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TRANSMISSION OF EXTERNAL PRICE DISTURBANCES AND THE COMPOSITION OF TRADE

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INTRODUCTION

The impact of exchange-rate movements on the domestic economy has been one of the most popular and controversial topics in international finance. The degree and time-path of internal adjustment following a one-shot change in the relative price of the domestic currency, has been a major point of contention in the debate between proponents of the "elasticity", "absorption" and/or "monetary" approaches to the balance of payments.[1] The explicit introduction of non-traded goods into macroeconomic modelling, most notably by Komiya (1967), Dornbusch (1973a, 1973b), Krueger (1974), Corden and Jones (1976) and others has further expanded and enriched the traditional analysis.

It was the move towards flexible exchange rates in 1971 and the fourfold increase in the price of oil in 1973 that caused a gradual shift in emphasis towards (a) a systematic re-examination of exchange-rate determination (Branson 1977, Dornbusch 1976, Kouri 1976) and (b) the explicit introduction of imported intermediate inputs in macroeconomic analysis (Findlay and Rodriguez 1977, Buiter 1978, Rodriguez 1977). A further consequence of these developments, has been the increasing use in such analyses of foreign-price movements as the primary source of exogenous shocks to the system, a role up to now principally attributed to exchange-rate disturbances.

This paper adopts a similar viewpoint and addresses itself specifically to the role of trade composition in the transmission of external price disturbances. The analysis focuses on the short-term responses of home-good prices, nominal income and the balance of trade to an increase in import prices and compares these responses for two polar cases: when imports are final goods and when imports are intermediate goods. The first case is treated in Section 1 while the second is taken up in Section 2. The comparison of results in Section 3 highlights the qualitative differences that can be attributed to trade composition.

In both cases the basic model extends the Dornbusch (1973a), Connolly-Taylor (1976) models in two directions: (a) incorporates a supply-side to what are essentially demand-side models and (b) replaces the classical full-employment assumptions with Keynesian assumptions of wage stickiness and unemployment.[2] More importantly it focuses, in a way similar to Harberger's (Harberger 1964), on those structural characteristics of an economy whose magnitude determines the overall effect of external disturbances on the target variables chosen. The model presented here, both in its formulation and the conclusions derived therefrom, can be viewed as complementary to the work of other authors (Findlay and Rodriguez 1977; Buiter 1978) in the sense that these studies share a similar methodology in the pursuit of different objectives.[3]

To make the exposition clear and concentrate on the composition of trade issue, a number of simplifying assumptions are made: the country in question is assumed to be "small" i.e. a price taker in both export and import markets.[4] Exchange rates are assumed fixed, so as to focus exclusively on the transmission process of external price disturbances. It could also be argued that most small and open economies still peg their exchange rates to that of their major trading partner either because of feasibility or optimality considerations.[5] The government sector is left out of the analysis altogether so that changes in the money stock reflect solely changes in the level of reserves.[6] Imported intermediate inputs are used in home-good production only, rather than in the export-good sector.[7] Finally, only the comparative static results are presented and compared here while the long-run steady state implications of the model are worked out elsewhere (Papaefstratiou 1977).

The basic conclusion derived in this paper is that whether imports are intermediate goods as opposed to final consumer goods has strikingly different implications for the transmission process of foreign-price disturbances. Whereas a price increase that affects imported consumer goods is usually followed by a rise in the price of non-traded goods and a surplus in the balance of trade, an increase in the price of imported intermediate commodities has ambiguous effects on home-good prices and is unambiguously associated with deficits in the balance of trade.[8]

Such a result reinforces the position that one should look carefully at fundamental structural differences across countries in order to understand differential paths of adjustment following a common set of external disturbances. Structural differences account not only for variation in the magnitude of the response but could also explain qualitative differences in the direction of change.

Section I: Transmission of Price Disturbances When Traded Goods are Final Goods

Let us assume that a small and open economy consists of two sectors: a sector for traded or international goods (I) and a sector for non-traded or home goods (H).[9] For reasons of comparison with the case of imported intermediate goods, traded goods can be further decomposed into an exported good (X) which is produced at home but consumed domestically or abroad and an imported good (MP) which is produced abroad but consumed at home.[10] All three goods are final goods and gross substitutes for each other.[11]

The seven equations presented below can fully describe the workings of a simple economic system where apart from the goods' markets there exists one asset, namely money, and a labor market that is characterized by an inifinitely elastic supply curve. Superscripts denote supply or demand of a particular commodity or factor while subscripts denote the type of good in question. Bars above such variables as the nominal wage (W) and the exchange rate (E) imply that these variables are held constant throughout. An asterisk denotes an exogenous variable such as foreign prices.

Non-Traded Good Sector

$$(1)\quad H^{s}[\frac{\bar{W}}{P_h}] - H^{d}[P_h, P_x, P_{mp}, C] = 0 \;.$$

Balance-of-Payments Equation

$$(2a)\quad X^{s}[\frac{\bar{W}}{P_x}] - X^{d}[P_h, P_x, P_{mp}, C] - \frac{P_{mp}MP^{d}}{P_x}[P_h, P_x, P_{mp}, C] = -x$$

where (2b) $-P_x \cdot x = S = \lambda[kY-M] = \bar{E}\dot{R}$.

