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A MODEL OF TRADE AND EXCHANGE RATE PROJECTIONS: EQUATIONS AND PARAMETERS

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A Model of Trade and Exchange Rate Projections: Equations and Parameters

ABSTRACT

This paper contains a detailed description of a model of trade and exchange rates. A verbal summary of the model may be found in NBER Working Paper #389.

The model contains equations for import demands, bilateral trade flows and trade prices for 26 regions and three commodities. A simple exchange rate model used developments in current accounts to model changes in nominal exchange rates. The regions covered are the twenty-three[1] OECD countries and three non-OECD region: LDCs, OPEC, and the centrally planned economies (CPEs).

Sector A contains an algebraic description of the model and a glossary of variables and parameters. Section B is a detailed discussion of the equations and the sources of the parameter values.

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[1] Belgium and Luxembourg are combined and Yugoslavia is included in the CPE region.

Introduction

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The model contains equations for import demands, bilateral trade flows and trade prices for 26 regions and three commodities. A simple exchange rate model used developments in current accounts to model changes in nominal exchange rates. The regions covered are the twenty-three[1] OECD countries and three non-OECD regions: LDCs, OPEC, and the centrally planned economies (CPEs).

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[1] Belgium and Luxembourg are combined and Yugoslavia is included in the CPE region.

A. Equations of the Trade & Exchange Rate Model

1. Trade Flows - Imports

a. OECD country imports of goods and services:

$$MGS_i = P_i Y_i \left[\left(\frac{Y_i}{Y_i^*}\right)^{\alpha_i} \left(\frac{PD_i}{PMGS_i}\right)^{\beta_i}\right]$$

b. LDC imports of goods and services and petroleum*:

$$\hat{MGSP}_{LDC} = \beta_{LDC} (\hat{PD}_{LDC} - \hat{PMGSP}_{LDC}) + \alpha_{LDC} (\hat{Y}_{LDC})$$

c. OPEC imports of goods and services and petroleum:

$$\hat{MGSP}_{OPEC} = \text{exogenous}$$

d. CPES imports of goods and services and petroleum:

$$MGSP_{CPES} = \frac{REV_{CPES}}{PMGSP_{CPE}}$$

e. Goods, services for OECD countries $(i = 1, 23)$:

$$MG_i = (1-\gamma_i)\ MGS_i$$

$$MS_i = \gamma_i\ MS_i$$

f. Goods, services, petroleum for Non-OECD regions $(i = 24, 26)$

$$MG_i = (1 - \gamma_i - \phi_i)\ MGSP_i$$

$$MS_i = \gamma_i\ MGSP_i$$

$$MP_i = \phi_i\ MGSP_i$$

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*Henceforth, the hat "^" over the variable refers to a percentage change of a variable.

g. Petroleum imports for OECD regions

$$\hat{MP}_i = \kappa_i \mu_i(\hat{PD}_i - \hat{PMP}_i) + (1 - \kappa_i)(\hat{MP}_{i,t-1} - \varepsilon_i \hat{Y}_{i,t-1}) + \varepsilon_i \hat{Y}$$

2. Trade Flows - Exports

a. $XG_i = \sum_j H_{ji} MG_j$

b. $XS_i = \delta_i \sum_j MS_j$

c. $XP_i = \sum_j \Gamma_{ji} MP_j$

3. Trade-Share Equations

a. $\hat{H}_{ij} = \lambda_{ij}(\hat{PXG}_j - \hat{PMG}_i) + \eta_{ij}(\hat{Y}_j - \sum_k H_{ij,t-1} \hat{Y}_k)$

b. $\hat{\delta}_i = \lambda s_i(\hat{PXS}_i - \sum_k \hat{PXS}_i \delta_{k,t-1}) + \eta s_i(\hat{Y}_i - \sum_k \delta_{\kappa,t-1} \cdot \hat{Y}_k)$

