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MACROECONOMIC POLICIES IN THE OECD AND LDC EXTERNAL ADJUSTMENT

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ABSTRACT

In this paper, the authors describe a simulation model for analyzing the effects of macroeconomic policies in the OECD on global macroeconomic equilibrium. Particular attention is paid to the effects on developing countries of alternative mixes of monetary and fiscal policies in the OECD. Though the model is quite small, it has several properties which make it attractive for policy analysis. First, the important stock-flow relationships and intertemporal budget constraints are carefully observed, so that the model is useful for short-run and long-run analysis. Budget deficits, for example, cumulate into a stock of public debt which must be serviced, while current account deficits cumulate into a stock of foreign debt. Second, the asset markets are forward looking, so that the exchange rate is conditioned by the entire future path of policies rather than by a set of short-run expectations. Third, the model is amenable to policy optimization exercises, and in particular can be used to study the effects of policy coordination versus non-coordination in the OECD, on global macroeconomic equilibrium.

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In Section I of this paper, the model is described in detail, and the basic numerical parameterization is also set out. Section II presents various policy multipliers, for fiscal and monetary impulses in the U.S. and the rest of the OECD. In Section III, we show how optimizing policies in the OECD will differ depending on the degree of macroeconomic policy coordination between the U.S. and the rest of the OECD. The developing countries are shown to be quite strongly affected by the absence of effective policy coordination among the developed economies. Section IV treats the welfare implications of OECD policies for the developing countries. We distinguish appropriate welfare measurements from simpler but commonly used measures involving LDC exports to the OECD. In Section V we present an historical simulation exercise which examines the implicatons of coordinated policy in response to the 1979 OPEC oil price shock. Section VI examines the impact of a shift in the U.S. monetary/fiscal mix (commencing in 1984) towards smaller fiscal deficits and more expansionary monetary policy. The main conclusions are summarized in Section VII.

I. The Simulation Model

A. Theoretical Framework

The model is for a four-region division of the world economy: the U.S., the rest of the OECD (hereafter denoted OECD), OPEC and the non-oil developing countries (hereafter denoted LDCs). At this point, only the developed country bloc has an internal macroeconomic structure; the non-oil LDCs and OPEC blocs embrace only the foreign trade aspects of these economies. Thus, while we can measure the effects of U.S. policies on LDC exports, we do not yet attempt to study the effects of LDC exports on internal macroeconomic equilibrium in the LDCs.

Each region produces a single output, which is an imperfect substitute in consumption for the outputs of the other regions. Thus, each region consumes the outputs of the other three, with relative consumption demands depending on the relative prices of the three goods. The notation C_j^i will signify the quantity of consumption by country i of the output of country j. Superscripts and subscripts U, O, P and L signify the U.S., OECD, OPEC and the LDCs, respectively. The trade matrix linking the four regions is given in Table 1.

Table 1: Trade Matrix

Exports from	Exports to U.S.	OECD	LDC	OPEC
U.S.	--	C_U^O	C_U^L	C_U^P
OECD	C_O^U	--	C_O^L	C_O^P
LDC	C_L^U	C_L^O	--	C_L^P
OPEC	C_P^U	C_P^O	C_P^L	--

We assume that growth of potential GDP in the U.S. and OECD is at a constant rate of n percent per year (n = 3% in the simulations that follow). All quantities, such as actual GDP (Q) or exports (C_j^i) are defined per unit of potential GDP. We adopt the normalization that potential GDP in the U.S. equals 1.0, and that all prices are 1.0 in the baseline (this fixes the values of the remaining quantities). Thus, the same values of C_j^i in years t and t+1 signify an actual quantity of exports that is growing at the rate n. Similarly, the level of GDP in the U.S. (Q^U) is per unit of potential GDP, so that $Q_t^U = .9$ for example, signifies a 10% output gap relative to potential in any year t.

In the U.S. and OECD, output is demand determined along conventional lines.

In any period, the nominal wage (W_t) is predetermined, and domestic prices (P_t) are a fixed markup over the wage. Consumer prices are a geometric weighted average of domestic and foreign prices, with weights equal to initial expenditure shares. Thus, in the U.S., we have:

$$(1) \qquad P^{CU} = P^{U^{\gamma_1}}(P^O E)^{\gamma_2}(P^L)^{\gamma_3}(P^P)^{(1-\gamma_1-\gamma_2-\gamma_3)}$$

(where no ambiguity will result, we drop the time subscript for period t). Here P^O is the OECD output price in the local currency (the "ECU" for convenience), and E is the nominal exchange rate, in \$/ECU. P^L is the \$-price of LDC output and P^P is the \$-price of OPEC output (i.e. oil). Note that while P^U_t is predetermined in period t, P^{CU}_t is not, since any of E_t, P^L_t and P^P_t may change in period t.

Aggregate demand is the sum of private domestic absorption (D), exports net of imports, and government spending. Note that D^U and D^O are defined in real units of the national good. From our earlier notation, U.S. export quantities are $(C^O_U + C^L_U + C^P_U)$, and the real value of imports in terms of U.S. goods is $[(P^O E/P^U)C^U_O + (P^L/P^U)C^U_L + (P^P/P^U)C^U_P]$. Henceforth, we define the U.S. real exchange rate vis-a-vis the OECD as $\Lambda^O = (P^O E/P^U)$, the real price of LDC goods as $\Lambda^L = P^L/P^U$, and the real price of OPEC oil as $\Lambda^P = P^P/P^U$. Combining all of the demand components we have that aggregate demand is:

$$(2) \qquad Q^U = D^U + G^U + (C^O_U + C^L_U + C^P_U) - \Lambda^O C^U_O - \Lambda^L C^U_L - \Lambda^P C^U_P$$

Private absorption is written as a linear function of GDP net of total taxes T, the real interest rate r, and financial wealth, H:

$$(3) \qquad D^U = (1-s)(Q^U - T^U) - \nu r^U + \delta H^U$$

There are counterpart equations for aggregate demand and absorption in the OECD.

Note that current absorption is written as a function of current disposable income rather than permanent income. This specification of course builds in a strong anti-Ricardian presumption that the time path of taxes affects the time path of private absorption, even for a given discounted value of the tax burden. Alternative specifications, such as in Blanchard (1984), would allow for a partial dependence of the absorption path on the path of taxes.

The real interest rate in (3) is the own-rate on U.S. goods. Letting i_t^U be the nominal interest rate, we have:

(4) $$i_t^U = r_t^U + (P_{t+1}^U - P_t^U)/P_t^U$$

In principal, the equation should have the *ex ante* expectation of P_{t+1}^U rather than its realization, but as we will proceed in a model without uncertainty and with perfect foresight, we assume $(P_{t+1}^U)^E = P_{t+1}^U$. Let π_{t+1}^U denote $(P_{t+1}^U - P_t^U)/P_t^U$, and π_{t+1}^{CU} denote the CPI inflation, $(P_{t+1}^{CU} - P_t^{CU})/P_t^{CU}$. We assume that nominal wage change $(W_{t+1}^U - W_t^U)/W_t^U$ is a function of π_t^{CU}, Q_t^U, and the change in Q_t^U (remember that Q_t^U is output relative to potential output), with $(W_{t+1}^U - W_t^U)/W_t^U = \pi_t^{CU} + \Omega Q_t^U + \tau(Q_t^U - Q_{t-1}^U)$. Next, by the assumption of a fixed price markup over wages, so that domestic price change equals wage change, we write:

(5) $$\pi_{t+1}^U = \pi_t^{CU} + \Omega Q_t^U + \tau(Q_t^U - Q_{t-1}^U)$$

The wealth term H in (3) comprises financial wealth of the private sector. Here we make some strong portfolio assumptions to simplify the model. U.S. residents hold two types of claims: U.S. $-denominated government debt and

\$-denominated loans to the LDCs. U.S. residents hold no OECD assets. OECD residents hold three types of assets: U.S. \$-denominated claims on U.S. residents, OECD ECU-denominated government debt, and ECU-denominated claims on the LDCs. OPEC holds \$-denominated claims on the U.S., OECD and LDCs. Both the U.S. and OECD governments hold official claims on the LDCs which are issued at concessional rates. As with the consumption of various country outputs, it is convenient to adopt the following notation for each country's holding of the other country's assets. All asset stocks are defined in <u>real</u> terms, with B^O, B_L^O, and A_L^O in units of OECD goods, and all the rest in real U.S. \$. A_U^O is the stock of claims on U.S. residents, held by the OECD. Similarly, A_U^P is the stock of claims on U.S. residents held by OPEC and A_L^U is the stock of claims on LDCs held by U.S. residents. Let B^U be the outstanding stock of U.S. government debt (where each asset is per unit of U.S. potential GDP). Note that as an accounting matter all B^U is held in the U.S., but since A_U^O and A_U^P are perfect

Table 2: Matrix of Asset Holdings

Claim on	Claim held by: US private	US official	OECD private	OECD official	OPEC private	OPEC official
US private	–	–	A_U^O	–	A_U^P	
US official	B^U	–	–	–	–	
OECD private	–	–	–	–	A_O^P	
OECD official	–	–	B^O	–	–	
OPEC	–	–	–	–	–	
LDCs	A_L^U	B_L^U	A_L^O	B_L^O	A_L^P	

substitutes for B^U, the assumption is not restrictive (i.e. the model behaves as if the OECD and OPEC hold claims on the U.S. government as well as the U.S. private sector). Table 2 shows the matrix of asset stocks. Wealth of U.S. residents is then $H^U = B^U + A^U_L - A^O_U - A^P_U$, and for OECD residents $H^O = B^O + (A^O_U/\Lambda^O) + A^O_L - (A^P_O/\Lambda^O)$. (Note that H^O is in units of OECD goods.) There are two limitations to this specification. Importantly, equity wealth is ignored (a proper treatment of equity wealth, as in Sachs (1983), would involve a substantial increase in complexity of the model). Second, real high-powered money balances are also not counted as part of wealth. This change would be easy to make but would probably not cause any major quantitative change to the model.

Let DEF be the inflation-adjusted fiscal deficit (relative to potential GDP):

(6) $$DEF^u = G^u + rB^u - T^u - v^U B^U_L$$

Here, B^U_L is official holdings of claims on LDCs and v^U is the (concessional) real rate of interest on these assets. (Note that the standard deficit measure would include nominal interest payments, iB^U, rather than real interest payments, rB^U. DEF improves upon the standard measure by being directly related to the change in the real value of the government's debt.) The change in B^U is related to DEF as:

(7) $$B^U_{t+1} = (B^U_t + DEF^U_t)/(1+n)$$

The term 1 + n arises since B is measured relative to potential GDP, which grows at the rate n. We assume that v^U adjusts slowly to a given fraction of r^U, according to the equation $v^U_t = a.v^U_{t-1} + b.r^U_t$. This equation was estimated using interest rate data calculated from the average terms of official and private debt (World Debt Tables, p. 2). The result was

$$v_t = \underset{(3.5)}{.82V_{t-1}} + \underset{(1.2)}{.13r_t} \qquad R = .75$$

where t-statistics are given in parentheses. This implies that in the steady state v = .72r, i.e. the concessional interest rate is 72 percent of the market rate.