Gross Domestic Production

(3) $Y = P_h H^s + P_x X^s$.

Income Identity

(4) $Y = C + S$

where (4a) $S = \lambda[kY-M]$

(4b) $C = (1-\lambda k)Y + \lambda M = P_h H^d + P_{mp} MP^d + P_x X^d$.

Money Market

(5) $\dot{M} - \bar{E}\dot{R} = 0$

Prices

(6) $P_x = \bar{E}P^*_x$.

(7) $P_{mp} = \bar{E}P^*_{mp}$.

Equation (1) describes the market for home goods which is constantly cleared. The supply of home goods is simply a function of the real wage, while demand is a function of relative prices and nominal consumption expenditures which are equal to aggregate income minus desired savings. Equation (2a) is the balance-of-payments equation with $-x$ describing the flow excess supply of goods which is then translated in Equation (2b) into a flow excess demand for money. If desired money holdings (ky) exceed the stock of money available, M, consumer will reduce their expenditures, i.e., save, to restore their desired cash positions. The speed of adjustment is described by parameter λ .

It is easy to prove that $\dot{\bar{E}R}$, the rate of accumulation of reserves, has to be equal to saving by rewriting Equation (2a) in the following form:

$$X^s - \frac{Y-P_hH^d-S}{P_x} = \frac{\dot{\bar{E}R}}{P_x} .$$

Substituting Equation (3) into the above equation, it follows that,

$$S = \dot{\bar{E}R}.$$

Finally, Equation (3) gives us the value of total domestic production, Equation (4) describes the income identity, Equation (5) the money market and Equations (6) and (7) fix the domestic prices of exported and imported commodities to their foreign levels through the exchange rate, E, which is taken to be fixed. Two additional points should be made here regarding the specification of the saving function (Equation 4a):

(a) Saving is dependent on both income (Y) and wealth (M). The marginal propensity to save out of income ($S_y = \frac{\partial S}{\partial Y}$) is positive and equal to λk whereas the marginal propensity to save out of an increase in wealth is negative and equal to minus the speed of adjustment λ, or, $S_w = - \lambda$.

(b) The specification is consistent with the more general and usual specification of the savings function described by Ando and Modigliani (1963) where $S = \dot{M} = \alpha_1 Y - \alpha_2 M$. In this present framework the coefficient α_1 is equal to λk and α_2 is equal to λ. Thus, coefficients α_1 and α_2 are not independent parameters; in the steady-state solution of the model

$\alpha_1 = k \cdot \alpha_2$ or k is equal to the ratio of the two coefficients.

The demand functions possess the following properties:

1) They are homogeneous of degree zero in all prices and consumption, so that

$$B_i - \sum_j B_{ij} = B_{ic};\ i,j = h,x,mp \quad \text{where}$$

B_i and B_{ij} are the own- and cross-price elasticities of demand respectively, and B_{ic} is the consumption elasticity.

2) The three goods are gross substitutes in consumption so that all cross price elasticities B_{ij}; i,j = h, x, mp are positive.

3) The consumption elasticities B_{ic} are unity, i.e., the indifference curves are assumed to be homothetic.

Using these properties, we can solve the model for $D_{h,x}$ and $D_{h,mp}$ i.e. the elasticity of home-good prices with respect to changes in the prices of the exported or imported goods.

From Equation (1):

$$E_h \frac{dP_h}{P_h} + B_h \frac{dP_h}{P_h} - B_{h,mp} \frac{dP_{mp}}{P_{mp}} - B_{h,x} \frac{dP_x}{P_x} - m_h \frac{1}{P_h H^d} dC = 0$$

where,

$E_h > 0$ = price elasticity of supply of home goods

$B_h > 0$ = own-price elasticity of demand for home goods

$B_{h,j} > 0$, j = x, mp cross-price elasticities of demand

$m_h = P_h \frac{\partial H^d}{\partial C}$ = marginal propensity to consume home goods.

From Equation (3),

$$dY = \frac{dP_h}{P_h} P_h H^s (1+E_h) + \frac{dP_x}{P_x} P_x X^s (1+E_x)$$

where $E_i, i = h,x > 0$ are the price elasticities of supply for home or exported goods. Finally from Equation (4b),

$$dC = (1-\lambda k)dY + \lambda dM$$

where $dM = 0$ in the short-run, flow-equilibrium version of the model.

