: & -\eta_1^+ (-\eta_2 + \varepsilon_2^+) \left(\frac{dp_1^+}{d\alpha}\right)^* \\ & - \varepsilon_2^+ (\varepsilon_1 - \eta_1^+) \left(\frac{dp_2^+}{d\alpha}\right)^* \geq 0 \end{aligned} \quad (IX'')$$

The result for the balance of trade is

$$\frac{dZ}{d\alpha} = \frac{\frac{\partial E_1^+}{\partial \alpha} \left(E_1 + \frac{dE_1}{dp_1} \right)}{\frac{dE_1}{dp_1} + \frac{\partial E_1^+}{\partial p_1^+}} + \frac{\frac{\partial E_2^+}{\partial \alpha} \left(E_2 + \frac{dE_2}{dp_2} \right)}{\frac{dE_2}{dp_2} + \frac{\partial E_2^+}{\partial p_2^+}} \quad (X)$$

or using the definitions for G and F

$$\frac{dZ}{d\alpha} = - \frac{\left(\frac{dp_1^+}{d\alpha} \right)^* G + \left(\frac{dp_2^+}{d\alpha} \right)^* F}{D} \quad (X')$$

by using elasticities

$$\begin{aligned} \frac{dZ}{d\alpha} \gtrless 0 : & - \left(\frac{dp_1^+}{d\alpha} \right)^* \eta_1^+ (1 + \epsilon_1) (\epsilon_2^+ - \eta_2) \\ & - \left(\frac{dp_2^+}{d\alpha} \right)^* \epsilon_2^+ (\epsilon_1 - \eta_1^+) (1 + \eta_2) \gtrless 0 \end{aligned} \quad (XI'')$$

3. Comparing the price change under flexible exchange rates $dp/d\alpha$ with the price change under constant exchange rates $(dp/d\alpha)_{\bar{w}}$,

$$\begin{aligned} \frac{dp}{d\alpha} - \left(\frac{dp}{d\alpha} \right)_{\bar{w}} &= \frac{1}{\Delta D} \left[\left(\frac{dE_1}{dp_1} + \frac{\partial E_1^+}{\partial p_1^+} \right) \frac{\partial E_2^+}{\partial p_2^+} \right. \\ &\quad \left. - \left(\frac{dE_2}{dp_2} + \frac{\partial E_2^+}{\partial p_2^+} \right) \frac{\partial E_1^+}{\partial p_1^+} \right] \cdot \left[\left(\frac{dp_1^+}{d\alpha} \right)^* G + \left(\frac{dp_2^+}{d\alpha} \right)^* F \right] \end{aligned} \quad (XII)$$

For the case of increasing autarky prices in both sectors and for elastic import demand ($|\eta_2| > 1$) we have

$$\begin{aligned} \frac{dp}{d\alpha} - \left(\frac{dp}{d\alpha} \right)_{\bar{w}} &\gtrless 0 : E_1 E_2^+ [(\epsilon_1 - \eta_1^+) \epsilon_2^+ \\ &\quad + \eta_1^+ (\epsilon_2^+ - \eta_2)] \gtrless 0 \end{aligned} \quad (XII')$$

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Zusammenfassung: Sektorale Struktur einer offenen Volkswirtschaft. — In einem Zwei-Länder-Zwei-Sektoren-Modell wird untersucht, wie die sektorale Struktur des Inlands durch sektorale Veränderungen im Ausland bei flexiblen und bei festen Wechselkursen beeinflusst wird. Das Modell zeigt, wie sich der flexible Wechselkurs anpassen muß, um sektorale Änderungen von einem Land in das andere zu übertragen, wenn die Importnachfrage im Inland elastisch und wenn sie unelastisch ist. Im Falle unelastischer Nachfrage kann — selbst wenn die Robinson-Bedingung gilt — statt einer Aufwertung eine Abwertung eintreten, mit interessanten Folgerungen. Das Modell deutet an, daß feste Wechselkurse sektorale Veränderungen in die falsche Richtung anregen und dadurch zu Zahlungsbilanzproblemen führen. Da die Zahlungsbilanzprobleme gegebenenfalls durch Wechselkursanpassungen und durch unverzerrte Preissignale gelöst werden müssen, erfordert die Politik fester Wechselkurse eine größere Reallokation von Ressourcen. Da diese auf kurze Sicht immobil sind, erweisen sich feste Wechselkurse als eine der Ursachen für strukturelle Arbeitslosigkeit.

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Résumé: La structure de secteur dans une économie ouverte. — Nous discutons dans un modèle de deux-pays-deux-secteurs comment la structure sectorielle dans le pays d'origine est effectuée par des changes sectoriels à l'étranger sous un système des taux des changes flexibles et fixes. Le modèle démontre comment le taux de change flexible doit s'ajuster pour transférer le change sectoriel d'un pays à l'autre si la demande d'importation du pays d'origine soit élastique ou non-élastique. En cas non élastique même sous la condition de Robinson une dévaluation devrait

se passer au lieu d'une révalorisation avec des implications intéressantes. Le modèle indique que les taux de change fixes stimulent des changes sectoriels en direction fautive en conduisant aux problèmes de balance de commerce extérieur. Parce qu'on doit résoudre les problèmes de balance de commerce extérieur éventuellement en ajustant le taux de change et en donnant des signaux des prix pas déformés, la politique de taux de change fixes a besoin d'une quantité plus grande des ressources qu'on doit redistribuer. Comme les ressources sont immobiles en court terme les taux de change fixes sont une cause implicite du chômage structurel.

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Resumen: Estructura sectorial en una economía abierta. — En un modelo de dos países con dos sectores se discute cómo la estructura sectorial de un país es afectada por cambios sectoriales en el exterior bajo un sistema con tasas de cambio flexibles y variables. El modelo muestra cómo la tasa de cambio flexible debe ajustarse para transferir cambios sectoriales de un país a otro, si la demanda por importaciones del país considerado es elástica o inelástica. En el caso de demanda elástica, incluso cuando la condición de Robinson es válida, puede ocurrir una devaluación con implicaciones interesantes en vez de una revaluación. El modelo indica que tasas de cambio fijas estimulan cambios sectoriales en la dirección equivocada llevando a problemas de balanza de pagos. Debido a que los problemas de balanza comercial deberán ser resueltos eventualmente por medio de un ajuste de la tasa de cambio y la imposición de precios guías no distorsionados, la política de tasas de cambio fijas hace necesaria la realocación de una mayor cantidad de recursos. Debido a que los recursos son inmóviles en el corto plazo, las tasas de cambio fijas son una de las causas subyacentes a un desempleo estructural.