It remains to specify the import demand functions for the economy. Imports are written as proportional to national absorption (D^U+G^U), and as a negative function of the relative import price. In particular, we assume an elasticity of demand of -1.5 for the OECD good, -1.0 for the LDC good and -.2 for the OPEC good.

(8) $$C_O^U = \alpha_0(D^U+G^U)(\Lambda^O)^{-1.5}$$

$$C_L^U = \alpha_1(D^U+G^U)(\Lambda^L)^{-1.0}$$

$$C_P^U = \alpha_2(D^U+G^U)(\Lambda^P)^{-0.2}$$

The OECD demands are similarly written, as:

(9) $$C_U^O = \alpha_3(D^O+G^O)(\Lambda^O)^{1.5}$$

$$C_L^O = \alpha_4(D^O+G^O)(\Lambda^L/\Lambda^O)^{-1.0}$$

$$C_P^O = \alpha_5(D^O+G^O)(\Lambda^P/\Lambda^O)^{-0.2}$$

Note that $\Lambda^L/\Lambda^O = P^L/EP^O$, which is the price of the LDC good relative to the OECD commodity, and Λ^P/Λ^O is the price of the OPEC good relative to the OECD commodity.

The final equation for the U.S. economy is the money demand equation, which is written in standard transactions demand form:

$$(10) \qquad M^U/P^U = (Q^U)^{\phi}(1+i^U)^{-\beta}$$

Note that i_t^U is the nominal \$ interest rate, equal to $r_t^U + \pi_{t+1}^U$.

The structural equations for the OECD are in almost all respects the same as for the U.S. The major exception is the portfolio block, since OECD residents hold U.S. assets while U.S. residents do not hold OECD assets. We assume that \$-denominated assets and ECU-denominated assets are imperfect substitutes in the OECD portfolio, and that $H^O = B^O + (A_U^O/\Lambda^O) + A_L^O - (A_O^P/\Lambda^O)$ is divided between ECU assets $(B^O+A_L^O)$ and net dollar assets $(A_U^O-A_O^P)/\Lambda^O$, based on relative asset returns. The dollar return to the OECD asset is $i_t^O + (E_{t+1}-E_t)/E_t$, and the dollar return to the U.S. asset is i^U, so that the return differential is $i^U - i^O - (E_{t+1}-E_t)/E_t$. This differential may also be written as $(i_t^U-\pi_{t+1}^U) - (i_t^O-\pi_{t+1}^O) - [\pi_{t+1}^O + (E_{t+1}-E_t)/E_t - \pi_{t+1}^U]$, or $r_t^U - r_t^O - (\Lambda_{t+1}^O-\Lambda_t^O)/\Lambda_t^O$. The bond market equation gives the net dollar asset demand as:

$$(11) \qquad (A_U^O-A_O^P)_t/\Lambda_t^O = \sigma[r_t^U - r_t^O - (\Lambda_{t+1}^O-\Lambda_t^O)/\Lambda_t^O] + \theta H_t^O$$

Θ is the marginal propensity to hold \$ assets out of financial wealth, and σ measures the degree of asset substitutability between \$ and ECU assets. Note that as $\sigma \to \infty$, the assets become perfect substitutes, with $r_t^U = r_t^O + (\Lambda_{t+1}^O-\Lambda_t^O)/\Lambda_t^O$.

We allow for multilateral financing of current account imbalances. The real dollar value of the OECD current account is given by:

$$(12) \quad CA^O = \Lambda^O(C_O^U+C_O^L+C_O^P) - C_U^O + \Lambda^L C_L^O + \Lambda^P C_P^O + r^U(A_U^O-A_O^P) + r^O(A_L^O\Lambda^O) + v^O(B_L^O\Lambda^O)$$

Note that as in the case of the government budget, the current account balance is defined using <u>real</u> interest rates, so that CA is linked to the change in real asset stocks. The balance of payments identity requires that CA^O be financed by changes in A^O_U, A^O_L, A^P_O, and B^O_L, according to:

$$(13)\quad A^O_{Ut+1} = (A^O_{Ut}+CA^O_t)/(1+n) - [(A^O_L+B^O_L)_{t+1} - (A^O_L+B^O_L)_t/(1+n)] + A^P_{Ot+1} - A^P_{Ot}/(1+n)$$

We make several simplifying assumptions to determine the change in each asset stock. For the official loans to LDCs from both the U.S. and OECD, (B^U_L, B^O_L), we assume a constant path per unit of potential U.S. GDP (i.e. a growth of 3% per period in the stock of official debt). In addition we allow for some deviation from this path as private loans rise or fall. This leads to the following equation:

$$(14)\qquad B^O_{Lt+1} = B^O_{Lt} + 0.1[A^O_{Lt+1}(1+n) - A^O_{Lt}]$$

We also assume that the change in LDC debt held by private agents in the OECD is a constant proportion of the flow supply of new LDC debt. In other words, LDC debt is financed in fixed proportions by the U.S., the OECD and OPEC. The proportion financed by each region is determined by the share of each region in the total stock of LDC debt in the initial steady state. Therefore the changes in A^L_O and A^L_P are governed by:

(15)

$$\text{(a)}\quad A^O_{Lt+1}\Lambda^O_t = \{a_1[(A^U_{Lt+1}+A^O_{Lt+1}\Lambda^O_t+A^P_{Lt+1})(1+n) - (A^U_{Lt}+A^O_{Lt}\Lambda^O_t+A^P_{Lt})] + A^O_{Lt}\Lambda^O_t\}/(1+n)$$

$$\text{(b)}\quad A^P_{Lt+1} = \{a_2[(A^U_{Lt+1}+A^O_{Lt+1}\Lambda^O_t+A^P_{Lt+1})(1+n) - (A^U_{Lt}+A^O_{Lt}\Lambda^O_t+A^P_{Lt})] + A^P_{Lt}\}/(1+n)$$

Clearly, a proportion a_1 of the LDC current account deficit (net of official flows) is financed by ECU loans, a proportion a_2 by OPEC loans, and the rest $(1-a_1-a_2)$ by U.S. resident loans. Remember that the (1+n) arises because the assets stocks are measured per unit of potential GDP, which grows at the rate n.

The remaining equations detail the foreign trade and finance of OPEC and the LDCs. The fundamental presumption here is that foreign borrowing of the LDCs is determined by the supply of loans from the U.S., OECD, and OPEC, rather than the demand for loans. For reasons described in many theoretical studies of foreign lending, this form of credit rationing results from the risk of debt repudiation by the LDCs. New foreign financing (i.e. measured by the current account deficit) is written as a function of three variables. First, we assume that there is inertia in the quantity of net lending, so CA^L_t is a function of CA^L_{t-1}. Second, net new lending is a decreasing function of the existing stock of debt. Third, net new lending is an increasing function of the value of LDC exports to the U.S., OECD and OPEC. Specifically, we write:

$$(16) \qquad CA^L_t = \omega CA^L_{t-1} + \varepsilon\{DEBT_t - \xi\Lambda^L_t(C^O_{Lt}+C^U_{Lt}+C^P_{Lt})[1 + n(1-\omega)/\varepsilon]\}$$

Where $DEBT = A^U_L + (A^O_L/\Lambda^O) + A^P_L + B^U_L + (B^O_L/\Lambda^O)$.

Here, the LDC current account balance is in constant U.S. dollar prices (i.e. current dollar value deflated by P^U). Net new foreign borrowing of the LDCs of course equals $-CA^L_t$. As $DEBT_t$ rises, CA^L_t is raised, indicating that a higher stock of real debt restricts the availability of new loans. Similarly, a rise in constant-dollar exports, $\Lambda^L_t(C^O_{Lt}+C^U_{Lt}+C^P_L)$, reduces CA^L_t, indicating that creditors are willing to extend new loans when LDC exports are high.

Note the multiplicand $[1 + n(1-\omega)/\varepsilon]$, and the constant term ξ. These terms have the following significance. For a given LDC export value, $\Lambda^L(C^O_L+C^U_L+C^P_L)$, equation (16) guarantees that $DEBT_t$ converges to ξ times the export level. Thus, ξ signifies a target debt-export ratio on the part of the creditors. In turn, when DEBT = $\xi\Lambda^L(C_L^O+C_L^U+C_L^P)$, it is easy to verify from (16) that CA_t^L = -nDEBT , so that the current account deficit, $nDEBT_t$, is exactly enough to keep the foreign debt growing at the rate n. In this way, the debt/export ratio remains constant. The parameters ω and ψ were estimated over the period 1977 to 1984 using data for non-oil LDC current account, net debt and exports (source: WEO). The results of the regression were:

$$CA_t^L = \underset{(6.3)}{0.9}\; CA_{t-1}^L + \underset{(6.6)}{0.3}\; DEBT_t - \underset{(7.4)}{0.47}\; Exports \qquad \bar{R}^2 = .91$$

Assuming n = .03 this implies ω = .9, ε = .3, ξ = 1.55. For the simulations we assume that the initial steady state value for ξ is 1.86, the 1983 value.