4. Price Equations

a. $\hat{PXG}_i = \omega_i \hat{PWG}_i + (1 - \omega_i) \hat{PD}_i$

b. $PXS_i = \omega_i \hat{PWS}_i + (1 - \omega_i) \hat{PD}_i$

c. $PMG_i = \sum_j H_{ij} PXG_j$

d. $PMS_i = \sum_j \delta_j PXS_j$

e. $PMP_i = \sum_j \Gamma_{ij} PXP_j$

f. $PMGS = \gamma_i PMS_i + (1 - \gamma_i) PMG_i \qquad i = 1, \ldots, 23$

g. $PMGSP = \gamma_i PMS_i + PMP_i + (1 - \gamma_i - \emptyset) PMG_i \qquad i = 24, \ldots, 26$

h. $PWG_i = \sum_j \Omega_{ij} \sum H_{j\kappa} PXG_\kappa$

5. Other Parts of Current Account and Asset Accumulation

a. Net investment income:

$$R_i = r_i S_{i,t-1}$$

b. Aid for LDC:

$$G_{LCD} = \bar{G}_{LDC}$$

for OECD:

$$G_i = G_{LDC} \cdot \frac{G_{i,\,t-1}}{G_{LDC,\,t-1}}$$

c. Other items in the current account:

$$Z_i = \bar{z}_i$$

d. Current account:

$$C_i = PXG_i \cdot XG_i + PXS_i \cdot XS_i + PXP_i \cdot XP_i - PMG_i \cdot MG_i - PMS_i \cdot MS_i - PMP_i \cdot MP_i + G_i + Z_i + R_i$$

e. NET foreign assets:

Total: $F_i = F_{i_{t-1}} + C_i$;

Accumulated since 1975: $S_i = S_{i_{t-1}} + C_i$.

f. Revenue:

$$REV_i = C_i + PMG_i \cdot MG_i + PMS_i \cdot MS_i + PMP_i \cdot MP_i$$

6. Domestic Price

$$\hat{PD}_i = \pi_i \hat{PMP}_i + \psi_i \hat{PMGS}_i + (1 - \pi_i - \psi_i) \hat{E}_i$$

7. Exchange Rate Equations

a. Exchange rate float equations for 6 major OECD countries:

$$\Delta E_i = \xi_i \Delta F_i + o_i \Delta F_j \quad ; \text{ where } j = \text{Germany}$$

and i = UK, FRANCE, ITALY:

or j = US

and i = Canada, Japan, Germany

b. Exchange rate basket rule for small countries and LDC:

-Let T be the total trade weights, i.e.:

$$T_{ij} = \frac{\text{Exports from } i \text{ to } j + \text{Exports from } j \text{ to } i.}{\text{Exports of } i + \text{Imports of } i}$$

-Let $i = 1, \ldots S$ Index the 17 small countries;

$j = S + 1, \ldots B$ Index the 7 major OECD countries, OPEC and CPEs.

-Let TSS be the SXS upper left submatrix of T, and
TSB be the SX(B-S) upper right submatrix of T, and

$$e_i = \frac{E_i}{E_{i_{75}}}$$

e_s the S element vector of small country exchange rate incides.

e_B the (B-S) element vector of large country exchange rate indices.

k_s a S x S diagonal matrix of parameters.

Then,

$$e_s = k_s \left[T_{ss} \; T_{sB}\right] e \quad ;$$

which gives after expansion of terms:

$$e_s = k_s T_{ss} e_s + k_s T_{sB} e_B \quad .$$

Therefore, the reduced form for the S exchange rates is:

$$e_s = k_s \left[I - T_{ss}\right]^{-1} T_{sB}\, e_B$$

Note: k_i is the basket target index, i.e., if e_i is to be pegged to a basket $k_i = 1$; and if e_i is to respond to current account imbalances $k_i = k_{i_{-1}} + \theta \frac{C_{i,t-1}}{REV_{i,t-1}}$.

c. Change of parameters if exchange rate changes in previous period:

-Let $RR_i = 1 - \left| \hat{E}_i \right|$

$RS_i = 1 - \left| \hat{E}_{t-1} \right|$

Then,

$$k_i = k_{i,\,t-1} + \theta \cdot \frac{RR}{RS} \cdot \frac{C_{i,t-1}}{REV_{i,t-1}}$$

