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ON THE EFFECTIVENESS OF A DEVALUATION IN THE E.C.-COUNTRIES

INTRODUCTION

In this paper an attempt is made at measuring the price effects of a devaluation in E.C.-countries. We analyse, first, how a change in the exchange rate leads to price changes in the tradable and non-tradable goods sectors and to changes in the consumer price index. By assuming alternatively a wage indexed and non-indexed economy, we are able to highlight the importance of wage indexing in the price adjustment process. This allows us to draw some conclusions concerning the effectiveness of exchange rate changes in the E.C.-countries.

In section I some well known results of the modern theory of devaluation are summarized. This allows to put the results of this paper in a broader perspective. In section 2 the model used to measure the price effects of a devaluation is developed and in a final section the results are presented and discussed.

I. THE THEORY

For a small open economy i.e. an economy which cannot influence its terms of trade, the effects of a devaluation can be described by the following graph [1]:

On the vertical axis the traded goods sector (T) is set out, on the horizontal axis the non-traded goods sector (NT). The

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1. For a more complete discussion see Dornbusch (1973), Corden and Jones (1975), Conolly and Taylor (1976).

curve AB represents the locus of production possibilities of the economy (transformation curve). The predevaluation relative price between traded and non-traded goods is given by the line pp.

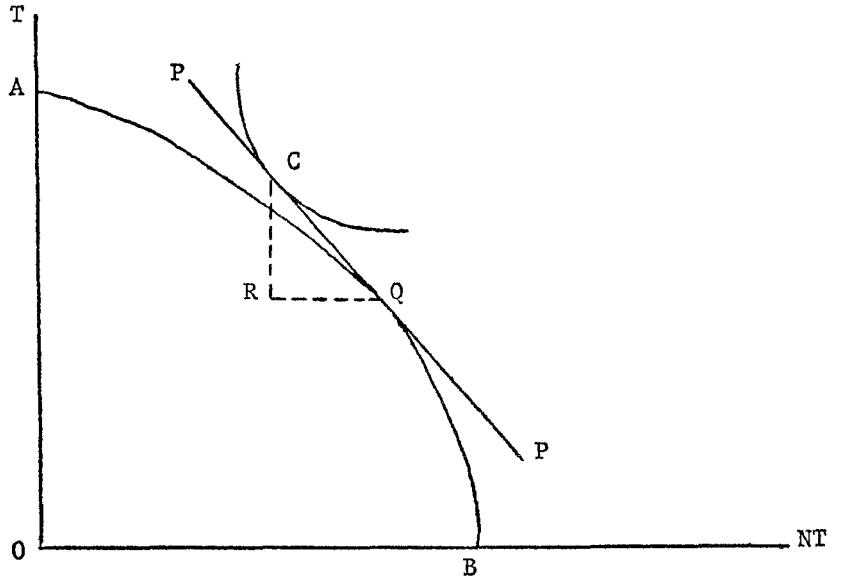

Figure 1

The point Q then gives the production point, i.e. the amounts of traded and non-traded goods being produced at price pp. Assuming an initial trade deficit, we have the consumption point C on the left of the production point Q. The distance CR then represents the excess demand for traded goods (the trade deficit), and RQ the excess supply of non-traded goods. Since the traded goods price is given by the world price, automatic adjustment will be difficult to come about, especially when the price of non-traded goods is inflexible downwards.

The disequilibrium just described is essentially caused by over-absorption of tradable goods. At the existing relative price of tradables and non-tradables the economy is not producing enough tradable goods to satisfy the demand for it. Therefore, in order to bring about equilibrium the authorities must induce a reduction of the absorption of tradable goods. This can be done either by an *expenditure reducing* policy or an *expenditure switching policy*. The expenditure reducing policy shifts the consumption point

downwards (toward the origin). The drawback is that it reduces the demand for both traded and non-traded goods, thereby leading to excess capacity and unemployment in the economy.