With P_{mp} and P_x exogenously determined, the system in matrix form becomes:

$$\begin{bmatrix} E_h + B_h & -m_h \frac{1}{P_h H^d}(1-\lambda k) \\ -P_h H^s (1+E_h) & 1 \end{bmatrix} \begin{bmatrix} dP_h/P_h \\ dY \end{bmatrix} =$$

$$\begin{bmatrix} B_{h,mp} \frac{dP_{mp}}{P_{mp}} + B_{h,x} \frac{dP_x}{P_x} \\ 0 + P_x X(1+E_x) \frac{dP_x}{P_x} \end{bmatrix}$$

This simple system can be solved for the ratio of percentage change in home-good prices or the income effects as foreign prices rise.

a. Effects on Home-Good Prices

From the matrix form of our model it follows that,

$$(8) \quad D_{h,x} = \frac{B_{h,x} P_h H^d + P_x X^s (1+E_x) m_h (1-\lambda k)}{(B_h - 1) P_h H^d + P_h H^s (1+E_h)(1-m_h(1-\lambda k))}$$

and

$$(9)\quad D_{h,mp} = \frac{B_{h,mp}P_hH^d}{(B_h-1)P_hH^d + P_hH^s(1+E_h)(1-m_h(1-\lambda k))} .$$

The following conclusions can be derived:

1) In the case where all commodities are final goods, home good prices respond positively to increases in the prices of either exported or imported commodities, provided that the marginal propensity to save out of income is less than unity ($\lambda k < 1$) and that all three goods are gross substitutes in consumption ($B_{h,x}, B_{h,mp} > 0$, and consequently $B_h > 1$).

The unambiguous nature of the results is largely dependent on this latter assumption. If imports were in fact complementary to home goods, so that $B_{h,mp} < 0$ then, the prices of home goods would in fact diminish, or $D_{h,mp} < 0$. If, instead, exports were complementary to home-goods, the sign of $D_{h,x}$ would be ambiguous due to the positive income effect.

2) In Equations (8) and (9) the substitution effect away from traded goods towards home-goods is given by $B_{h,i}P_hH^d$, $i = h,mp$ respectively, while the consumption effect following a rise in the price of exports, is given by $m_h(1 - \lambda k)P_xX^s(1 + E_x)$. It can be readily seen that the magnitude of $D_{h,i}$, $i = x,mp$ is determined by the relevant magnitude of the cross price elasticities of demand ($B_{h,x}$ and $B_{h,mp}$), the marginal propensity to consume non-traded goods (m_h), and the price elasticity of supply for export-type goods (E_x).

(3) The denominator in both (8) and (9) is exactly the same and represents substitution away from home goods both directly, as their price starts rising (given by $(B_h-1)P_h H^d$), and indirectly through the income effect (given by $P_h H^s(1+E_h)$ $(1-m_h(1-\lambda k))$).

The greater is the price elasticity of supply of home goods E_h, the larger becomes the indirect income effect, saving , and the demand for traded commodities; thus, excess demand for home goods decreases as E_h increases, dampening in the process the responsiveness of home good prices to exogenous price increases.

(4) Finally, in comparing the responsiveness of home-good prices to increases in the prices of either exports or imports, we should note that unless $B_{h,mp}$ is very large relative to $B_{h,x}$ and unless $m_h \rightarrow 0$, home good prices will rise more with an increase in the price of exports rather than with an increase in the price of imports. This, of course, would be true in an economy which does not produce domestically any or very little of its imports.

b. Effects on Income and the Balance of Trade

As was shown before, in a one asset model, saving is equal to the rate of accumulation of reserves. Therefore, in the short run, while the stock of money is held constant,

$$d\,(\bar{E}\dot{R}) = dS = \lambda k dY$$

The rate of change of reserves has to equal the rate of change of saving which in turn must equal the rate of change of income times the marginal propensity to save.

The above suggests that the implications of exogenous price disturbances on the balance of payments can be easily inferred from the general matrix by solving the system for $\frac{dY}{dP_i} P_i$, where $i = x, mp$, and multiplying the solution by λk. It follows that,

(10) $d(\dot{\bar{E}R}) =$

$$\lambda k\left[\frac{B_{h,x}[P_x X(1+E_x)+P_h H^S(1+E_h)]+B_{h,mp}P_x X^S(1+E_x)+(1+E_h)P_x X^S(1+E_x)}{(B_h-1)+(1+E_h)[1-m_h(1-\lambda k)]}\right]\cdot\frac{dP_x}{P_x}$$

and

$$(11)\quad d(\dot{\bar{E}R}) = \lambda k\left[\frac{B_{h,mp}P_h H^S(1+E_h)}{(B_h-1)+(1+E_h)[1-m_h(1-\lambda k)]}\right]\frac{dP_{mp}}{P_{mp}}\ .$$

In Appendix 1 we show that Equation (10) is equal to the marginal propensity to save <u>times</u> the overall (direct and indirect) effects on income of exogenous price disturbances. The same can be easily proven for $\frac{d(\dot{\bar{E}R})P_{mp}}{dP_{mp}}$.

Thus, in the case where traded goods are final goods, increases in foreign prices result in a balance-of-trade surplus, as income and hence saving increases in the process. The unambiguous sign regarding reserve changes depends critically again on the assumption of gross substitutability.

Finally, as was the case earlier, the value of the elasticity parameters of the system critically affects the magnitude of the ensuing surplus in the balance of trade.

Having analysed the implications of external price disturbances for the price of non-traded goods, income and the balance-of-trade, we now move to the case of intermediate-good imports.

2. Transmission of Price Disturbances when Traded Goods are Intermediate Goods

The purpose of this section is twofold: (a) To introduce imported intermediate goods into the general traded/non-traded goods model and (b) to study the channels through which exogenous price increases of intermediate goods affect the domestic economy. It will be left to the third section of this paper to compare the results of Section 1 and Section 2, i.e., compare the case where imports are final goods with the case where imports are intermediate goods.