VARIABLES--

Trade Flows

XG	Exports of Goods billions of 1975 $
XS	Exports of Non-Factor Services billions of 1975 $
XP	Exports of Petroleum (SITC 331) billions of 1975 $
MGS	Imports of Goods & Non-Factor Services billions of 1975 $
MG	Imports of Goods billions of 1975 $
MS	Imports of Non-Factor Services billions of 1975 $
MP	Imports of Petroleum (SITC 331) billions of 1975 $

Prices

E	$/Local Exchange Rate 1975 = 1
PD	Domestic GDP-Deflator in $ 1975 = 1
PXG	Export of Goods Deflator in $ 1975 = 1
PXS	Export of Non-Factor Services Deflator in $ 1975 = 1
PXP	Export of Petroleum Deflator in $ 1975 = 1
PMGS	Import of Goods & Non-Factor Services Deflator in $ 1975 = 1
PMG	Import of Goods in $ 1975 = 1
PMS	Import of Non-Factor Services in $ 1975 = 1
PMP	Import of Petroleum in $ 1975 = 1
PWG	Index of Competitor's goods export prices in $ 1975 = 1

Other Current Account Items

C	Balance on Current Account billions of $
G	Net Official Current Transfers billions of $
Z	Other Items in the current account billions of $ (Net labor income, errors & omissions, net private transfers, initial level of net investment income)
R_i	Investment income billions of $
REV	Revenue from foreign activity billions of $

Capital Account Items

F	Net Foreign Assets billions of $
S	Net Foreign Assets billions of $, accumulated since beginning of simulation

Output

Y	GDP, billions of 1975 U.S. $
Y*	GDP at full-employment, billions of 1975 U.S. $

PARAMETERS--

Import Equations

α_i Elasticity of non-oil goods and non-factor services (MGS) with respect to ratio of actual to potential GDP.

β_i Elasticity of MGS with respect to the ratio of domestic prices to import prices.

ρ_i Constant term in MGS equation.

γ_i Share of imports of non-factor services (MS) in MGS (For 3 non-OECD regions. This is share of MS in (MG + MS + MP).

ϕ_i Share of imports of petroleum in total imports for non-OECD regions.

κ_i Speed of adjustment in oil import equation.

μ_i Relative price elasticity of oil import demand.

ε_i Income elasticity of oil import demand.

Trade Shares

H_{ij} Region j's share of region i's non-oil goods imports.

δ_i Region i's share of total world exports of non-factor services.

Γ_{ij} Region j's share of region i's petroleum imports.

Ω_{ij} Region j's share of region i's non-oil goods exports.

λ_{ij} Price elasticity of substitution for region j's goods in region i's market.

η_{ij} Income elasticity of substitution for region j's goods in region i's market.

λs_i Price elasticity for region i's service exports.

ηs_i Income elasticity for region i's service exports.

Price Equations

π_i Elasticity of PD with respect to PMP.

ψ_i Elasticity of PD with respect to PMGS.

ω_i Elasticity of PXG and PXS with respect to PWG and PWS.

Exchange Rate System

ξ_i Coefficient on change in own net foreign assets in exchange-rate equation.

o_i Coefficient on change in other region net foreign assets in exchange-rate equation.

B. Parameters of the Trade and Exchange Rate Model and Their Sources

1. Import Equations

The short-run income elasticity in import equation for goods and services is (α) and the price elasticity is (β). In the long-run, when (Y) equals full-employment output (Y*) income elasticity is one and the long-term import/output ratio is (P) when relative prices remain stable.

Several estimates for the parameters α and β are available in the literature for different countries. Most comprehensive sources are Basevi (1973), Branson (1972), Houthakker-Magee (1969), Samuelson (1973), and Taplin (1973). Moreover, Stern, Francis and Schummacher (1977) provide an excellent survey of literature concerning price elasticities. [1/] These are the main sources for our purposes; especially the Taplin estimates were extensively exploited. Table 1 gives the estimates we have used in our model, which come mainly from Taplin's study. We wanted to exploit one common source as much as possible to guarantee the internal consistency of the parameter estimates.