The expenditure switching policy brought about by a devaluation, increases the domestic currency price of traded goods.[2] This is shown in figure 2, where, as a result of the devaluation the *pp* line rotates counterclockwise, say to *p'p'*. A new production point is reached in *Q'*, which happens to coincide with the new consumption point *C'*. The devaluation, therefore, clears the two markets, and the trade deficit disappears.

This effect of the devaluation can be considered as the outcome of a *production* and a *consumption* effect:

(a) the increase in the price of traded goods relative to the price of non-traded goods induces producers to shift resources away from the production of non-traded goods towards the more profitable production of traded goods (exportables and import substitutes). This production effect is represented by the movement from *Q* to *Q'*.

(b) the increase in the relative price of traded goods leads to a substitution in the consumption of traded and non-traded goods. The demand for traded goods declines and the demand for non-traded goods increases. This consumption effect is represented by the movement from *C* to *C'*.

The previous analysis implicitly assumes that the devaluation leaves the price of the non-traded goods unchanged. As a result a given percentage devaluation leads to the same percentage increase of the relative price of traded goods. This, however, is unrealistic, for two reasons.

First, the increase in the domestic currency price of imports leads to a cost-push effect in the non-traded goods sector using imports as inputs. The same cost-push effect exists when exportables are used as inputs in the domestic production of non-traded goods. Second, when wages are indexed (or in the absence of

2. The small open economy assumption is important here. Since the economy is assumed to be a price taker in the world market, the devaluation increases the domestic currency price of exports and imports by the same amount. The devaluation, therefore, does not affect the terms of trade, and exports and imports can be considered as one composite commodity.

money illusion by wage earners) the increase in the consumer price index resulting from the devaluation will push up wages, and will add further to the cost push effect.

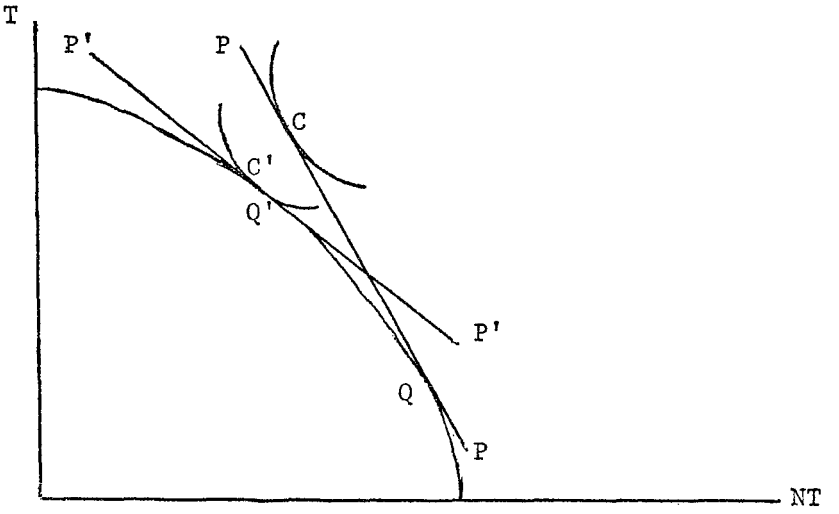

Figure 2

These two effects will tend to reduce the increase of the relative price of traded goods. As a result the effectiveness of the devaluation as an expenditure switching device will be reduced. It is conceivable that when the economy is very open, and with all wages indexed, a devaluation does not change the relative price of traded and non-traded goods, and, therefore, becomes ineffective to bring about a switch in expenditure and production. However, a devaluation then becomes a pure expenditure reducing policy. For, as long as the monetary authorities keep the money supply at the pre-devaluation level, the general price increase following the devaluation leads to excess demand for money. This leads to a decline in expenditures and, thus, to an improvement in the trade balance. A devaluation, in this case, is equivalent to a restrictive monetary policy. As such it will be effective to improve the trade balance.

The present paper aims at measuring these cost push effects of a devaluation of the currencies in the E.C. This will enable us

to shed some light on the effectiveness of exchange rate changes in the E.C. countries.