It is assumed throughout that the country in question imports only intermediate goods which are then used solely in the production of home goods. One could think of a rudimentary economy whose exports consist mainly of agricultural goods and which imports, say oil, for its domestic transportation services. The restrictive nature of the assumption is helpful in that it facilitates a close comparison between the case where imports are final goods and the case where imports are intermediate goods.

It is also assumed that the home-good sector is characterized by a fixed-proportions production function in which it takes one unit of the imported commodity to produce one unit of home goods. Capital (fixed in the short run) and labor can be substituted for each other both in the export-good sector where these factors are the only two inputs, as well as in the home-good sector where intermediate inputs are also needed. The production functions for both domestically-produced goods can therefore be written as follows:

For the export-good sector,

$$X^S = F_x(\bar{K}_x, L_x)$$

and for the home-good sector,

$$H^S = \min\{F_h(\bar{K}_h, L_h), \frac{1}{b_h} a_h MP\} \ .$$

The assumption that all imports are used in home-good production implies that a_h, or the percentage of imports used in this sector is equal to one; in addition to that, the input-output ratio namely b_h, can also be assumed to equal unity.

Profit maximizing behavior in the home-good sector would suggest that entrepreneurs equate the nominal wage to the net value of marginal product, giving us

$$W = (P_h - P_{mp})F_h'(L)$$

where, as before, the price of imports is tied to the world price level through a fixed exchange rate. Thus, the supply function for home goods can be written as follows:

$$H^s = H^s[\frac{W}{P_h - P_{mp}}] .$$

In the export-good sector the nominal wage is equated to the gross marginal product, or

$$W = P_x F'_x(L) ,$$

where again the price of exports is tied to the world price level. The supply function for exports, therefore, is

$$X^s = X^s[\frac{W}{P_x}].$$

Gross output in this economy (Q) is equal to the sum of the total value of production in both sectors, and gross national product or valued added (V) is equal to the value of gross output minus the value of intermediate imported inputs. Hence,

$$V = P_x X^s + P_h H^s - P_{mp} MP ,$$

which, following the assumptions made, is equal to

$$V = P_x X^s + (P_h - P_{mp}) H^s .$$

The above set of assumptions and the whole treatment of intermediate goods in the production process follows closely the work by Findlay and Rodriguez (1977).

The following seven equations describe fully the model with imported intermediate goods.

Non-Traded Good Sector

(1') $H^s[\frac{\bar{W}}{P_h - P_{mp}}] - H^d[P_h, P_x, C] = 0$.

Balance-of-Payments Equation

(2a') $X^s[\frac{\bar{W}}{P_x}] - X^d[P_x, P_h, C] - \frac{P_{mp}}{P_x} MP^d[\frac{\bar{W}}{P_h - P_{mp}}] = -x$

(2b') where $-P_x \cdot x = S = \lambda[kV-M] = \dot{\bar{E}}R$.

Gross National Product

(3') $V = (P_h - P_{mp})H^s + P_x X^s$.

Income Identity

(4') $V = C + S$,

$S = \lambda[kV-M]$.

$C = (1-\lambda k)V + \lambda M = P_h H^d + P_x X^d$.

Money Market

(5') $\dot{M} - \dot{\bar{E}}R = 0$.

Prices

(6') $P_x = \bar{E}P^*_x$.

(7') $P_{mp} = \bar{E}P^*_{mp}$.

Equation (1') describes the market for non-traded goods which is constantly cleared. Equation (2a') is the balance-of-trade equation where the only new feature is a derived demand for imports which depends on the supply of home goods and hence the net real wage in the nontraded-good sector. The flow excess supply of traded goods is translated into savings or a flow excess demand for money through the following manipulation of Equation (2a'):

$$X^s - \frac{V-P_h H^d - S}{P_x} - \frac{P_{mp}}{P_x} MP^d = \frac{\dot{\bar{E}R}}{P_x} .$$

Replacing V by Equation(3'), it follows that,

$$X^s - \frac{P_x X^s + P_h H^s - P_{mp} MP^d - P_h H^d - S}{P_x} - \frac{P_{mp}}{P_x} MP^d = \frac{\dot{\bar{E}R}}{P_x} \text{ so that,}$$

$$S = \dot{\bar{E}R} ,$$

or saving is equal to the rate of accumulation of reserves.

Equation (3') is the equation for value added, Equation (4') the income identity and Equation (5') the money market clearing equation.

The above system can be solved for the elasticity of home-good prices with respect to export or import-good prices.

From Equation (1'),

$$E_h [\frac{P_h}{P_h - P_{mp}} \frac{dP_h}{P_h} - \frac{P_h}{P_h - P_{mp}} \cdot \frac{dP_{mp}}{P_{mp}}] + B_h \frac{dP_h}{P_h} - B_{h,x} \frac{dP_x}{P_x} - m_h \frac{1}{P_h H^d} dC = 0$$

where again,

$E_h > 0$ = price elasticity of supply of home goods

$B_h > 0$ = home-good price elasticity of demand

$B_{h,x} > 0$ = cross-price elasticity of demand

$m_h = P_h \frac{\partial H^d}{\partial C}$ = marginal propensity to consume home goods.