In the petroleum import equations the income elasticity (ε), the price elasticity (μ) and the speed of adjustment (κ) are "guesstimates" based on Interfutures energy scenerio and they reflect assumptions of a decreased share of petroleum in the world energy balance and the ranking of regions according to their substitution possibilities. These are shown in Table 2. The service share of imports (γ) is taken to be the 1975 value. 1975 data were also used to derive the constant terms (P) and (ϕ) in the import equations for goods and services and for petroleum respectively.

[1/] The recent IMF World Trade Model by Deppler and Ripley (1978) was not available at the time when the survey of trade elasticities was carried out.

TABLE 1: Activity (α) and Price (β) Elasticities of Imports

		α	β
1.	Australia	2.12	0.42
2.	Austria	2.04	0.95
3.	Belgium-Luxembourg	2.27	0.65
4.	Canada	2.18	1.59
5.	Denmark	2.08	0.85
6.	Finland	2.02	0.50
7.	France	2.30	0.39
8.	Germany	2.35	0.60
9.	Iceland	2.13	0.06
10.	Ireland	1.96	2.40
11.	Italy	1.26	1.03
12.	Japan	2.12	0.81
13.	The Netherlands	2.27	0.02
14.	Norway	1.90	1.20
15.	Portugal	1.86	0.40
16.	Spain	2.48	1.55
17.	Sweden	2.02	0.76
18.	Switzerland	2.25	1.10
19.	United Kingdom	2.24	0.22
20.	United States	2.81	1.05
21.	Greece	1.80	1.47
22.	New Zealand	2.00	1.12
23.	Turkey	2.29	0.65
24.	Non-oil LDCs	1.00	0.70
25.	OPEC	1.00	0.70
26.	Centrally Planned Economies	1.00	0.70

Source: Price elasticity β: Taplin (1973) except for Australia which is from Samuelson (1973).

Income elasticity α: This is Taplin's activity elasticity plus one. It should be noted here that Taplin's activity variable "autonomous expenditure", is an aggregate including government expenditure, gross fixed capital formation and exports of goods, and services. The activity variable we use in our model is GDP. It may be the case with our income elasticity that it overpredicts the cyclical effect of income on imports. This should not, however, be a serious drawback as we have constrained the long-term income elasticity to be unity. The income and price elasticities for non-OECD regions are set to one and .70 respectively.

TABLE 2: Parameters in the Petroleum Import Equation

		Income Elasticity (ε)	Long-Run Price Elasticity (μ)	Speed of Adjustment (κ)
1.	Australia	.80	1.00	.80
2.	Austria	.80	.30	.23
3.	Belgium-Luxembourg	.80	.30	.23
4.	Canada	.80	1.00	.80
5.	Denmark	.80	.30	.23
6.	Finland	.80	.30	.23
7.	France	.80	.30	.23
8.	Germany	.80	.30	.23
9.	Iceland	.80	.30	.23
10.	Ireland	.80	.30	.23
11.	Italy	.80	.50	.23
12.	Japan	.80	.30	.70
13.	The Netherlands	.80	.30	.23
14.	Norway	.80	1.00	.80
15.	Portugal	.80	.30	.23
16.	Spain	.80	.30	.23
17.	Sweden	.80	.30	.23
18.	Switzerland	.80	.30	.23
19.	United Kingdom	.80	1.00	.80
20.	United States	.80	1.40	.70
21.	Greece	.80	.30	.23
22.	New Zealand	.80	.30	.23
23.	Turkey	.80	.30	.23
24.	Non-oil LDCs	.80	.30	.23
25.	OPEC	.80	.30	.23
26.	Centrally Planned Economies	.80	.30	.23

To disaggregate total volume of imports of OPEC, non-oil LCDs and Centrally Planned Economies into imports of goods, services and petroleum, 1975 shares were used.

2. Trade Share Equations

The empirical estimates for trade share elasticities (λ) was taken from Samuelson (1973) and is shown in Table 3. The trade share elasticities with respect to relative potential output growth rates for each region were set equal to one for each region.