The value of LDC imports is simply given by the value of LDC exports, minus the level of interest servicing on the debt, plus the current account balance. Thus:

$$(17)\quad (C_U^L+\Lambda^O C_O^L+\Lambda^P C_P^L) = \Lambda^L(C_L^O+C_L^U+C_L^P) - [r^U(A_L^U+A_L^P) + v^U(B_L^U) + r^O(A_L^O\Lambda^O) + v^O(B_L^O\Lambda^O)] - CA^L$$

In turn, the value of total imports, $C_U^L + \Lambda^O C_O^L + \Lambda^P C_P^L$ is divided between expenditure on U.S., OECD and OPEC goods on the basis of constant expenditures shares η_1, η_2 and $(1-\eta_1-\eta_2)$ (i.e. Cobb-Douglas utility) so that

$$(18)\quad (a)\quad C_U^L = \eta_1(C_U^L+\Lambda^O C_O^L+\Lambda^P C_P^L)$$

$$(b)\quad C_O^L = \eta_2(C_U^L+\Lambda^O C_O^L+\Lambda^P C_P^L)/\Lambda^O$$

$$(c)\quad C_P^L = (1-\eta_1-\eta_2)(C_U^L+\Lambda^O C_O^L+\Lambda^P C_P^L)/\Lambda^P$$

Table 3: Four Region Model of the World

U.S. Equations

$$Q^U = D^U + G^U + (C_U^O + C_U^L + C_U^P) - \Lambda^O C_O^U - \Lambda^L C_L^U - \Lambda^P C_P^U$$

$$\Lambda^O = EP^O/P^U$$

$$\Lambda^L = P^L/P^U$$

$$\Lambda^P = P^P/P^U$$

$$D^U = (1-s)(Q^U - T^U) - \nu r^U + \delta H^U$$

$$H^U = B^U + A_L^U - A_U^O - A_U^P$$

$$B_{t+1}^U = (B_t^U + DEF_t^U)/(1+n)$$

$$DEF^U = G^U + r^U B^U - v^U B_L^U - T^U$$

$$M^U/P^U = Q^{U\phi}(1+i^U)^{-\beta}$$

$$i_t^U = r_t^U + \pi_{t+1}^U$$

$$v_t^U = .82 r_t^U + .13 v_{t-1}^U$$

$$\pi_{t+1}^U = (P_{t+1}^U - P_t^U)/P_t^U$$

$$\pi_{t+1}^{CU} = (P_{t+1}^{CU} - P_t^{CU})/P_t^{CU}$$

$$\pi_{t+1}^U = \pi_t^{CU} + \Omega Q_t^U + \tau(Q_t^U - Q_{t-1}^U)$$

$$P^{CU} = (P^U)^{\gamma_1}(P^O E)^{\gamma_2}(P^L)^{\gamma_3}(P^P)^{(1-\gamma_1-\gamma_2-\gamma_3)}$$

$$C_O^U = \alpha_O(D^U + G^U)(\Lambda^O)^{-1.5}$$

$$C_L^U = \alpha_1(D^U+G^U)(\Lambda^L)^{-1.0}$$

$$C_P^U = \alpha_2(D^U+G^U)(\Lambda^P)^{-0.2}$$

$$TB^U = (C_U^O+C_U^L+C_O^P) - (C_O^U\Lambda^O+C_L^U\Lambda^L+C_P^U\Lambda^P)$$

OECD Equations

$$Q^O = D^O + G^O + (C_O^U+C_O^L+C_O^P) - C_U^O/\Lambda^O - C_L^O(\Lambda^L/\Lambda^O) - C_P^O(\Lambda^P/\Lambda^O)$$

$$D^O = (1-s)(Q^O-T^O) - \nu r^O + \delta H^O$$

$$H^O = B^O + A_U^O/\Lambda^O + A_L^O - A_O^P/\Lambda^O$$

$$B_{t+1}^O = (B_t^O+DEF_t^O)/(1+n)$$

$$DEF^O = G^O + r^O B^O - v^O B_L^O - T^O$$

$$M^O/P^O = Q^{O\phi}(1+i^O)^{-\beta}$$

$$i_t^O = r_t^O + \pi_{t+1}^O$$

$$v_t^O = .82r_t^O + .13v_{t-1}^O$$

$$\pi_{t+1}^O = (P_{t+1}^O-P_t^O)/P_t^O$$

$$\pi_{t+1}^{CO} = (P_{t+1}^{CO}-P_t^{CO})/P_t^{CO}$$

$$\pi_{t+1}^O = \pi_t^{CO} + \Omega Q_t^O + \gamma(Q_t^O-Q_{t-1}^O)$$

$$P^{CO} = (P^O)^{\gamma_4}(P^U/E)^{\gamma_5}(P^L/E)^{\gamma_6}(P^P/E)^{(1-\gamma_4-\gamma_5-\gamma_6)}$$

$$C_U^O = \alpha_3(D^O+G^O)(\Lambda^O)^{-1.5}$$

Now we turn to the pricing of LDC output. P^L is the nominal price of LDC output in U.S. dollars. It is set as a variable markup over a basket of U.S., OECD and OPEC goods, where the markup depends on the volume of LDC exports to these regions. From (18), the LDC import price index should be written $(P^U)^{\eta_1}(P^O E)^{\eta_2}(P^P)^{(1-\eta_1-\eta_2)}$, so we adopt the following pricing rule:

$$(19) \qquad P^L = (P^U)^{\eta_1}(P^O E)^{\eta_2}(P^P)^{(1-\eta_1-\eta_2)}(C_L^U + C_L^O + C_L^P)^{\gamma_L}$$

For later use, it is convenient to denote the LDC terms of trade, $P^L/[(P^U)^{\eta_1}(P^O E)^{\eta_2}(P^P)^{(1-\eta_1-\eta_2)}]$, as S, and to point out that each one percent increase in LDC export volume raises the LDC terms of trade by γ_L percent. In the simulations, we choose $\gamma_L = 0.5$.

Finally, we turn to the equations for the OPEC bloc. The equations for OPEC imports and the pricing of OPEC output are derived in the same manner as for the LDCs. In deriving the OPEC current account equation we assume that OPEC adjusts its consumption expenditure to reach a target ratio of wealth to income. The specific form of the equation is the following:

$$(20) \qquad CA_t^P = \zeta[\psi(C_P^U + C_P^O + C_P^L)_t (P^P/P^U)_t - H_{t-1}^P] + nH_{t-1}^P$$

Here ψ is the desired ratio of wealth to income. A rise in OPEC income leads to a short-run improvement in OPEC's current account, until assets are accumulated to restore the desired wealth income ratio. It is easy to verify that when $\psi(C_P^U + C_P^O + C_P^L)(P^P/P^U) = H^P$ the following holds:

$$CA^P = nH^P$$

so that the current account surplus (nH^P) is sufficient to keep wealth growing at rate n. Since income is growing at rate n, the wealth income ratio remains constant. We estimated the equation for CA^P over the period 1977 to 1984 using data for the current account and exports of oil exporting countries and data for OPEC wealth (WEO, pp. 50, 58). The result was:

$$CA_t^P = \underset{(7.9)}{.54} \; EXPORTS_t^P - \underset{(-6.1)}{.26} \; H_{t-1}^P \qquad \bar{R}^2 = .87$$

assuming n = .03 this implies $\xi = .29$ and $\psi = 1.86$.

B. Numerical Parameterization and Simulation Methodology

The entire model is set forth in Table 3, and a list of variable definitions is given at the end of the table. Formally, the model is a twenty-dimensional non-linear difference equation system, with the following list of state variables: P_t^U, P_t^O, A_{Ut}^O, A_{Lt}^U, A_{Lt}^O, A_{Lt}^P, A_{Ot}^P, B_{Lt}^U, B_{Lt}^O, B_t^O, B_t^U, v_{t-1}^U, v_{t-1}^O, H_{t-1}^P, Q_{t-1}^U, Q_{t-1}^O, P_{t-1}^{CU}, P_{t-1}^{CO}, CA_{t-1}^L, and E_t. Let Z_t signify this vector of state variables. Then, the model can be written implicitly in the form:

$$Z_{t+1} = F(Z_t, C_t) \tag{21}$$

where C_t is a vector of "control" (or policy) variables selected by the macroeconomic authorities of the U.S. and OECD. The vector C_t includes G_t^U, T_t^U, M_t^U, G_t^O, T_t^O and M_t^O. In the calculations of policy multipliers, the path of C_t is set exogenously. In the policy optimization exercises, C_t is selected (either cooperatively or non-cooperatively by the U.S. and OECD), to maximize a dynamic policy function subject to (21).

Of the 20 variables in Z_t, the first 19 are known as "pre-determined" variables, since at any time t, the world economy inherits from the past the values of P_t^U, P_t^O, A_{Ut}^O, A_{Lt}^U, A_{Lt}^O, A_{Lt}^P, A_{Ot}^P, B_{Lt}^U, B_{Lt}^O, B_t^O, B_t^U, v_{t-1}^U, v_{t-1}^O, H_{t-1}^P, Q_{t-1}^U,

$$C^O_L = \alpha_4(D^O+G^O)(\Lambda^L/\Lambda^O)^{-1.0}$$

$$C^O_P = \alpha_5(D^O+C^O)(\Lambda^P/\Lambda^O)^{-0.2}$$

$$TB^O = (C^U_O+C^L_O+C^P_O) - [C^O_U/\Lambda^O + C^O_L(\Lambda^L/\Lambda^O) + C^O_P(\Lambda^P/\Lambda^O)]$$

$$A^O_{Ut+1} = (A^O_{Ut}+CA^O_t)/(1+n) - [(A^O_L+B^O_L)_{t+1} - (A^O_L+B^O_L)_t/(1+n) + A^P_{Ot+1} - A^P_{Ot}/(1+n)]$$

$$CA^O = (A^O_U-A^P_O)r^U + (A^O_L\Lambda^O)r^O + (B^O_L\Lambda^O)v^O + TB^O\Lambda^O$$

$$(A^O_U-A^P_O)_t/\Lambda^O_t = \sigma[r^U_t - r^O_t - (\Lambda^O_{t+1}-\Lambda^O_t)/\Lambda^O_t] + \Theta H^O_t$$

LDC Equations

$$P^L = (P^U)^{\eta_1}(P^O{}_E)^{\eta_2}(P^P)^{(1-\eta_1-\eta_2)}(C^U_L+C^O_L+C^P_L)^{\gamma_L}$$

$$C^L_U = \eta_1(C^L_U+\Lambda^O C^L_O+\Lambda^P C^L_P)$$

$$C^L_O = \eta_2(C^L_U+\Lambda^O C^L_O+\Lambda^P C^L_P)/\Lambda^O$$

$$C^L_P = (1-\eta_1-\eta_2)(C^L_U+\Lambda^O C^L_O+\Lambda^P C^L_P)/\Lambda^P$$

$$TB^L = \Lambda^L(C^U_L+C^O_L+C^P_L) - C^L_U - \Lambda^O C^L_O - \Lambda^P C^L_P$$

$$CA^L_t = \omega CA^L_{t-1} + \varepsilon\{DEBT_t - \xi\Lambda^L_t(C^O_{Lt}+C^U_{Lt}+C^P_{Lt})[1 + n(1-\omega)/\varepsilon]\}$$

$$DEBT_t = A^U_L + (A^O_L/\Lambda^O) + A^P_L + B^U_L + (B^O_L/\Lambda^O)$$

$$B^U_{Lt+1} = B^U_{Lt} + .1[A^U_{Lt+1}(1+n) - A^U_{Lt}]$$

$$B^O_{Lt} = B^O_{Lt} + .1[A^O_{Lt+1}(1+n) - A^O_{Lt}]$$

$$A_{Lt+1}\Lambda_t = \{a_1[(A_{Lt+1}+A_{Lt+1}\Lambda_t+A_{Lt+1})(1+n) - (A_{Lt}+A_{Lt}\Lambda_t+A_{Lt}\ )] + A_{Lt}\Lambda_t\}/(1+n)$$