From Equation (3') we have,

$$dV = \frac{dP_h}{P_h}(P_h H^s)(1+E_h) + \frac{dP_x}{P_x}(P_x X^s)(1+E_x) - \frac{dP_{mp}}{P_{mp}} \frac{P_{mp}}{P_h}(P_h H^s)(1+E_h).$$

Finally from Equation (4'),

$$dC = (1-\lambda k)dV + \lambda dM ,$$

and since $dM = 0$ in the short run, $dC = (1-\lambda k)dV$.

In matrix form,

$$\begin{bmatrix} \frac{E_h P_h}{P_h - P_{mp}} + B_h & -m_h(1-\lambda k)\frac{1}{P_h H^d} \\ -P_h H^s(1+E_h) & 1 \end{bmatrix} \begin{bmatrix} dP_h/P_h \\ dV \end{bmatrix} =$$

$$\begin{bmatrix} B_{h,x}\frac{dP_x}{P_x} + \frac{E_h P_{mp}}{P_h - P_{mp}} \frac{dP_{mp}}{P_{mp}} \\ P_x X^s(1+E_x)\frac{dP_x}{P_x} - P_h H^s(1+E_h)\frac{dP_{mp}}{P_{mp}}\frac{P_{mp}}{P_h} \end{bmatrix}.$$

a'. Effects on Home-Good Prices

The solutions of the system above for the foreign-price elasticity of home-good prices are given in Equations (8') and (9') below:

$$(8') \quad Z_{h,x} = \frac{B_{h,x}P_hH^d+P_xX^s(1+E_x)m_h(1-\lambda k)}{(B_h-1)P_hH^d + P_hH^s(1+E_h)(1-m_h(1-\lambda k))+P_hH^sE_h\frac{P_{mp}}{P_h-P_{mp}}}.$$

and

$$(9') \quad Z_{h,mp} = \frac{\frac{E_hP_{mp}\cdot P_hH^s}{P_h-P_{mp}} - P_{mp}MP(1+E_h)m_h(1-\lambda k)}{(B_h-1)P_hH^d+P_hH^s(1+E_h)(1-m_h(1-\lambda k))+P_hH^s\cdot E_h\frac{P_{mp}}{P_h-P_{mp}}}.$$

The first consideration is the direction of change of our main endogenous variable, namely the price of home goods. As the price of exports rises, the price of home goods unambiguously rises ($Z_{h,x} > 0$), as a result of gross substitutablility in consumption, a positive value added in the home-good sector and a positive marginal propensity to consume out of total income.

The direction of change is not unambiguous, however, in the case of price disturbances which affect the imported intermediate goods. In that case, supply-inflationary effects are coupled with demand-deflationary pressures. Home-good prices will increase or decrease depending on whether the ensuing reduction in supply of home goods, represented by $\frac{E_hP_hH^sP_{mp}}{P_h-P_{mp}}$, outweighs the reduction in demand for home goods, represented by $P_{mp}MP(1+E_h)m_h(1-\lambda k)$. Hence, for $Z_{h,mp} \gtrless 0$, it must be that

$$E_h \gtrless \frac{(P_hH^d-P_{mp}MP)(1-\lambda k)}{(1-\lambda k)P_xX^s+\lambda M}.$$

For $Z_{h,mp} > 0$, the price elasticity of supply for home goods must be greater than the ratio of consumption expenditures out of income that is generated in the home-good sector to the sum of expenditures out of income created in the export-good sector and out of asset holdings.

This condition determines the domestic inflationary impact of a rise in intermediate good prices; its sign is based on the structural characteristics of an economy in the area around initial equilibrium.

From the above discussion it follows that if the price elasticity of supply is zero then home good prices must necessarily fall. If $E_h = 0$, then

$$Z_{h,mp} = \frac{-P_{mp}MP \cdot m_h(1-\lambda k)}{(B_h-1)P_hH^d+P_hH^s(1-m_h(1-\lambda k))}$$

which is negative. In economic terms, if there is no reduction in supply due to the increase in input prices, then the demand-deflationary effects will dominate and the price of home goods will unambiguously fall.

Furthermore, if the price elasticity of demand for home goods is zero or $B_h = 0$, then the direct substitution effect from home goods to exports is eliminated, the demand curve for home goods is inelastic, and the change in the price of home goods equals the exogenous increase in the price of imports or $dP_h = dP_{mp}$. (Proof of this is provided in Appendix 2.)

In conclusion one should note that while the domestic effects of an increase in the price of exports are clearly inflationary, this is not necessarily true in the case of increases in the price of intermediate goods. The direction of change of home-good prices crucially depends on the magnitude of the price elasticity of supply of home goods; ceteris paribus, the more elastic the supply the more inflationary the outcome.