TABLE 3: Trade Share Elasticities with respect to Relative Prices

Market	Λ_j	Market	Λ_j
Australia	-1.58	Norway	-1.39
Austria	-0.31	Portugal*	-1.94
Belgium-Luxembourg	-1.04	Spain	-0.83
Canada	-1.79	Sweden	-0.60
Denmark	-1.33	Switzerland	-1.39
Finland	-1.67	United Kingdom	-0.99
France	-1.55	United States	-1.42
Germany	-1.64	Greece*	-1.94
Iceland	-1.94	New Zealand*	-1.94
Ireland	-2.06	Turkey*	-1.94
Italy	-0.86	Non-oil LDCs	-1.13
Japan	-1.17	OPEC	-1.13
Netherlands	-0.82	Centrally Planned Economies	-1.13

Source: Samuelson (1973) pp. 10-11. Samuelson reports only a compound estimate for "other OECD" including Iceland, Portugal, Greece, New Zealand and Turkey. This is used for the above countries and is shown by * in Table 2. The compound estimates for "non-OECD" was used accordingly for non-oil LDCs, OPEC and centrally planned economies.

The numerical values for (λs) are 1975 service export share weighted averages of substitution elasticities for goods import share matrix (see Table 2). These were used due to unavailability of other empirical estimates. The import share approach could not be used for services because data for bilateral flows are not available. The 1975 market shares are shown in Table 4.

TABLE 4: World Trade Share of Services (δ_i) in the Year 1975

Market	δ_i	Market	δ_i
Australia	.011	Norway	.022
Austria	.023	Portugal	.006
Belgium-Luxembourg	.027	Spain	.032
Canada	.026	Sweden	.013
Denmark	.018	Switzerland	.005
Finland	.006	United Kingdom	.092
France	.063	United States	.158
Germany	.083	Greece	.004
Iceland	.001	New Zealand	.004
Ireland	.004	Turkey	.003
Italy	.052	Non-oil LDCs	.102
Japan	.050	OPEC	.022
The Netherlands	.042	Centrally Planned Economies	.042

Source: IMF, International Financial Statistics.

The petroleum import share matrix is determined exogenously outside the model. The initial matrix used in the projections is from the year 1975. It can be changed, according to different assumptions on petroleum exports in different simulation runs.

3. Export Price Equation

One alternative to obtain estimates for the coefficients in the export price equation would be to use substitution elasticities from our import share equation and price elasticities from our import equations (calculate a compound price elasticity for each exporting country from substitution elasticities (λ) and price elasticities (β)) in the import function and obtain supply elasticities from other sources. As econometric information about trade supply elasticities is very scarce (the only relevant empirical estimates for our purposes that we are aware of are those reported in Artus and Rhomberg (1973)) and they are the same for each country in their model, we have chosen another approach. In the literature there exist versions of the type of equation in our model. Those studies which we consider the most suitable for our purposes are Artus and Rhomberg (1973), Samuelson (1973), and Dornbusch and Krugman (1977). The elasticities of export prices with respect to competitors' price and some measure of the cost variable from the above sources are shown in Table 5. The coefficients for these variables do not necessarily sum to unity; we therefore calculated the "first state estimates" as arithmetic means, using the estimates in columns 1, 2 and 3 for the coefficient of competitors' prices and estimates in columns 5, 6 and 7 for the coefficient of domestic prices. Then these coefficients were scaled to add up to one. These are our final estimates for (ω) for OECD countries and they are shown in Table 6.

Branson and Papaefstratiou (1978) calculated proxies for market power for a sample of 41 countries consisting of both developed and developing countries. They assumed that market power in any commodity is an increasing function of the country's share in world trade.

A comparison of the market power index for 15 developed countries using our estimates (Australia, Austria, Belgium, Canada, Denmark, France, Germany, Italy, Japan, Netherlands, Norway, Spain, Sweden, The United Kingdom and The United States) shows that these are closely related. This dependence allowed us to derive a value for ($1-\omega$) for the export price equation of non-oil LDCs in our model which is .70. This same elasticity was also applied to the export price equations for goods and services of Centrally Planned Economies and OPEC.