$$A^P_{Lt+1} = \{a_2[(A^U_{Lt+1}+A^O_{Lt+1}\Lambda^O_t+A^P_{Lt+1})(1+n) - (A^U_{Lt}+A^O_{Lt}\Lambda^O_t+A^P_{Lt})] + A^P_{Lt}\}/(1+n)$$

$$A^U_{Lt+1} = (A^U_{Lt+1}+CA^L_t\ \ )/(1+n) - [(A^O_L\ +A^P_L+B^U_L+B^O_L)_{t+1} - (A^O_L+A^P_L+B^U_L+B^O_L)_t/(1+n)]$$

OPEC Equations

$$P^P = (P^U)^{\eta_3}(P^O{}_E)^{\eta_4}(P^L)^{(1-\eta_3-\eta_4)}(C^U_P+C^O_P+C^L_P)^{\gamma_P}$$

$$C^P_U = \eta_3(C^P_U+\Lambda^O C^P_O+\Lambda^L C^P_L)$$

$$C^P_O = \eta_4(C^P_U+\Lambda^O C^P_O+\Lambda^L C^P_L)/\Lambda^O$$

$$C^P_L = (1-\eta_3-\eta_4)(C^P_U+\Lambda^O C^P_O+\Lambda^L C^P_L)/\Lambda^L$$

$$H^P = A^P_U + A^P_O + A^P_L$$

$$TB^P = \Lambda^P(C^U_P+C^O_P+C^L_P) - C^P_U - \Lambda^O C^P_O - \Lambda^L C^P_L$$

$$CA^P_t = \zeta[\psi(C^U_P+C^O_P+C^L_P)_t(P^P/P^U)_t - H^P_{t-1}] + nH^P_{t-1}$$

$$A^P_{Ut+1} = (A^P_{Ut}+CA^P_t)/(1+n) - [(A^P_O+A^P_L)_{t+1} - (A^P_O+A^P_L)_t/(1+n)]$$

$$A^P_{Ot+1} = \{b_1[(A^P_U+A^P_O+A^P_L)_{t+1}(1+n) - (A^P_U+A^P_O+A^P_L)_t] + A^P_{Ot}\}/(1+n)$$

Definitions

A_j^i	Claims on country j held by private creditors in country i
B_j^i	Claims on country j held by official creditors in country i
B^i	Government debt of country i
C_j^i	Consumption by country i of the output of country j
CA	Current account
D	Domestic absorption
DEBT	LDC debt
DEF	Government deficit
E	Exchange rate ($/ECU)
G	Government Expenditure
H	Real Financial Wealth
i	Nominal interest rate
M	Nominal money supply
n	Growth rate
P^i	Price level of country i goods
P^C	Consumer price index
π_t	Domestic price inflation
π_t^C	Consumer price inflation
Q	Gross domestic product
r	Real interest rate

T	Taxes
TB	Trade Balance
v	Concessional real interest rate
Λ	Real exchange rate

$Q^{O}_{t-1}, P^{CU}_{t-1}, P^{CO}_{t-1}, CA^{L}_{t-1}$. The twentieth variable in Z_t, the exchange rate E_t, is not inherited from the past. Rather, as is common in perfect foresight dynamic models, E_t is selected as the unique value of the exchange rate that keeps the overall economy dynamically stable, given the inherited values of the rest of Z_t, and the anticipated path of current and future C_t.

For many purposes, it is simpler to work with a linearized version of the model of Table 3 (this is particularly true when we study the optimal policy packages of the U.S. and the OECD). Thus, in practice, the model of Table 3 is linearized in the following way. All price variables, e.g., P^{u}_{t}, are re-interpreted as the exponents of log prices. Thus, we write log prices by using lower-case variables, e.g. $p^{u}_{t} = \log(P^{u}_{t})$ and $\lambda^{L}_{t} = \log(\Lambda^{L}_{t})$, and so rewrite the equation $\Lambda^{L}_{t} = P^{L}_{t}/P^{u}_{t}$ as $\exp(\lambda^{L}) = \exp(p^{L}_{t})/\exp(p^{u}_{t})$. All quantity variables are kept in level form. Then, the model is linearized about a set of initial conditions, which have the property that all prices start at 1.0 (and all log prices at 0.0). Thus, upon linearization, the Λ^{L} equation is simply $\lambda^{L} = p^{L}_{t} - p^{U}_{t}$, for example. A detailed version of the linearized model is available from the authors upon request.

Let us now turn to the numerical parameterization of the model. In calibrating the model, we require coefficients for structural equations, trade and expenditure shares and initial asset stocks. The initial asset stocks are required for the linearization. A list of key assumed parameter values for the coefficients of the structural equations is shown in Table 4. As a starting point for empirical investigation, and in lieu of econometric estimates, the U.S. and OECD are treated as having the same structure in aggregate demand, pricing, and money demand. The only differences between the regions are in the composition and direction of trade (which are directly measurable in the data), and in portfolio preferences (where the differences are to some degree measurable in the data, as well as being based on the general observation that international debts are predominantly denominated in U.S. dollars).

The direction and composition of trade is based on 1983 trade data of the IMF Direction of Trade Statistics (DOT), values for which are shown in Table 5. The numbers in parentheses express the $ values as a share of 1983 U.S. GDP. The figures for trade between OPEC and the LDCs were derived by the authors from data in DOT and WEO (Table 20) for exports and imports of non-oil and

Table 5: Trade Shares, 1983*

$billion

	Exports to			
Exports from	U.S.	OECD	LDC	OPEC
U.S.	--	125.5 (.038)	58.9 (.018)	16.4 (.005)
OECD	153.3 (.047)	--	151.0 (.046)	76.8 (.023)
LDC	77.9 (.024)	124.8 (.038)	--	84.4 (.026)
OPEC	24.7 (.008)	110.0 (.034)	96.9 (.030)	--

*The numbers in parentheses are shares of U.S. GDP.

oil-exporting developing countries. To approximate exports from OPEC to the LDCs we used the following procedure. We calculated total OPEC exports less industrial country imports from OPEC. We then calculated total LDC imports less industrial country exports to the LDCs. The first measure yields an underestimate and the second yields an overestimate of OPEC exports to the LDCs. Both measures were then averaged to get the figure in the table. A similar procedure was used to calculate exports from the LDCs to OPEC. The data from this trade matrix are used to derive the following parameters: γ_1 to γ_6, α_1 to α_5 and η_1 to η_4.

In linearizing this model and in forming parameters a_1, a_2 and b_1, we require initial asset stocks. We use estimates of these stocks as of the end of 1983. We now describe the procedures followed to derive these estimates. The data sources include: IMF World Economic Outlook (WEO), World Debt Tables(WDT), World Bank (WB), Economic Report of the President (ERP) and Mattione (1983).

- LDC debt

We assume that total LDC gross debt is 16% short term debt (less than 1 year to maturity) and 84% long term debt (see WEO, Table 37). Of the long term debt 39% is held by official creditors and 61% by private creditors. Assuming that short term debt is all private creditors, this implies that total LDC debt is 33% official creditor and 67% private creditor.

Using currency composition of long debt (source WB) we find that 78% of long debt is in $US and 22% is in ECU (where all the residual, 6%, is allocated to $US). Note that "ECU" debt here signifies an OECD currency of denomination other than the U.S. dollar. Assuming that short debt is all $US denominated, this implies total debt is 82% $US and 18% ECU. By further calculation from data on the currency compositon of LDC debt we estimate the currency composition of the debt, disaggregated into the type of creditor, given in Table 6. Note that the cateogry "$US official debt" includes loans from international agencies. Debt is also distinguished by the nature of the interest charges, in particular whether the rate is fixed or floating (i.e. pegged to a short-term rate such as LIBOR), and whether the rate is at market terms or concessional terms. For our purposes, we will treat all market-determined rates in a particular currency to be at the same level (i.e. we will not distinguish the rates on fixed versus floating securities). We do, of course, make a separate allowance for market versus concessional rates. LDC Gross Debt is given in Table 7. Net debt is calculated by subtracting LDC reserves from the gross debt.

Table 6: LDC Gross Debt by Type of Loan

(end of 1983)

Type of Creditor	Interest Rate	Share of Total Debt
ECU private	floating, market	3%
ECU private	fixed, market	7%
ECU official	fixed, concessional	1%
OPEC private	floating, market	12%
U.S. private	floating, market	31%
U.S. private	fixed, market	8%
U.S. official	fixed, concessional	29%
Private	floating, market	46%
Private	fixed, market	15%
Official	fixed, concessional	39%

Source: Authors' estimates based on data cited in the text.

Table 7: LDC Debt Positions

(end of 1983)	$U.S.b
Debt Outstanding of Non-oil LDCs (WEO, p.8) + IMF credit (WEO p67)	685.5 10.3
LDC Gross Debt Outstanding	695.8
Reserves of All (Non-oil) LDC's (WEO, p.66)	100.2
LDC Net Debt	595.6

By applying the share of each type of creditor in total debt to the gross debt figure in Table 6, we are able to derive the breakdown of debt given in Table 8. Since we are only allowing for a market interest rate and a concessional interest rate, the private creditor debt is aggregated and assumed to be earning a market rate whereas the official creditor debt is assumed to be earning the concessional interest rate. The breakdown of net debt into type of lender is shown in Table 9. It is derived assuming that 70% of LDC reserves are in $US and 30% in ECU (see Kenen (1983), p. 17, where we assume that all unspecified sources are $US). We subtract the value of 70% of LDC reserves from U.S. market rate loans, assuming that LDC reserves earn market rates. Accordingly we subtract the value of 30% of LDC reserves from ECU market rate loans. The stocks are then converted into shares of US GDP (1984) where US GDP in 1984 is used to be consistent with the timing in the model.

Table 8: Composition of LDC Gross Debt

(end of 1983)

		$USb	Share of USGDP
Gross Debt		696	.190
ECU Loans	(.2)	140	.038
Total $ Loans	(.8)	556	.152
OPEC Loans to LDCs*		84	.023
=> US Share of $ Loans		472	.129
U.S. $ Loans at Market Rates	(.39)	271	.074
U.S. $ Loans at Concessional Rates	(.29)	201	.055
ECU Loans at Market Rates	(.10)	70	.019
ECU Loans at Concessional Rates	(.10)	70	.019
OPEC Loans at Market Rates	(.12)	84	.023

*Source: WEO, p. 58.