We can now turn to the income and balance-of-trade effects of exogenous price disturbances in the case where imports are intermediate goods.

b' Effects on Income and The Balance-of-Trade

It has been shown that in the short run, when the stock of money is constant,

$$d(\dot{\bar{E}R}) = dS = \lambda k dV$$

or that the change in the balance-of-trade is equal to the marginal propensity to save times the change in value added.

To see the effect of increases in the price of either traded good on the balance of trade we can simply solve the model for $\frac{dV}{dP_x/P_x}$ and $\frac{dV}{dP_{mp}/P_{mp}}$ respectively and multiply each solution by λk. Hence,

$$(10') \quad \frac{d(\dot{\bar{E}R})}{dP_x/P_x} = \lambda k \cdot \frac{dV}{dP_x/P_x}$$

$$= \lambda k \cdot \frac{B_{h,x}(P_x X^s(1+E_x)+P_h H^s(1+E_h))+(1+E_h \frac{P_h}{P_h-P_{mp}})P_x X^s(1+E_x)}{(B_h-1)+(1-m_h(1-\lambda k))(1+E_h)+E_h \frac{P_{mp}}{P_h-P_{mp}}}$$

an expression which is unambiguously positive given the usual assumptions. As in Appendix 1, it can be shown that this expression is identical to the direct and indirect effects on value added of an exogenous increase in the price of exports. In conclusion, increases in the price of exports result in a positive rate of accumulation of reserves or a surplus in the balance of trade.

Increases in the price of the imported intermediate inputs, however, unambiguously result in a balance-of-trade deficit as can be seen from Equation (11'):

$$(11')\quad \frac{d(\dot{\bar{E}R})}{dP_{mp}/P_{mp}} = \lambda k \cdot \frac{dV}{dP_{mp}/P_{mp}}$$

$$= \lambda k \cdot \frac{-B_h P_{mp} MP(1+E_h)}{(B_h-1)+(1-m_h(1-\lambda k))(1+E_h) + \dfrac{E_h P_{mp}}{P_h - P_{mp}}} .$$

To explain the unambiguously negative nature of the change in the balance of trade, we go back to the definition of value added and see what actually happens. We know from Equation (3') that,

$$dV = P_x X^s(1+E_x)\frac{dP_x}{P_x} + P_h H^s(1+E_h)\frac{dP_h}{P_h} - \frac{P_{mp}}{P_h} P_h H^s(1+E_h)\frac{dP_{mp}}{P_{mp}} .$$

Thus with P_x exogenously fixed,

$$\frac{dV}{dP_{mp}/P_{mp}} = -\frac{P_{mp}}{P_h} P_h H^s (1+E_h) + P_h H^s (1+E_h) \frac{dP_h/P_h}{dP_{mp}/P_{mp}} \quad .$$

For this expression to be positive, $\frac{dP_h}{dP_{mp}}$ would have to be greater than one. But from the $Z_{h,mp}$ solution we know that,

$$\frac{dP_h}{dP_{mp}} = \frac{P_h}{P_{mp}} \cdot \left[\frac{\frac{E_h P_{mp} \cdot P_h H^s}{P_h - P_{mp}} - P_{mp} MP (1+E_h) m_h (1-\lambda k)}{B_h P_h H^d - P_h H^s (1+E_h) m_h (1-\lambda k) + \frac{E_h P_h H^s}{P_h - P_{mp}}} \right] .$$

For this to be greater than one it would be necessary that

$$P_h \left(\frac{E_h P_{mp} P_h H^s}{P_h - P_{mp}} - P_{mp} MP (1+E_h) m_h (1-\lambda k)\right) >$$

$$P_{mp} \left(B_h P_h H^d - P_h H^s (1+E_h) m_h (1-\lambda k) + \frac{E_h P_h \cdot P_h H^s}{P_m - P_{mp}}\right)$$

or that, $P_{mp} \cdot B_h \cdot P_h H^d < 0$. This would be contrary to our assumptions; it would imply that home goods are inferior goods.

Therefore, value added has to decrease with an increase in the price of the intermediate input and this will result in a unambiguous deficit in the balance of trade.

3. Comparison of Results and Conclusions

Table I, provides a summary of the major results derived in the previous sections. These include the responsiveness of home-good prices to exogenous price disturbances, ($D_{h,i}$ and $Z_{h,i}$ where $i = x, mp$), and the balance-of-trade effects ($dB/dP_i . P_i$ where $i = x, mp$).

The major difference in the specification of the cases presented in Section 1 and 2 lies in the treatment of imports. While in Section 1, imports are final goods, they are intermediate goods in Section 2. Thus, income in the first case equals the total value of production, whereas income in the second case equals value added. Furthermore, whereas $B_h - 1 = B_{h,x} + B_{h,mp}$ and $C = P_h H^d + P_{mp} MP$ in the first case, in the case where imported goods are inputs, $B_h - 1 = B_{h,x}$, and $C = P_h H^d + P_x X^d$. Thus, even though we are not interested in quantitative comparisons between results but rather in qualitative differences, we should note that, for given values of home-good and export-type good consumption, aggregate consumption in Section 2 is smaller than aggregate consumption in Section 1 ($C_2 < C_1$) and for a given own price elasticity of demand, $(B_{h,x})_1 < (B_{h,x})_2$.