TABLE 5: Coefficients of Export Price Equations from Different Sources[a/]

MARKET	Domestic costs			Average of (1)-(3)	Competitors' price			Average of (5)-(7)
	1	2	3	4	5	6	7	8
Australia	.39		.57	.48	.00		.24	.12
Austria	.00	.35		.18	.21	.65		.43
Belgium-Luxembourg	.00	.28		.14	.78	.72		.75
Canada	.67	.34	.71	.57	.00	.66	.29	.32
Denmark	.36	.31		.34	.47	.69		.58
Finland	.42			.42	.66			.66
France	.42	.57	.28	.42	.59	.43	.72	.58
Germany	.38	.58	.17	.38	.00	.42	.83	.42
Iceland	.36			.36	.08			.08
Ireland	.57			.57	.50			.50
Italy	.00	.49	.25	.25	.80	.57	.75	.69
Japan	.00	.52	.41	.31	.60	.48	.59	.56
Netherlands	.15	.30		.23	.56	.70		.63
Norway	.00	.33		.17	.96	.67		.82
Portugal	.36			.36	.08			.08
Spain	.56	.42		.49	.00	.58		.29
Sweden	.39	.36		.38	.83	.64		.74
Switzerland	1.05	.42		.74	.00	.58		.29
United Kingdom	.81	.40	.47	.56	.27	.60	.53	.47
United States	.99	.78	.70	.82	.19	.22	.30	.24
Greece	.36			.36	.08			.08
New Zealand	.36			.36	.08			.08
Turkey	.36			.36	.08			.08
Non-oil LDCs								
OPEC								
Centrally Planned Economies								

a/ Sources: (1),(5), Samuelson (1973); (2),(6), Artus-Rhomberg (1973); (3),(7), Dornbusch-Krugman (1977) except for Australia, which is derived from the Reserve Bank of Australia's Model's (Johnson-Butlin 1977) export price equation.

b/ Column (2) is taken from the simulation exercise reported in Artus and Rhomberg, and it shows the effects of a 10 per cent devaluation of a currency of each country on the export prices of a devaluing country. The column for domestic price coefficients is obtained simply by subtracting coefficients reported in the column (2) from unity.

TABLE 6: Export Price Elasticities with respect to Domestic Costs and Competitor's Prices

	Market	Competitors Price (ω)	Domestic Costs ($1 - \omega$)
1.	Australia	.20	.80
2.	Austria	.70	.30
3.	Belgium-Luxembourg	.84	.16
4.	Canada	.37	.63
5.	Denmark	.63	.37
6.	Finland	.61	.39
7.	France	.58	.42
8.	Germany	.53	.47
9.	Iceland	.18	.82
10.	Ireland	.47	.53
11.	Italy	.73	.27
12.	Japan	.48	.52
13.	The Netherlands	.73	.27
14.	Norway	.83	.17
15.	Portugal	.18	.82
16.	Spain	.37	.63
17.	Sweden	.66	.34
18.	Switzerland	.28	.72
19.	United Kingdom	.46	.54
20.	United States	.73	.77
21.	Greece	.18	.82
22.	New Zealand	.18	.82
23.	Turkey	.18	.82
24.	Non-Oil LDCs	.30	.30
25.	OPEC	.30	.70
26.	Centrally Planned Economies	.30	.70

Source: See text.

4. Other Parts of the Current Account

The "world interest rate" in the net investment income equation was set to .03. Initial (1975) value for "other terms" in the current account is kept constant during the projection period.

5. Domestic Price Equation

The coefficients for the effects of imported raw materials (ψ) and petroleum price increases (π) are calculated according to the following formulas from the 1975 data and are shown in Table 7.

$$\psi = \frac{\text{value of raw material imports}}{\text{value of raw material imports + value of petroleum imports + domestic labour costs}}$$

$$\pi = \frac{\text{value of petroleum imports}}{\text{value of raw material imports + value of petroleum imports + domestic labour costs}}$$

The following empirical counterparts are used:

value of petroleum imports	= SITC 331
value of raw material imports	= SITC 0 + 2 + (3 - 331) + 4 + 5 + 6
domestic labour costs	= compensation of employees from the OECD's national income accounts