Table 9: Composition of LDC Net Debt

(end of 1983)

	$USb	Share of US GDP	Variable Name
Net Debt LDC	596	.163	--
U.S. $ Loans at Market Rates	201	.055	A_L^U
U.S. $ Loans at Concessional Rates	201	.055	B_L^U
ECU Loans at Market Rates	40	.011	A_L^O
ECU Loans at Concessional Rates	70	.019	B_L^O
OPEC $ Loans at Market Rates	84	.023	A_L^P

- OPEC Holdings of US, OECD and LDC assets

We base our calculations of OPEC asset holdings on data contained in Mattione (1983; Table I.4). The data is only available for the beginning of 1983. Therefore we derive the proportions to 1983 GDP and assume the same ratios for end of 1983. Our assumptions are presented in Table 10. We assume

Table 10: OPEC Asset Holdings

(beginning of 1983)

	$USb	Share of Total	Share of USGDP	Variable Name
$ placements (.7xTotal)	264.1	0.7		--
in US	86.7			--
in LDC's*	74.0	0.2	.023	A_L^P
in OECD	103.4			--
ECU placements (.3 x total)	113.2	0.3	.034	A_O^P
$ Claims against U.S. citizens	190.1	0.5	.058	A_U^P
Total Net Assets	377.3	1.0	.115	--

*Note that the 1982 value for OPEC loans to LDCs given in Mattione (24.9b) is less than the value given in the WEO (74b). The value used here is from WEO. The $US placements in the OECD has been adjusted accordingly.

that 70% of OPEC assets are held in dollars (Mattione, p. 21). Assume that OPEC holds $86.7b in claims against U.S. residents in the U.S. (Mattione, Table I4) and $74b in claims against the LDCs (WEO, p. 58). This implies that the remainder of claims held by OPEC in dollars are held in the OECD ($103.4b). We assume that these claims are held in Eurodollar deposits in Europe and are effectively claims against U.S. citizens. These OPEC claims against U.S. citizens held in Europe are then added to the OPEC claims against U.S. citizens held in the U.S. to get the total OPEC claims against the U.S., given in Table 10. This gives $190.1b or 50% of total OPEC asset holdings as claims against the US. The remaining 50% is divided between holdings of dollar denominated LDC assets (20%) and ECU-denominated OECD assets (30%).

- U.S. Assets

We still need to derive the initial stock of US assets held by OECD residents and the outstanding stock of US and OECD government bonds. From the Economic Report of the President (1984) we have the net asset position of the U.S. (adjusting for direct foreign investment) beginning in 1983. We can add to this the net U.S. holdings of claims against the LDCs and subtract the net OPEC holdings of claims against the U.S. (held in the U.S.) to arrive at a figure for net OECD claims against the U.S. We assume a figure of $280b (.088 as a share of 1983 U.S. GDP). We use the total US government debt held by private agents net of Federal Reserve holdings as the stock of Government debt. From ERP (1984) this is equal to $986b at the end of 1983 (.27 of 1984 U.S. GDP).

- OECD Asset Holdings

We have already derived the OECD holdings of US and LDC assets and the claims against the OECD held by OPEC. We assume that the outstanding stock of OECD government debt is the same proportion of OECD GDP as the US stock is of US GDP. This give a figure for the stock of outstanding OECD govenment debt as a proportion of US GDP for the end of 1983 of .375.

Table 11: Ratio of Net Asset Holdings to US GDP

end of 1983

		Claim held by				
	US		OECD		OPEC	
Claim on	private	official	private	official	private	official
US private	-	-	.088	-	.058	
US official	.27	-	-	-	-	
OECD private	-	-	-	-	.034	
OECD official	-	-	.375	-	-	
OPEC	-	-	-	-	-	
LDCs	.055	.055	.011	.019	.023	

Table 11 summarizes the asset positions that we have derived as proportions of US GDP.

II. Numerical Simulations

Using the parameterization just described, we now study five types of "disturbances" in the model: (1) a sustained U.S. fiscal policy expansion (1% of US GDP); (2) a sustained U.S. monetary policy expansion (1% of M^U); (3) a sustained OECD fiscal policy expansion (1% of OECD GDP); (4) a sustained OECD monetary expansion (1% of M^O); and (5) a portfolio shift away from dollar-denominated assets, toward ECU-denominated assets.

The model was simulated using two alternative techniques for solving dynamic rational expectations models. These were multiple shooting (see Lipton et al., 1982), and the Fair-Taylor method (see Fair and Taylor, 1983). We found that if either technique ran into convergence problems the other technique overcame the problem.

Table 12 shows various aspects of a sustained, bond-financed U.S. fiscal expansion, beginning in 1984. The fiscal expansion begins as a 1% of GDP rise in government expenditure, with no change in taxes. Over time, the higher expenditure level is left unchanged, but taxes are raised in line with rising debt-service changes, in order to keep the deficit constant at 1% of GDP. To read the table, note that "%" signifies percentage deviation from the initial baseline; "D" signifies the level deviation from the initial baseline; "$bl" signifies billions of dollars deviation from the initial baseline; and "$84" signifies the devaluation from baseline in constant, 1984 dollars.

In the case of a U.S. fiscal expansion, we have a rise in U.S. GDP of 0.9 percent relative to the baseline in the first year, and lower inflation of 0.2 percentage points. The inflation reduction has two sources: on the one hand, the exchange rate appreciates 3.4 percent, which contributes to reduced import prices; on the other hand, the inflationary effects of the fiscal expansion via the Phillips curve do not operate (by assumption) until 1985. In the second year of the shock, inflation is 0.2 percentage points higher than the baseline. U.S. short-term interest rates rise by 0.8 percentage points (80 basis points) above the baseline in 1984, and are 1.3 percentage points above baseline in the third year of the shock. The U.S. current account worsens by $16b, or 0.4 percent of GDP, in 1984, and continues to worsen for the next three years.

As explained in Sachs and Wyplosz (1984), the short-run appreciation of the dollar is reversed in the long run, as the OECD claims on the U.S. rise over

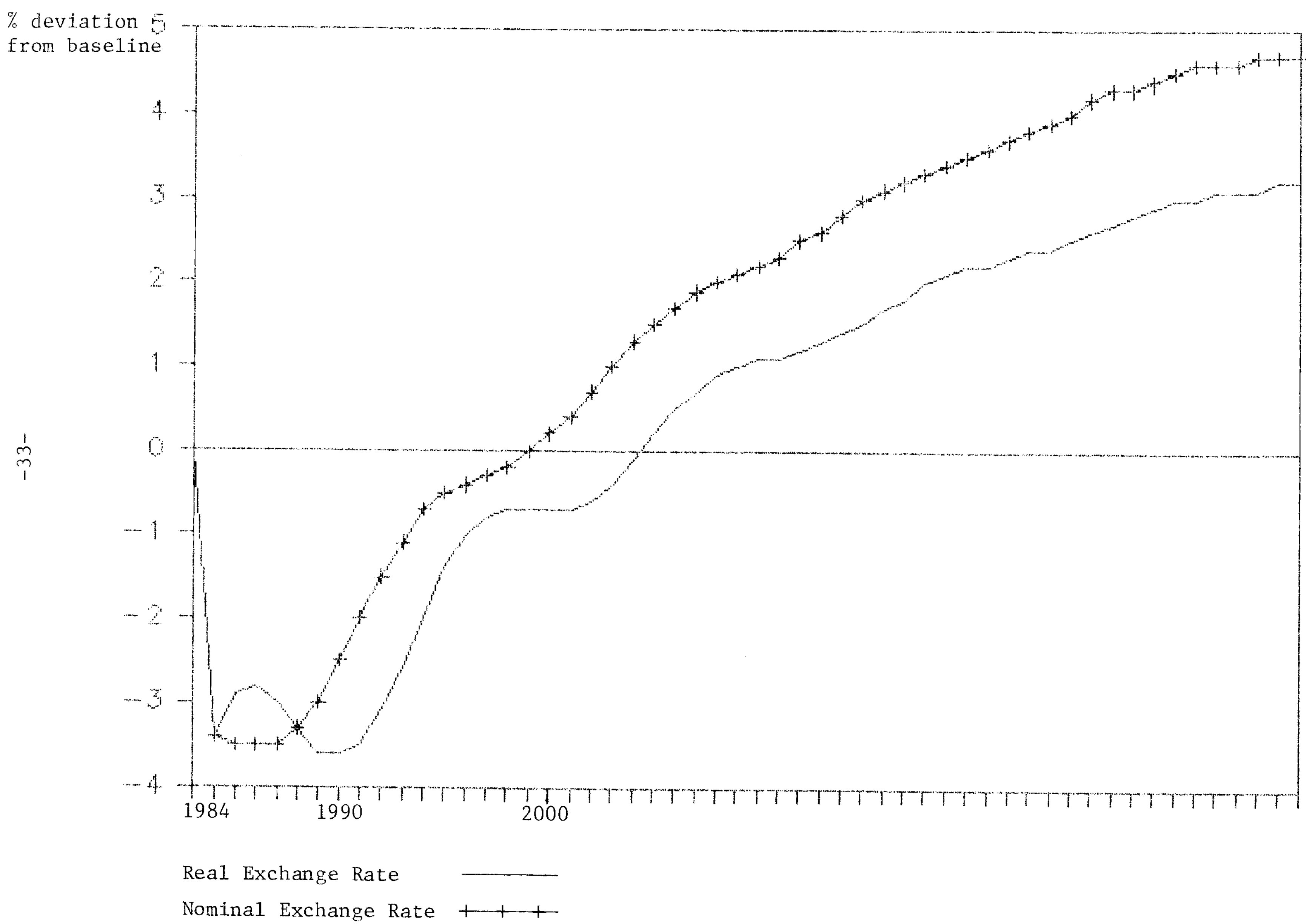
Table 12: Effects of U.S. Fiscal Expansion