II. THE MODEL

In order to analyse the cost push effects of exchange rate changes the following simple model is used. The percentage change in the producer price of good i can be decomposed as follows :

$$\hat{p}_i = \sum_{j=1}^{N} a_{ji}\,\hat{p}_j + m_i\,(\hat{p}_{mi} + \hat{e}) + b_i\hat{w}_i + c_i\hat{s}_i$$

$$\text{for } i = 1, \ldots, N \qquad (1)$$

where the symbol $\hat{}$ represents a percentage change and $\sum_j a_{ji} + m_i + b_i + c_i \leqslant 1$ [3].

p_i = the price of one unit of the output of sector i, in domestic currency,

a_{ji} = the share of the value of input of good j in the total supply of good i, the latter being defined as the sum of national production and imports. Therefore a_{ji} is equal to $\dfrac{X_{ji}}{X_i + M_i}$; ($X_{ji}$ = the value of intermediate input of good j in sector i [4]; X_i = the value of total domestic output of good i, M_i = the value of imports of good i),

p_{mi} = the foreign currency price of the bundle of goods imported by sector i,

e = the exchange rate, i.e. the price of foreign currency in terms of domestic currency,

3. The inequality sign holds if there are indirect taxes levied on good i. In the paper it is assumed that taxes do not change, so that the tax variable can be disregarded.
4. The available national input-output tables of the E.C.-countries yield only total intermediate inputs, being the sum of domestic and imported intermediate inputs. They do not discriminate between domestic and imported intermediate inputs.

m_i = the share of the imports of good i in the total available supply of good i, therefore $m_i = \frac{M_i}{X_i + M_i}$,

w_i = the wage rate in sector i,

b_i = the share of wages in the value of total supply of sector i,

s_i = the surplus in sector i. It consists of the cost of capital and profits.

c_i = the share of the surplus in the value of total supply of sector i.

The first term on the right hand side of equation (1), therefore, represents the effect of a change in the cost of intermediate inputs on the final output price. The second term represents the effect of a changed import price, and the third term the effect of a change in wage cost. Finally $c_i\hat{s}_i$ is the residual, representing the effect of changes in profits (and capital costs, which in the remainder of the paper will be disregarded) on the final output price.

We now add to this identity equations describing the pricing behavior of the different sectors of the economy. We will take the so-called Scandinavian model as a starting point. Distinguishing between traded (competitive) and non-traded goods (sheltered) sectors, a different pricing behavior in the competitive and sheltered sectors is postulated :

— In the competitive sectors the prices are given by the world prices, corrected for exchange rate changes. Thus,

$$\hat{p}_i = \hat{p}_{wi} + \hat{e} \qquad \text{for } i = 1, \ldots, T \qquad (2)$$

where T is the number of competitive sectors.

Equation (2) implies that the producers of good i are price takers in the world market. As a result a devaluation (an increase in e) leads to a proportional increase in the domestic currency price of good i, and leads to an increase in profits in the competitive sector i.

— In the sheltered sectors the producers are assumed to pass on any cost increase to the final output price. Put differently, this implies that they keep the share of profits in total output constant, i.e. :

$$\hat{s}_i = 0 \qquad \text{for } i = T + 1, \ldots, N \qquad (3)$$

where $N - T$ is the number of sheltered sectors.

Combining (1), (2) and (3) yields the following equations :

— for the competititive sectors :

$$c_i\hat{s}_i = (\hat{p}_{wi} + \hat{e}) - \sum_{j=1}^{T} a_{ji}(\hat{p}_{wj} + \hat{e}) - \sum_{j=T+1}^{N} a_{ji}\hat{p}_j - m_i(\hat{p}_{mi} + \hat{e}) - b_i\hat{w}_i \quad \text{for } i = 1, \ldots, T \qquad (4)$$

Since the focus of this part of the paper is on the effects of a devaluation we disregard the exogenous variables $\hat{p}_{wi}$, and $\hat{p}_{mi}$. They are set equal to zero. We obtain

$$c_i\hat{s}_i = (1 - m_i - \sum_{j=1}^{T} a_{ji})\hat{e} - \sum_{j=T+1}^{N} a_{ji}\hat{p}_j - b_i\hat{w}_i \quad \text{for } i = 1, \ldots, T \qquad (5)$$

It should be noted that, whereas $\hat{s}_i$ represents the percentage change in profits, $c_i\hat{s}_i$ can be interpreted as the change in profits per unit value of output. This follows from the definition of $c_i = \frac{s_i}{X_i + M_i}$, so that $c_i\hat{s}_i = \frac{ds_i}{X_i + M_i}$. Therefore, $c_i\hat{s}_i$ represents the change in profit margin.