1) If all final goods are gross substitutes in consumption then, an increase in their price causes home-good prices to rise unambiguously, regardless of deflationary real-balance effects. Complementarity in consumption between traded and non-traded goods would potentially reverse that conclusion. The unambiguous direction of change rests on the following assumptions: homogeneity of degree one with respect to income and wealth in the savings function and

homogeneity of degree zero in prices and consumption in the home-good demand function; given these assumptions, one can translate freely between nominal and real terms at least on the demand side.

2) The direction of change of home-good prices is ambiguous when it comes to imported inputs. This ambiguity arises not because of opposite-signed effects on the demand side but because of the simultaneity of inflationary supply-side and deflationary demand-side effects. Even in this case, a "large enough" home-good price elasticity of supply would ensure a positive direction of change.

3) Finally, the effects of exogenous price increases have unambiguous but opposite effects on the balance of trade depending on whether the traded commodity whose price increases is a final or an intermediate good.

The above results illuminate the discussion around potential contradictions between economic theory and reality which are based on the contention that the monetary approach to the balance of payments could not explain the appearance of deficits as a result of the oil price increase in the early 70's. As we have shown, the theory is, in this case at least, totally consistent with facts.

The analysis also explains why small and open economies are much more vulnerable to oil-price increases than to increases in the price of imported final goods. Apart from the inevitable balance-of-trade deterioration, increases in the price of intermediate goods could result in stagflation as the increased cost in production is coupled with a reduction in national income and demand.

Table I: The Composition of Trade and Transmission of Price Disturbances

Summary of Results

	Section 1: MP = final goods; $Y = P_x X^s + P_h H^s$	Sign	Section 2: MP = intermediate goods; $V = P_x X^s + (P_h - P_{mp})H^s$	Sign
a. Relative Price Solutions	$D_{h,x} = \frac{B_{h,x} P_h H^d + P_x X^s (1+E_x) m_h (1-\lambda k)}{(B_h - 1) P_h H^d + P_h H^s (1+E_h)(1-m_h(1-\lambda k))}$	>0	$Z_{h,x} = \frac{B_{h,x} P_h H^d + P_x X^s (1+E_x) m_h (1-\lambda k)}{(B_h - 1) P_h H^d + P_h H^s (1+E_h)(1-m_h(1-\lambda k)) + P_h H^s \frac{E_h P_{mp}}{P_h - P_{mp}}}$	>0
	$D_{h,mp} = \frac{B_{h,mp} P_h H^d}{(B_h - 1) P_h H^d + P_h H^s (1+E_h)(1-m_h(1-\lambda k))}$	>0	$Z_{h,mp} = \frac{\frac{E_h P_{mp} \cdot P_h H^s}{P_h - P_{mp}} - P_{mp} MP (1+E_h) m_h (1-\lambda k)}{(B_{h-1}) P_h H^d + P_h H^s (1+E_h)(1-m_h(1-\lambda k)) + P_h H^s \frac{E_h P_{mp}}{P_h - P_{mp}}}$	?
b. Balance of Payments	$\frac{dB}{dP_x} P_x = \lambda k [P_x X (1+E_x) + P_h H^s (1+E_h) D_{h,x}]$	>0	$\frac{dB}{dP_x} P_x = \lambda k [P_x X^s (1+E_h) + P_h H^s (1+E_h) Z_{h,x}]$	>0
	$\frac{dB}{dP_{mp}} \cdot P_{mp} = \lambda k [P_h H^s (1+E_h) D_{h,mp}]$	>0	$\frac{dB}{dP_{mp}} P_{mp} = \lambda k [P_h H^s (1+E_h) Z_{h,mp} - \frac{P_{mp}}{P_h} P_h H^s (1+E_h)]$	<0

Appendix 1

We want to prove that

$$\frac{B_{h,x}[P_x X^s(1+E_x)+P_h H^s(1+E_h)]+B_{h,mp}P_x X^s(1+E_x) + (1+E_h)P_x X^s(1+E_x)}{(B_h-1)+(1+E_h)[1-m_h(1-\lambda k)]} =$$

$$[P_x X(1+E_x) + P_h H^s(1+E_h) \frac{dP_h/P_h}{dP_x/P_x} .$$

We know that,

$$Y = P_h H^s + P_x X^s$$

so,

$$dY = \frac{dP_h}{P_h} P_h H^s(1+E_h) + \frac{dP_x}{P_x} P_x X^s(1+E_x)$$

and

$$\frac{dY}{dP_x/P_x} = P_x X^s(1+E_x) + P_h H^s(1+E_h) \frac{dP_h/P_h}{dP_x/P_x} .$$

But from the relative price solutions we know that

$$\frac{dP_h/P_h}{dP_x/P_x} = \frac{B_{h,x}P_h H^d+P_x X^s(1+E_x)m_h(1-\lambda k)}{(B_h-1)P_h H^d+P_h H^s(1+E_h)[1-m_h(1-\lambda k)]} .$$