		1984	1985	1986	1987
US GDP ($84)	%	0.9	1.0	0.8	0.4
US GDP ($84)	$b	32.3	37.3	30.5	15.1
US INFLATION	D	-0.2	0.2	0.4	0.5
US INTEREST RATE	D	0.8	1.0	1.3	1.5
EXCHANGE RATE ($/E)	%	-3.4	-3.5	-3.5	-3.5
OECD GDP	%	0.9	0.3	-0.3	-0.7
OECD INFLATION	%	0.2	0.6	0.5	0.3
OECD INTEREST RATE	D	0.8	1.0	1.1	1.1
LDC IMPORTS ($)	%	-1.0	-1.0	-1.3	-1.6
LDC IMPORTS ($)	$b	-3.3	-3.6	-4.7	-6.1
LDC IMPORTS (vol)	%	1.4	0.9	0.2	-0.4
LDC EXPORTS ($)	%	-0.7	-0.6	-0.6	-0.6
LDC EXPORTS ($)	$b	-2.3	-2.1	-2.1	-2.0
LDC EXPORTS (vol)	%	1.1	0.8	0.6	0.4
LDC CA ($)	% OF US GDP	0.0	0.0	-0.1	-0.1
LDC CA ($)	$b	0.0	-0.7	-2.0	-2.3
LDC IN ON DEBT ($)	% OF US GDP	0.1	0.1	0.1	0.1
LDC IN ON DEBT ($)	$b	2.1	2.5	3.4	4.6
US CA ($)	% OF US GDP	-0.4	-0.5	-0.5	-0.6
US CA ($)	$b	-16.0	-17.5	-20.7	-23.9
LDC CAP GAIN ON DEBT ($)	% OF US GDP	0.0	0.0	0.1	0.1
LDC CAP GAIN ON DEBT ($)	$b	0.0	0.8	2.4	3.3
PRICE OF LDC EXPORTS IN $US	%	-1.8	-1.5	-1.2	-1.0
LDC TOT	%	0.5	0.4	0.3	0.2
OPEC TOT	%	0.4	0.2	0.0	-0.2

time. Figure 1 shows the 55-year trajectory of the real and nominal exchange rate. After an initial jump appreciation of 3.4 percent, the nominal exchange rate peaks at 3.5 percent appreciation relative to baseline, and then gradually depreciates over the remaining time. Just as the appreciation in the early years helps to export inflation, the subsequent depreciation may be thought of as a re-import of the inflation. However, even though the inflationary gains from currency appreciation are temporary, it may still be desirable to induce a real appreciation at the beginning of a disinflation program, since on a path of declining inflation, the appreciation exports inflation when inflation is high (and therefore socially costly), while the subsequent depreciation re-imports inflation when it is low. We return to this argument later.

The table also outlines various effects of the U.S. expansion on the rest of the world. OECD GDP rises by 0.9 percent in the first year, though it <u>falls</u> relative to baseline in 1986-87. Inflation rises on impact, as the ECU depreciation raises OECD import prices. ECU nominal interest rates are pulled up in line with U.S. rates. The expansion has three effects on LDC foreign trade. First, the rise in interest rates raises the interest servicing bill, by $2.1b in 1984. Second, the dollar price of LDC exports and imports both fall. P^L falls by 1.8 percent in 1984, due to the 3.4 percent dollar appreciation. The import price index falls by 2.3 percent, so that the LDC terms of trade improve slightly, by .5 percent. Third, export volumes rise, as the real economic activity in the U.S. and OECD both increase. In fact, the percentage rise in export volumes is less than the fall in trade prices, so that dollar values of LDC exports actually fall. Note that the rise in export

Figure 1: Exchange Rate Changes Following U.S. Fiscal Policy



volumes allows a 1.4 percent increase in import volumes in 1984. As we shall see, the welfare implications of these three effects are, on balance, negative, since the small terms-of-trade gain does not outweigh the losses from higher interest rates.

The implications of a U.S. monetary expansion are shown next, in Table 13. A U.S. monetary expansion causes a more inflationary boom in the U.S., as the exchange rate now depreciates on impact. Per unit of GDP gain, monetary policy is more inflationary than fiscal policy. Also, per unit of GDP gain, the worsening of the U.S. current account is less with monetary policy than with fiscal policy. These differential effects of U.S. monetary and fiscal policy have the following implications in the model. A policy mix of expansionary fiscal policy (G increases by 1.1 percent of GDP), and contractionary monetary policy (M declines by 0.9 percent), causes:

- no output change
- an inflation reduction of -0.2 percentage points in the first year
- a worsening of the current account of $15.8b in the first year

As long as the current account is not a short-run target, the "Mundellian mix" of loose G, tight M is an attractive anti-inflationary mix.

Note the effects of a U.S. monetary expansion on the rest of the world. Contrary to the case of U.S. fiscal policy, the monetary experience brings net benefits to the LDCs. Interest rates (particularly real interest rates) are reduced by the money expansion. The interest burden falls $1.9b in 1984, and though it rises slightly in nominal terms in 1985 and 1986 ($0.3b and $0.6b), it falls as well in later years when measured in real terms. Specifically, the

Table 13: Effects of U.S. Monetary Expansion

		1984	1985	1986	1987
US GDP ($84)	%	1.1	0.7	0.3	-0.2
US GDP ($84)	$b	40.8	27.0	9.9	-7.6
US INFLATION	D	0.0	0.5	0.5	0.4
US INTEREST RATE	D	-0.1	0.1	0.2	0.3
EXCHANGE RATE ($/E)	%	0.7	0.6	0.7	0.8
OECD GDP	%	0.0	0.1	0.1	0.1
OECD INFLATION	%	0.0	0.0	0.1	0.1
OECD INTEREST RATE	D	0.0	0.0	0.1	0.2
LDC IMPORTS ($)	%	1.2	1.3	1.4	1.5
LDC IMPORTS ($)	$b	4.1	4.6	5.2	5.5
LDC IMPORTS (vol)	%	0.7	0.7	0.6	0.4
LDC EXPORTS ($)	%	0.4	0.6	0.9	1.3
LDC EXPORTS ($)	$b	1.2	1.9	3.2	4.4
LDC EXPORTS (vol)	%	-0.1	0.0	0.1	0.1
LDC CA ($)	% OF US GDP	0.0	-0.1	-0.1	-0.1
LDC CA ($)	$b	-0.1	-3.1	-3.2	-2.7
LDC IN ON DEBT ($)	% OF US GDP	-0.1	0.0	0.0	0.0
LDC IN ON DEBT ($)	$b	-1.9	-1.5	-0.8	0.1
US CA ($)	% OF US GDP	0.0	-0.1	-0.1	-0.1
US CA ($)	$b	0.2	-3.6	-4.7	-4.9
LDC CAP GAIN ON DEBT ($)	% OF US GDP	0.0	0.1	0.1	0.1
LDC CAP GAIN ON DEBT ($)	$b	0.0	3.0	3.3	2.9
PRICE OF LDC EXPORTS IN $US	%	0.5	0.6	0.9	1.1
LDC TOT	%	-0.1	0.0	0.0	0.1
OPEC TOT	%	0.2	0.2	0.1	0.1

real interest payments fall by \$1.9b in 1984, \$1.5b in 1985, and \$0.8b in 1986. The U.S. monetary expansion slightly worsens the LDC terms of trade by 0.1 percent in 1984 but improves it thereafter, and it increases the prices of exports and imports relative to U.S. prices. We show later that an equiproportional rise in the real price of exports and imports (relative to P^{US}) is welfare worsening as long as the LDCs are running trade balance deficits along the pre-shock path.

The major differences in effects of OECD policy and U.S. policy lie in the differing effects on the exchange rate. As seen in Tables 14 and 15, an OECD fiscal expansion strengthens the ECU, while a monetary expansion weakens the ECU. Following an OECD fiscal expansion, the dollar price of LDC exports <u>rises</u>, while it falls with a U.S. expansion.

A final experiment, shown in Table 16, is the case of a portfolio shift in the private sector, away from \$ assets and towards ECU assets. We include this case for two reasons. First, there is a school of thought which attributes at least part of the post-'79 rise of the dollar to a "safe haven" effect on the U.S., pulling in funds from abroad. This safe haven effect may be modelled as a portfolio shift, and can therefore be read off of Table 16, with the signs <u>reversed</u>. Second, there is also some debate as to the dangers from a reversal of that effect in coming years, often stated as the question: "What happens in the near future when European and Japanese asset holders recognize the implications of the looming U.S. current account deficits and start to 'move out' of dollars?" The shock is modelled as an intercept shift ($dI < 0$) in the portfolio equation (11):

Table 14: Effects of OECD Monetary Expansion

		1984	1985	1986	1987
US GDP ($84)	%	0.0	0.1	0.1	0.0
US GDP ($84)	$b	1.1	5.2	4.2	-1.1
US INFLATION	D	0.0	0.0	0.1	0.1
US INTEREST RATE	D	0.0	0.1	0.2	0.2
EXCHANGE RATE ($/E)	%	-0.5	-0.6	-0.8	-1.0
OECD GDP	%	1.3	0.6	-0.1	-0.7
OECD INFLATION	%	0.0	0.7	0.7	0.4
OECD INTEREST RATE	D	0.1	0.3	0.5	0.4
LDC IMPORTS ($)	%	1.0	1.0	0.8	0.5
LDC IMPORTS ($)	$b	3.3	3.4	2.9	1.8
LDC IMPORTS (vol)	%	1.1	0.7	0.2	-0.2
LDC EXPORTS ($)	%	0.6	0.6	0.5	0.4
LDC EXPORTS ($)	$b	1.9	2.0	1.9	1.3
LDC EXPORTS (vol)	%	0.5	0.2	0.0	-0.2
LDC CA ($)	% OF US GDP	0.0	0.0	0.0	0.0
LDC CA ($)	$b	-0.2	-0.3	-0.8	-0.9
LDC IN ON DEBT ($)	% OF US GDP	0.0	0.0	0.0	0.0
LDC IN ON DEBT ($)	$b	-0.2	-0.1	0.3	0.7
US CA ($)	% OF US GDP	0.0	0.0	0.0	0.0
US CA ($)	$b	0.0	1.1	0.8	-0.1
LDC CAP GAIN ON DEBT ($)	% OF US GDP	0.0	0.0	0.0	0.0
LDC CAP GAIN ON DEBT ($)	$b	0.0	0.0	0.5	0.8
PRICE OF LDC EXPORTS IN $US	%	0.1	0.4	0.6	0.6
LDC TOT	%	0.3	0.1	0.0	-0.1
OPEC TOT	%	0.4	0.2	0.0	-0.2

Table 15: Effects of OECD Fiscal Expansion

		1984	1985	1986	1987
US GDP ($84)	%	0.8	0.3	-0.1	-0.5
US GDP ($84)	$b	28.3	13.1	-3.7	-20.5
US INFLATION	D	0.2	0.5	0.5	0.4
US INTEREST RATE	D	0.7	0.9	1.1	1.1
EXCHANGE RATE ($/E)	%	3.1	2.7	2.2	1.7
OECD GDP	%	1.3	1.0	0.5	-0.3
OECD INFLATION	%	-0.1	0.6	0.8	0.8
OECD INTEREST RATE	D	1.1	1.6	2.0	2.3
LDC IMPORTS ($)	%	3.0	3.1	3.1	2.9
LDC IMPORTS ($)	$b	10.1	10.9	11.4	10.7
LDC IMPORTS (vol)	%	0.5	0.4	0.1	-0.4
LDC EXPORTS ($)	%	2.9	3.2	3.5	3.6
LDC EXPORTS ($)	$b	9.2	10.4	11.9	12.5
LDC EXPORTS (vol)	%	0.3	0.3	0.3	0.2
LDC CA ($)	% OF US GDP	0.0	-0.1	-0.1	-0.1
LDC CA ($)	$b	-0.7	-4.6	-4.8	-4.3
LDC IN ON DEBT ($)	% OF US GDP	0.0	0.0	0.1	0.1
LDC IN ON DEBT ($)	$b	0.7	1.9	3.3	4.9
US CA ($)	% OF US GDP	0.3	0.2	0.2	0.2
US CA ($)	$b	10.3	7.5	7.6	7.8
LDC CAP GAIN ON DEBT ($)	% OF US GDP	0.0	0.1	0.1	0.1
LDC CAP GAIN ON DEBT ($)	$b	0.0	3.3	3.1	2.5
PRICE OF LDC EXPORTS IN $US	%	2.6	2.9	3.2	3.4
LDC TOT	%	0.1	0.2	0.2	0.1
OPEC TOT	%	0.4	0.3	0.1	-0.1