— for the sheltered sectors :

$$\hat{p}_i = \sum_{j=1}^{T} a_{ji}\hat{e} + \sum_{j=T+1}^{N} a_{ji}\hat{p}_j + b_i\hat{w}_i + m_i\hat{e} \quad \text{for } i = T+1, \ldots, N \qquad (6)$$

Note that for the competitive sectors the endogenous variables are the profits s_i, whereas in the sheltered sectors the prices are endogenous.

In order to complete the system we have to add how wages adjust, to the devaluation. In the following, two alternative assumptions are made :

— *Absence of wage indexing.* This implies that $\hat{w}_i = 0$ in all sectors. Here, as in the next case, we disregard the exogenous

influences on wages, such as productivity changes. The purpose is to isolate the devaluation-induced wage changes from other wage increases.

— *Complete wage indexing.*
We then have that

$$\hat{w}_i = \hat{p}_c = \sum_{i=1}^{N} h_i \hat{p}_i \qquad (7)$$

where $\hat{p}_c$ = the percentage change in the consumer price index.
h_i = the weight of good i in the consumption basket.

The model consisting of equations (5), (6), (7) can be solved for the endogenous variables, $\hat{s}_i (i = 1, \ldots, T)$, $\hat{p}_i$ $(i = T + 1, \ldots N)$, and $\hat{p}_c$. For more detail the reader is referred to appendix 1.

III. THE RESULTS

In this section the model is applied to a group of E.C.-countries (Belgium, France, Germany, Italy, Netherlands, U.K.).[5] The estimates of the coefficients of the model can be obtained from the national input-output tables.

We used the input-output tables as presented by the Statistical Office of the E.C..[6] The advantage of this source is that the tables are presented in a uniform way, and, therefore, are better comparable than the tables presented in the national sources. The last available tables relate to the year 1970.

An important problem is the selection of competitive and sheltered sectors. This selection should be based on an analysis of the pricing behavior between the different sectors. Such an analysis was performed by Van Poeck for the Belgian economy.[7] It allowed him to discriminate between competitive and sheltered sectors in Belgium. The same list of competitive and sheltered sectors was used with some minor adjustments for all the E.C.-countries. This

5. Denmark and Ireland were not included, since the relevant statistical data could not be obtained.
6. The data provided by the Statistical Office are provisional.
7. See Van Poeck (1976).

is not an unrealistic assumption : sectors such as steel, petroleum, chemical products etc., which are competitive sectors in Belgium are also likely to be competitive sectors in the other E.C.-countries. In appendix 2 this list is presented. The following table gives the shares of the competitive sectors in total consumption and production in different E.C.-countries.

TABLE 1

Share of the Competitive Sectors in Consumption and Production

	Share of competitive sectors in total consumption	Share of competitive sectors in total production
Belgium	0.29	0.49
France	0.33	0.41
Germany	0.36	0.48
Italy	0.32	0.41
Netherlands	0.33	0.41
U.K.	0.30	0.46

The results of the model are summarized in tables 2 and 3. The first column of tables 2 and 3 gives the effect of a 1 per cent devaluation on the consumer price index. In the absence of wage indexing, a 1 per cent devaluation increases the CPI by approximately 0.5 per cent in all countries. If we assume complete wage indexing the effect of a 1 per cent devaluation on the CPI is substantially increased to approximately 2/3 of 1 per cent. We find that the effects on the CPI are very similar in all the countries.