Substituting into our expression for $\frac{dY}{dP_x/P_x}$ we get,

$$\frac{dY}{dP_x/P_x} = \frac{B_{h,x}P_h H^s(1+E_h)P_h H^d}{(B_h-1)P_h H^d+P_h H^s(1+E_h)[1-m_h(1-\lambda k)]} +$$

$$\frac{P_x X^s(1+E_x)(B_h-1)P_h H^d+P_x X^s(1+E_x)P_h H^s(1+E_h)[1-m_h(1-\lambda k)]}{(B_h-1)P_h H^d+P_h H^s(1+E_h)[1-m_h(1-\lambda k)]} +$$

$$\frac{P_h H^s(1+E_h)P_x X^s(1+E_x)m_h(1-\lambda k)}{(B_h-1)P_h H^d+P_h H^s(1+E_h)[1-m_h(1-\lambda k)]} .$$

Adding the ratios and noting that $B_h - 1 = B_{h,x} + B_{h,mp}$ the expressions in the numerator involving m_h drop out and we get,

$$\frac{dY}{dP_x/P_x} = \frac{B_{h,x} \cdot [P_h H^s (1+E_h) + P_x X^s (1+E_x)] + B_{h,mp} P_x X^s (1+E_x) + (1+E_H) P_x X^s (1+E_x)]}{(B_h - 1) + (1 \pm E_h)[1 - m_h(1-\lambda k)]}$$

which is the expression we want.

Appendix 2

The denominator of Equation (9'),

$$(B_h-1)P_hH^d + P_hH^s(1+E_h)(1-m_h(1-\lambda k)) + \frac{P_hH^sE_hP_{mp}}{P_h-P_{mp}}$$

is equal to,

$$(B_h-1)P_hH^d + P_hH^s(1-m_h(1-\lambda k)) + E_h\cdot P_hH^s[\frac{P_{mp}}{P_h-P_{mp}}+1-m_h(1-\lambda k)],$$

or

$$(B_h-1)P_hH^d+P_hH^s(1-m_h(1-m_h(1-\lambda k)) + E_h\cdot P_hH^s[\frac{P_h}{P_h-P_{mp}} -m_h(1-\lambda k)].$$

This is equal to,

$$B_hP_hH^d - P_hH^s(1+E_h)m_h(1-\lambda k) + \frac{E_h\cdot P_h\cdot P_hH^s}{P_h-P_{mp}}.$$

Hence, if $B_h = 0$, Equation (9') becomes,

$$\frac{dP_h}{P_h} = \frac{-P_{mp}H^s(1+E_h)m_h(1-\lambda k)+E_h\dfrac{P_hH^sP_{mp}}{P_h-P_{mp}}}{-P_hH^s(1+E_h)m_h(1-\lambda k) + \dfrac{E_h\cdot P_hH^s\cdot P_h}{P_h-P_{mp}}}\frac{dP_{mp}}{P_{mp}}.$$

It follows that,

$$\frac{dP_h}{P_h} = \frac{P_{mp}}{P_h}\cdot\frac{dP_{mp}}{P_{mp}}$$

or that $dP_h = dP_{mp}$.

NOTES

1. For a good overview of alternative approaches to balance-of-payments adjustment, see M. v. N. Whitman (1975).

2. Full employment assumptions were incorporated in an earlier version of this model.(Papaefstratiou 1977). The endogeneity of wages changes the solutions quantitatively but does not result in important qualitative differences.

3. Findlay and Rodriguez (1977) describe a one-sector economy which is large enough to affect its terms of trade and is characterized by flexible rather than fixed exchange rates. They are interested in macro-policy effectiveness when imports are intermediate goods. They also look at the effects of an exogenous price increase on the domestic economy but their analysis is conducted in a highly aggregate level. Buiter (1978) analyses the effects of a number of external disturbances on output, employment and the price level under a freely floating exchange rate regime. The asset markets are fully developed and there are no non-traded produced goods. His conclusions regarding the effects of an oil-price increase on the domestic economy are analogous to those of this paper.

4. For an easy way to incorporate non-small country assumptions into a macro-model, see Branson and Papaefstratiou (1978).

5. For a complete discussion on the topic of exchange rate regime choice, see Branson and Papaefstratiou (1978).

6. The introduction of the government sector is treated in Papaefstratiou (1977, ch. 2)

7. If imported inputs were used in the export-good sector as well, then, an increase in the price of imports would result in even more pronounced effects on income than is the case now since value added in that sector would be reduced. Increases in the price of the final good would probably increase output and have ambiguous effects on income and the balance of trade as demand for intermediate inputs will increase.

8. The results obtained here for the final-goods case are in sharp contrast to those of Connolly and Taylor (1976). In their model, the presence of a substitution and a liquidity effect in the demand functions make the impact of an exogenous price disturbance on home-good prices ambiguous. This ambiguity is resolved here due to the assumption of gross substitutability in consumption between the three type of goods.

9. The terms "traded" and "non-traded" are preferred here to the ambiguous terms "tradeables" and "non-tradeables". Also the terms "home" and "non-traded" goods are used interchangeably. For a discussion on the often confusing use of these terms, see Papaefstratiou (1977).

10. The decomposition of traded goods into exported and imported commodities is justified on comparative rather than analytical grounds. The same holds true for our assumption that there is no import-competing production.

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