Table 16: Effects of a Shift in Portfolio Preference Away from $ Assets

		1984	1985	1986	1987
US GDP ($84)	%	2.5	0.6	-0.8	-1.6
US GDP ($84)	$b	91.2	22.0	-30.2	-63.2
US INFLATION	D	0.9	1.6	1.2	0.7
US INTEREST RATE	D	2.2	2.6	2.9	3.0
EXCHANGE RATE ($/E)	%	12.9	12.5	12.6	12.9
OECD GDP	%	-2.5	-0.2	1.5	2.2
OECD INFLATION	%	-0.6	-1.7	-1.0	-0.1
OECD INTEREST RATE	D	-2.2	-2.4	-2.1	-1.7
LDC IMPORTS ($)	%	6.7	7.3	8.5	9.4
LDC IMPORTS ($)	$b	22.9	25.6	30.8	35.2
LDC IMPORTS (vol)	%	-2.5	-0.9	0.4	1.0
LDC EXPORTS ($)	%	6.9	7.8	9.4	10.7
LDC EXPORTS ($)	$b	22.0	25.5	31.8	37.4
LDC EXPORTS (vol)	%	-1.5	-0.3	0.9	1.5
LDC CA ($)	% OF US GDP	0.0	-0.4	-0.3	-0.3
LDC CA ($)	$b	-1.5	-14.1	-12.3	-10.1
LDC IN ON DEBT ($)	% OF US GDP	0.0	0.1	0.2	0.2
LDC IN ON DEBT ($)	$b	1.0	3.6	6.4	9.1
US CA ($)	% OF US GDP	0.9	0.5	0.5	0.7
US CA ($)	$b	32.8	18.7	20.8	26.2
LDC CAP GAIN ON DEBT ($)	% OF US GNP	0.0	0.3	0.2	0.1
LDC CAP GAIN ON DEBT ($)	$b	0.0	11.5	8.4	5.0
PRICE OF LDC EXPORTS IN $US	%	8.4	8.0	8.5	9.2
LDC TOT	%	-0.8	-0.1	0.4	0.7
OPEC TOT	%	-0.7	-0.1	0.3	0.5

$$(22) \qquad (A_U^O - A_O^P)_t / \Lambda_t^O = dI + \sigma[r_t^U - r_t^O - (\Lambda_{t+1}^O - \Lambda_t^O)/\Lambda_t^O] + \theta H_t^O$$

The magnitude of dI is selected so that the dollar depreciates by about 13 percent on impact. As expected, such a shift raises U.S. interest rates and reduces European interest rates, since the existing stocks of A_U^O, A_L^P and B^O must be willingly held by OECD residents, even after dollar assets lose some of their attractiveness. U.S. inflation rises, while OECD inflation falls, in view of the dollar depreciation. Given the presumed elasticities of trade flows, U.S. GDP rises, as the expansionary effect of the real exchange rate depreciation outweighs the contractionary effect of rising interest rates, while OECD GDP falls. As usual, we identify three effects on LDC welfare. First, the dollar depreciation raises the price of LDC exports and imports in terms of U.S. goods. Second, there is an ambiguous effect on the LDC terms of trade, since U.S. GDP rises, while OECD GDP falls. In fact, the LDC TOT worsens by 0.8 percent. Finally, U.S. real interest rates rise, raising the debt servicing burden on the developing countries. Note that (real) interest payments increase by a total of $11.0b in the first three years following the portfolio shift.

III. The Implications of Policy Coordination

In several recent papers (including Oudiz and Sachs, 1984a, and Oudiz and Sachs, 1984b), we have investigated the implications of policy coordination for macroeconomic equilibrium in a multi-country policy setting. One theme has emerged repeatedly. In a regime of floating exchange rates, and in an environment with high initial inflation, policymakers in each country have an incentive to choose a policy mix to strengthen their currency, thereby exporting inflation abroad. This strategic attempt may beggar the country's trading partners (by forcing them to import inflation), but even more importantly, it may leave all countries worse off than under alternative policies. The policy inefficiency arises because the mutual attempts to export inflation cancel out (at least partially), while the mechanisms by which the currency appreciation is attempted impose a direct cost. In particular, countries may be led to pursue overly restrictive monetary policies and overly expansionary fiscal policies, for exchange rate purposes. High interest rates will be a side effect of this non-cooperative process. We have shown that a cooperative equilibrium allows a more balanced (and presumably more desirable) policy mix.

Earlier work has called into question the quantitative importance of policy coordination (the qualitative importance may be established on theoretical grounds alone). In Oudiz and Sachs (1984a), we found in a three-country game that the gains to the U.S., Germany, and Japan are rather modest. This paper points out an aspect of the issue not previously remarked upon. Even if the gains within the developed country region are rather small, the LDCs may have a great deal at stake in successful coordination among the advanced countries. After all, the LDCs are large losers in any process which promotes high real interest rates, as does the adoption of a mix with expansionary fiscal and contractionary monetary policies. Since the move to coordination reduces real interest rates, the LDCs prove to be large beneficiaries in the process.

The analytical framework for studying policy coordination is complex, and a self-contained discussion would necessarily be lengthy. Here, we merely present some simulation results based on the techniques developed in our earlier papers. In particular, we postulate intertemporal policy objective functions, for the U.S. and the rest of the OECD, of the form:

$$(23) \qquad V^U = \sum_{t=0}^{\infty} \beta^t V(Q_t^U, \pi_t^{CU}, CA_t^U, DEF_t^U)$$

$$(24) \qquad V^O = \sum_{t=0}^{\infty} \beta^t V(Q_t^O, \pi_t^{CO}, CA_t^O, DEF_t^O)$$

Thus, welfare in each country depends on the time path of the output gap, inflation, current account deficit, and budget deficit. A quadratic form for V is selected. Specifically, we assume $\beta = (1/1.1)$ and the quadratic form for V that we select is $V = 0.5Q_t^2 + 1.0(\pi_t^C)^2 + 0.5CA_t^2 + 0.1DEF_t^2$. In the non-cooperative setting, U.S. policymakers select U.S. policies (M^U, G^U, T^U) to maximize V^U, subject to the policies selected by the OECD; while OECD authorities similarly select policies to maximize V^O, subject to the choices in the U.S. In the cooperative setting, a <u>single</u> policy controller chooses $(M^U, G^U, T^U, M^O, G^O, T^O)$ in order to maximize a weighted average of V^u and V^O, such as $\alpha V^U + (1-\alpha)V^O$. Let V^{UN} and V^{UC} be the U.S. utility levels reached in the non-cooperative and cooperative cases (similar definitions hold for V^{ON} and V^{OC}). Then, for appropriate choices of α, we show that coordination is welfare improving for both countries, i.e. $V^{UC} > V^{UN}$ and $V^{OC} > V^{ON}$. The specific numerical techniques for finding the equilibria are quite involved, requiring a repeated application of dynamic programming. Details may be found in Oudiz and Sachs (1984b).

We show in this section that non-cooperative policymakers with the objective functions in (23) and (24), choose a high interest rate strategy for disinflation with the goal of maintaining a strong currency. Under cooperation the same goals are reached with sharply reduced interest rates, to the benefit of the LDCs. The gain to the LDCs is, strictly speaking, a loss to the developed countries rather than a pure efficiency gain from cooperation. With lower interest rates, the LDCs pay less to their creditors in the U.S., OECD and OPEC, so that the real transfer burden is reduced.

Why would the policy authorities in the U.S. and OECD coordinate in such a way as to reduce the flow of real income from the LDCs? One reason is that real GDP, and not real income, enters their objectives in (23) and (24). The policy authorities are assumed not to care directly about the size of the real interest payments from the LDCs (they care insofar as those payments indirectly affect output, inflation, the current account, etc.). The effects of coordination on real interest rates are therefore incidental to the effects on output, inflation, and the other targets in the developed countries. We believe that this is an accurate reflection of the policy goals in the U.S. and the rest of the OECD. We have also tried including interest flows in the objective functions by using GNP rather than GDP as a target. The effect was to alter the quantitive results, with a modest reduction in the gains for the LDCs from coordination, although the qualitative results remained unchanged. The gains to the LDCs remain significant, it appears, because the effects of monetary and fiscal policies on output and inflation in the developed countries are far more important, in quantitive terms, than the effects of these policies on interest flows from the LDCs. For example a monetary contraction of 1%

reduces U.S. output by $40 billion while increasing interest payments from the LDCs by less than $2 billion. Thus monetary and fiscal policy seem to be geared primarily to output and inflation, as we assume, rather than to the size of interest transfers from the LDCs.

Thus we stress again that the gains to the LDCs from US-OECD coordination are, by and large not efficiency gains, but transfer gains, that result from policy shifts related to inflation and output in the developed countries. The high real interest rates of the last four years have been the side effects of a particular disinflation strategy, rather than an attempt to extract extra interest payments from the LDCs. Similarly, a reduction in real interest rates from greater coordination of policies would have a salutary, if unintended, effect on LDC welfare.