6. Exchange Rate Equations

For floaters exchange rate equations applying the asset market approach of exchange rate determination were obtained by linking the exchange rate equations estimated in Branson-Halttunen-Masson (1978) and in Branson-Halttunen (1979) to the trade block. These sources give the exchange rate equations for Germany, Japan, the United Kingdom, France, and Italy. The (dollar/local currency) exchange rates were used for the first two countries and for Canada[1/] and the (Deutsche Mark/local currency) rates for the three remaining countries which were converted also to determine (dollar/local currency) exchange rates. The money stock variables in

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[1/] Equation for $\left(\frac{\$US}{\$CA}\right)$ exchange rate was estimated separately along the lines suggested by asset market approach.

TABLE 7: The Weights of Imported Raw Materials and Petroleum in the Domestic Price Equation

Market	(1) Petroleum Prices	(2) Import Prices of Raw Materials
1. Australia	0.018	0.101
2. Austria	0.022	0.195
3. Belgium-Luxembourg	0.043	0.316
4. Canada	0.031	0.106
5. Denmark	0.028	0.226
6. Finland	0.045	0.197
7. France	0.047	0.130
8. Germany	0.030	0.157
9. Iceland	0.000	0.288
10. Ireland	0.033	0.332
11. Italy	0.066	0.168
12. Japan	0.063	0.102
13. The Netherlands	0.068	0.257
14. Norway	0.000	0.241
15. Portugal	0.055	0.266
16. Spain	0.064	0.143
17. Sweden	0.021	0.176
18. Switzerland	0.010	0.177
19. United Kingdom	0.044	0.166
20. United States	0.019	0.040
21. Greece	0.109	0.241
22. New Zealand	0.018	0.101
23. Turkey	0.030	0.110
24. Non-Oil LDCs*	0.000	0.000
25. OPEC*	0.000	0.000
26. Centrally Planned Economies*	0.000	0.000

Source: See text.

*The data are not available for non-oil LDCs, OPEC, and CPEs.

the exchange rate equations were neglected[2/] due to the fact that our growth projections do not give any indiciation of the future monetary growth of these countries and only the effects coming through changes in net private foreign asset stocks were taken into account.

Exchange rate equations were estimated in log-form and that is why the obtained parameters are elasticities. For our purpose these equations were translated into a linear form using the following procedure. The exchange rate equations can be written in elasticity form as:

(i) $$\frac{dE}{E} = \alpha^{1} \frac{dF^{1}}{F^{1}} - \alpha^{f} \frac{dF^{f}}{F^{f}}$$

where:

E = the exchange rate (foreign currency/local currency).

F = net private foreign asset stock, subscript ^{1} and f refer to local and foreign, respectively.

α = estimated elasticities; ^{1} and f refer to local and foreign respectively.

multiplying by E and rearranging we obtain

(ii) $$dE = \underbrace{\alpha^{1} \frac{E}{F^{1}}}_{\xi} dF - \underbrace{\alpha^{f} \frac{E}{F^{f}}}_{0} dF^{f}$$

where ξ and ^{0} are the coefficients shown in Table 8. To calculate these, 1975 values for E and F were used. Equation (ii) is the equation for exchange rates for Canada, France, Germany, Italy, Japan and the United Kingdom used in the model.

[2/] Thus implicitly we assume that the effects coming through changes in both countries' money stocks cancel each other out. The work is in progress to allow exchange rates to respond to different growth rates of money stocks.

TABLE 8: Effect of changes in the net private foreign asset stocks on the exchange rate.

Change in the Exchange Rate	Change in the net private foreign asset stock (U.S. bill).	
	U.S. (dollars)	Local (dollars)
$e(\frac{\$}{DM})$	-.001201	.001463
$e(\frac{\$}{YEN})$	-.000001830	.00003431
$e(\frac{\$}{\$CA})$	-.0002150	.001169
	Germany (dollars)	Local (dollars)
$e(\frac{\$}{E})$	-.02320	.03268
$e(\frac{\$}{LIRA})$	-.000009880	.000008414
$e(\frac{\$}{FF})$	-.000432	.001186

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