Columns 2 and 3 summarize the results which should shed some light on the effectiveness of a devaluation. In column 2 the changes in the relative price between goods of the competitive and the sheltered sector are presented. These were obtained by aggregating the competitive sectors and the sheltered sectors, using the weights in the consumption basket, h_i $(i = 1, \ldots, T)$ and h_i $(i = T + 1, \ldots, N)$ respectively. The results indicate that without indexing a one percent devaluation yields an increase in the relative price of « competitive goods » of approximately 3/4 of one per cent in all E.C.-countries. With wage indexing, however, the relative price increase of « competitive goods » is reduced, to about half a percentage point in all the E.C.-countries. This means that to induce an increase of 1 per cent in the relative price of « competitive goods », a devaluation by approximately 2 per cent would be necessary.

The last column of tables 2 and 3 shows the effect of a one

per cent devaluation on the average profit margin ($c\hat{s}$) in the competitive sectors. A value of $c\hat{s} = 1$ would indicate that the profit margin in the competitive sectors increases by the full amount of the devaluation. A value of $c\hat{s} = 0$ would indicate that the increased profitability of the competitive sectors resulting from the devaluation is completely offset by increased costs, induced directly or indirectly by the devaluation. The results indicate that, in all E.C.-countries, without wage indexing, more than half of the positive effect of the devaluation on the profitability of the competitive sectors is offset by increased costs. This devaluation induced cost effect is the strongest in the two smaller countries, Belgium and the Netherlands, where a 1 per cent devaluation leads to an increase in the input costs of the competitive sectors by more than 2/3 of 1 per cent.

TABLE 2

Effect of a 1 per cent devaluation (without wage indexing)

	On CPI	On relative price competitive/sheltered sectors	On profits in competitive goods sectors
Belgium	0.47	0.75	0.32
France	0.45	0.81	0.46
Germany	0.53	0.73	0.43
Italy	0.45	0.80	0.46
Netherlands	0.50	0.75	0.31
U.K.	0.47	0.76	0.40

TABLE 3

Effect of a 1 per cent devaluation (with wage indexing)

	On CPI	On relative price competitive/sheltered sectors	On profits in competitive goods sector
Belgium	0.64	0.51	0.20
France *			
Germany	0.70	0.46	0.27
Italy	0.62	0.56	0.30
Netherlands	0.71	0.44	0.18
U.K.	0.66	0.49	0.22

The introduction of wage indexing increases this cost push effect and further reduces the profitability of the competitive sectors.

* The effects for France could not be computed since the French input-output table does not have a separate row for the wage component.

The results with wage indexing strikingly demonstrate that most of the devaluation-induced increase in profits disappears due to the cost push effects generated by the devaluation. This is especially the case in Belgium, the Netherlands and the U.K.

These results imply that the switch in production from « sheltered goods » towards « competitive goods » will be made difficult in most E.C.-countries, so that the effectiveness of a devaluation as a production switching device is reduced. This is especially the case in the smaller countries (Belgium and the Netherlands), but also in those countries that use an automatic wage indexing system.

It also follows that the devaluation, by substantially increasing the general price level, will have strong expenditure reducing effects, provided, of course, the money supply is not increased to accomodate for the devaluation induced excess demand for money. Under those circumstances a devaluation becomes a substitute for a restrictive monetary policy, and will be effective in equilibrating the trade balance. It can, however, also be argued that a devaluation should not be used, as the monetary restriction can better be brought about by directly reducing the money supply, instead of reducing the real money supply through a general price increase.

IV. CONCLUSION

In concluding this study it is necessary to stress some of its limitations.

First, the use of fixed input-output coefficients assumes that firms will not try to substitute imported inputs for domestic inputs after the devaluation. This is a strong assumption, and more so for the larger countries of the Community where these substitution possibilities exist.

Second, the dichotomy between the pricing behavior of traded and non-traded goods sectors, as postulated by the Scandinavian model, is too strong. Not all traded goods sectors are price takers, and not all sheltered sectors are price makers. More research should be done to make the model more realistic in this respect.

Third, the results of the model give no indication of the speed with which the price transmission operates. It could be that the time it takes for the price effects to be fully realised is three months, six months, a year or more. More research in this area is necessary.

Fourth, the initial conditions in aggregate demand have been left out of the picture. If, initially, there is excess aggregate demand the devaluation will add further to excess demand in the non-traded goods sectors, thereby inducing the producers in these sectors to increase their profit margins (instead of keeping them constant). This would further add to the price effects of a devaluation. Conversely, if initial aggregate demand is weak the price effects of a devaluation may be reduced.

APPENDIX 1 :

THE SOLUTION OF THE MODEL

The equation (5)-(6) can be rewritten in matrix notation as follows :

$$\hat{s}_T = (I - M - A'_{TT})\hat{e}_T - A'_{NT}\hat{p}_N - B_T\hat{w}_T \qquad \text{(A1)}$$

and

$$\hat{p}_N = A'_{NN}\hat{p}_N + A'_{TN}\hat{e}_T + B_N\hat{w}_N + M_N\hat{e}_N \qquad \text{(A2)}$$

where

$$\hat{s}_T = \begin{bmatrix} c_i\hat{s}_1 \\ \vdots \\ c_T\hat{s}_T \end{bmatrix} \text{ and } M_T = \begin{bmatrix} m_1 & \cdots & 0 \\ \vdots & \ddots & \vdots \\ 0 & \cdots & m_T \end{bmatrix} \quad M_N = \begin{bmatrix} m_{T+1} & \cdots & 0 \\ \vdots & \ddots & \vdots \\ 0 & \cdots & m_N \end{bmatrix}$$

A_{TT}, A_{NT}, A_{TN} and A_{NN} are the submatrices of the matrix of technical coefficients, A, obtained as follows :

$$A = \left[\begin{array}{c|c} A_{TT} & A_{TN} \\ \hline A_{NT} & A_{NN} \end{array}\right]$$

The first T rows and colums of A relate to the interindustry transactions within the group of traded goods sectors ; the last N-T rows and colums of A relate to the interindustry transaction within

the group of non-traded goods sectors ; A_{NT} is the matrix of the coefficients of the inputs of the traded goods sectors from the non-traded goods sectors ; A_{TN} is the matrix of the coefficients of the inputs of the non-traded goods sectors from the traded goods sectors.

$\hat{e}_T$, $\hat{e}_N$ are vectors of order T respectively N having the percentage devaluation as entries.

$$\hat{p}_N = \begin{bmatrix} \hat{p}_{T+1} \\ \cdot \\ \cdot \\ \cdot \\ \hat{p}_N \end{bmatrix}, \quad \hat{w}_T = \begin{bmatrix} \hat{w}_1 \\ \cdot \\ \cdot \\ \cdot \\ \hat{w}_T \end{bmatrix}, \quad \hat{w}_N = \begin{bmatrix} w_{T+1} \\ \cdot \\ \cdot \\ \cdot \\ \hat{w}_N \end{bmatrix}$$

$$B_T = \begin{bmatrix} b_1 & \cdots & 0 \\ \cdot & \cdot & \cdot \\ \cdot & \cdot & \cdot \\ \cdot & \cdot & \cdot \\ \cdot & \cdot & \cdot \\ \cdot & \cdot & \cdot \\ \cdot & \cdot & \cdot \\ 0 & \cdots & b_T \end{bmatrix} \qquad B_N = \begin{bmatrix} b_{T+1} & \cdots & 0 \\ \cdot & \cdot & \cdot \\ \cdot & \cdot & \cdot \\ \cdot & \cdot & \cdot \\ \cdot & \cdot & \cdot \\ \cdot & \cdot & \cdot \\ \cdot & \cdot & \cdot \\ 0 & \cdots & b_N \end{bmatrix}$$

In the absence of wage indexing ($\hat{w}_T = \hat{w}_N = 0$) the solution of the model is as follows :

$$\hat{p}_N = (I - A'_{NN})^{-1} A'_{TN} \hat{e}_T + (I - A'_{NN})^{-1} M_N \hat{e}_N \qquad \text{(A3)}$$

$\hat{p}_N$ can then be substituted into (A1) to yield a solution for $\hat{s}_T$. With complete wage indexing we have

$$\hat{w}_i = \Sigma h_i \hat{p}_i \qquad \text{for } i = 1, \ldots, N \qquad \text{(A4)}$$

Substituting this into (A1) and (A2), and rearranging yields

$$\hat{s}_T = (I - M_T - \tilde{A}'_{TT})\hat{e} - \tilde{A}'_{NT}\hat{p}_N \qquad \text{(A5)}$$

and

$$\hat{p}_N = \tilde{A}'_{NN}\hat{p}_N + \tilde{A}'_{TN}\hat{e}_T + M_N\hat{e}_N \qquad \text{(A6)}$$

where $\tilde{A}'_{TT} = A'_{TT} + H_{TT}$

$\tilde{A}'_{NT} = A'_{NT} + H_{TN}$

$\tilde{A}'_{TN} = A'_{TN} + H_{NT}$

$\tilde{A}'_{NN} = A'_{NN} + H_{NN}$

$$H = \left[\begin{array}{c|c} H_{TT} & H_{TN} \\ \hline H_{NT} & H_{NN} \end{array}\right] = \left[\begin{array}{ccc|ccc} b_1h_1 & \cdots & b_1h_T & b_1h_{T+1} & \cdots & b_1h_N \\ \vdots & & \vdots & \vdots & & \vdots \\ \dot{b}_Th_1 & \cdots & \dot{b}_Th_T & \dot{b}_Th_{T+1} & \cdots & \dot{b}_Th_N \\ \hline b_{T+1}h_1 & \cdots & b_{T+1}h_T & b_{T+1}h_{T+1} & \cdots & b_{T+1}h_N \\ \vdots & & \vdots & \vdots & & \vdots \\ \dot{b}_Nh_1 & \cdots & \dot{b}_Nh_T & \dot{b}_Nh_{T+1} & \cdots & \dot{b}_Nh_N \end{array}\right]$$

The model (A5)-(A6) can be solved by first solving (A6) for $\hat{p}_N$ and substituting $\hat{p}_N$ into (A5) to obtain $\hat{s}_T$.

APPENDIX 2 :

LIST OF COMPETITIVE and SHELTERED GOODS SECTORS

A. *Competitive goods sectors*

1. Crude petroleum, natural gas and petroleum products.
2. Ferrous and non-ferrous ores and metals.
3. Non-metallic mineral products.
4. Chemical products.
5. Metal products except machinery and transport equipment.
6. Agricultural and industrial machinery.
7. Office and data processing machines ; precision and optical instruments.
8. Electrical goods.
9. Motor vehicles.
10. Other transport equipment.
11. Meat and meat preparations, other products from slaughtered animals.
12. Textiles and clothing.
13. Leathers, leather and skin goods, footwear.
14. Timber, wooden products and furniture.
15. Paper and printing products.
16. Rubber and plastic products.
17. Other manufacturing products.
18. Maritime and air transport services.

B. *Sheltered goods sectors*

1. Agricultural, forestry and fishing products [8]
2. Coal, lignite and briquettes.
3. Products of coking.
4. Electric power, gas, steam and water.
5. Milk and dairy products.[8]

8. Sector 1 and sector 5 are included in the sector of the sheltered goods because the agricultural policy in the European Community provides for import subsidies and export taxes aiming at keeping the domestic price of agricultural products at a pre-devaluation level.

6. Other food products.
7. Beverages.
8. Tobacco products.
9. Building and construction.
10. Recovery and repair services.
11. Wholesale and retail trade.
12. Lodging and catering services.
13. Inland transport services.
14. Auxiliary transport services.
15. Communication services.
16. Services of credit and insurance institution.
17. Business services provided to enterprises.
18. Services of renting of real estate.
19. Market services of education and research.
20. Market services of health.
21. Recreational and cultural services.
22. General public services.
23. Non-market services of education and research provided by general government and private non-profit institutions.
24. Non-market services of health provided by general government and private non-profit institution.
25. Other services.

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