In Tables 17 and 18 we compare the non-cooperative and cooperative equilibria. As an illustration, we assume that both the U.S. and the OECD inherit a 10 percent inflation rate, and then pursue policies of disinflation. In the non-cooperative setting, both regions embark on a mix of sharp fiscal expansion and monetary contraction in the attempt of both to keep their currencies strong. The policy mix for the U.S. is shown in Figure 2. The monetary policy calls for a decrease of 12 percent in M^U in the first year of the disinflation, followed by a return to fast money growth two years later. Basically, this policy involves a large one-shot reduction in the path of M^U/P^U. Fiscal policy, on the other hand, is extremely expansionary, with the deficit rising briefly to 5 percent of GDP. A similar set of actions is undertaken abroad, though given the specific parameter assumptions of the model the overall

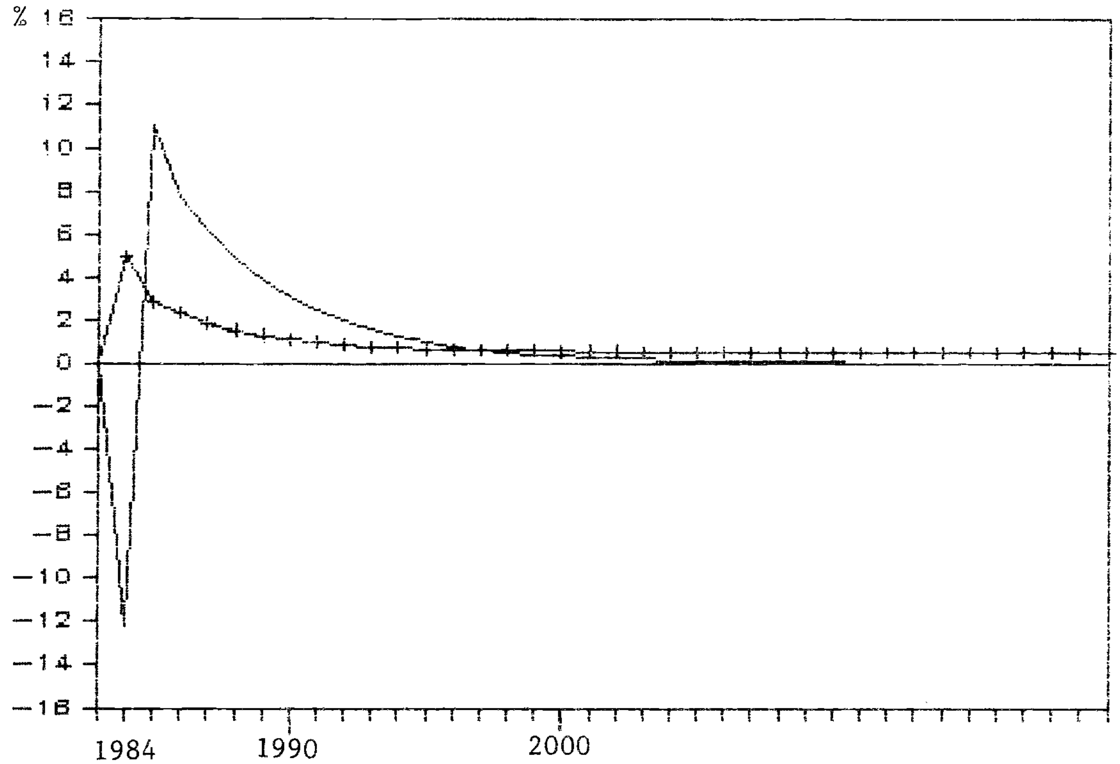
Table 17: Effects of Non-Cooperative Disinflation

		1984	1985	1986	1987
US GDP ($84)	%	-9.6	-7.7	-6.2	-5.0
US GDP ($84)	$b	-350.8	-288.9	-240.1	-200.1
US INFLATION	D	9.5	5.7	4.6	3.7
US INTEREST RATE	D	16.1	11.7	9.5	7.7
EXCHANGE RATE ($/E)	%	-5.5	-4.6	-3.2	-1.7
OECD GDP	%	-9.8	-7.0	-5.2	-3.8
OECD INFLATION	%	10.0	4.7	3.5	2.5
OECD INTEREST RATE	D	15.1	10.7	8.4	6.6
LDC IMPORTS ($)	%	-6.7	1.1	6.1	10.3
LDC IMPORTS ($)	$b	-23.0	3.7	22.0	38.3
LDC IEXPORTS (Vol)		-11.1	-9.2	-9.1	-9.0
LDC EXPORTS ($)	%	3.9	9.7	14.0	17.6
LDC EXPORTS ($)	$b	12.6	31.8	47.6	61.5
LDC EXPORTS (vol)	%	-0.2	-0.4	-0.7	-1.1
LDC CA ($)	% OF US GDP	-1.6	-0.8	-0.6	-0.4
LDC CA ($)	$b	-57.9	-31.8	-24.1	-17.8
LDC IN ON DEBT ($)	% OF US GDP	1.0	0.8	0.7	0.6
LDC IN ON DEBT ($)	$b	37.4	29.8	27.1	24.5
US CA ($)	% OF US GDP	-2.5	-1.7	-1.5	-1.4
US CA ($)	$b	-91.5	-65.3	-59.1	-54.0
LDC CAP GAIN ON DEBT ($)	% OF US GDP	1.6	0.9	0.7	0.6
LDC CAP GAIN ON DEBT ($)	$b	59.5	34.9	28.6	23.5
PRICE OF LDC EXPORTS IN $US	%	4.2	10.0	14.8	18.7
LDC TOT	%	-0.1	-0.2	-0.4	-0.5
OPEC TOT	%	-4.3	-3.3	-2.8	-2.4

Table 18: Effects of Cooperative Disinflation

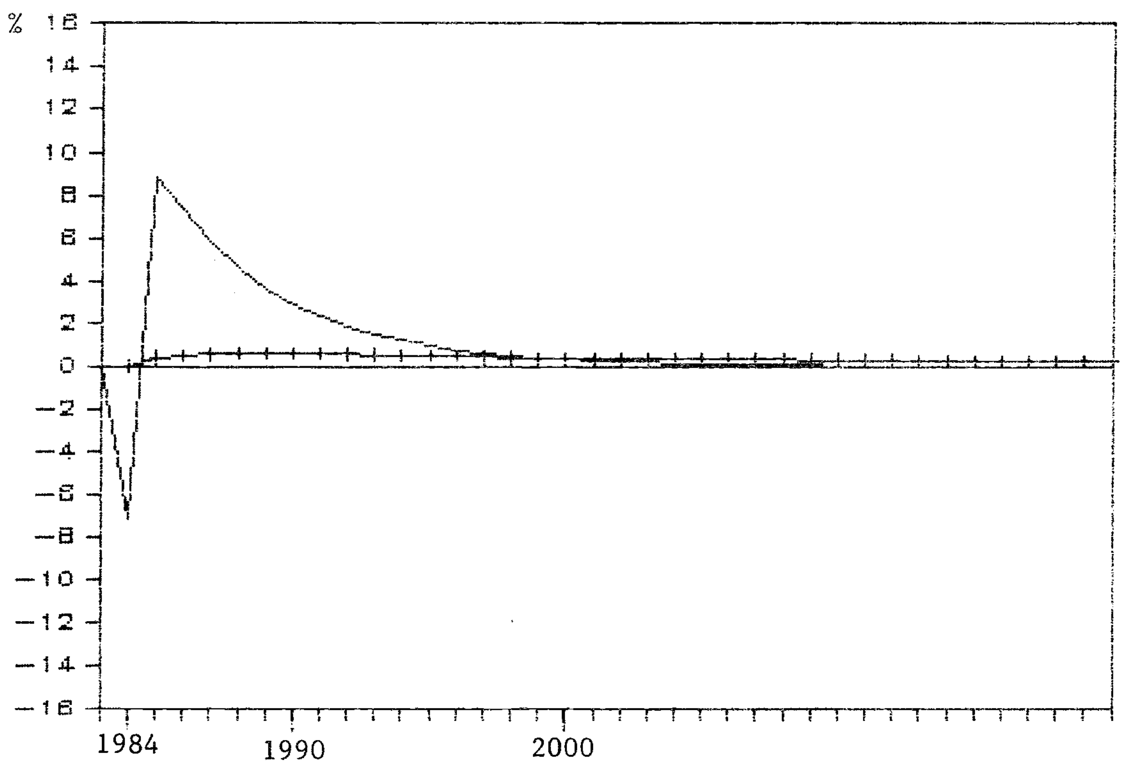
		1984	1985	1986	1987
US GDP ($84)	%	-9.7	-7.8	-6.2	-5.0
US GDP ($84)	$b	-353.7	-291.5	-241.6	-200.9
US INFLATION	D	9.6	5.7	4.6	3.7
US INTEREST RATE	D	10.4	8.6	6.9	5.6
EXCHANGE RATE ($/E)	%	-4.3	-3.3	-1.9	-0.3
OECD GDP	%	-9.9	-7.1	-5.2	-3.8
OECD INFLATION	%	10.0	4.5	3.4	2.4
OECD INTEREST RATE	D	9.3	6.8	4.7	3.1
LDC IMPORTS ($)	%	-3.6	3.5	8.6	12.8
LDC IMPORTS ($)	$b	-12.5	12.2	31.0	47.8
LDC IMPORTS (vol)	%	-8.8	-7.6	-7.5	-7.3
LDC EXPORTS ($)	%	1.1	8.4	13.3	17.2
LDC EXPORTS ($)	$b	3.6	27.7	45.0	60.1
LDC EXPORTS (vol)	%	-2.7	-1.8	-1.8	-1.9
LDC CA ($)	% OF US GDP	-1.6	-0.8	-0.6	-0.4
LDC CA ($)	$b	-56.9	-30.6	-22.8	-16.6
LDC IN ON DEBT ($)	% OF US GDP	0.5	0.4	0.4	0.3
LDC IN ON DEBT ($)	$b	16.9	15.9	14.0	12.3
US CA ($)	% OF US GDP	-1.9	-1.3	-1.2	-1.0
US CA ($)	$b	-69.4	-50.7	-45.7	-41.5
LDC CAP GAIN ON DEBT ($)	% OF US GDP	1.6	0.9	0.7	0.6
LDC CAP GAIN ON DEBT ($)	$b	59.5	35.0	28.8	23.6
PRICE OF LDC EXPORTS IN $US	%	3.8	10.2	15.1	19.1
LDC TOT	%	-1.3	-0.9	-0.9	-0.9
OPEC TOT	%	-3.8	-3.0	-2.5	-2.1

Figure 2: U.S. Macroeconomic Policy Under Non-Cooperative Disinflation



Money Growth ———— Fiscal Deficit (% of GDP) +—+—+—+

Figure 3: U.S. Macroeconomic Policy Under Cooperative Disinflation



Money Growth ———— Fiscal Deficit (% of GDP) +—+—+—+

mix yields a $ appreciation of 5.5 percent. The U.S. nominal interest rate rises to 21.1 percent in the first year of the disinflation. (Note that the table shows an interest rate increase of 16.1, which is the difference of 21.1 percent and the baseline 5 percent rate.)

Under a cooperative policy regime, in which the weighting of the U.S. in overall utility is 0.5 (with the OECD at 0.5), both the U.S. and OECD reach higher levels of intertemporal utility, with far less extreme policy mixes. In Figure 3, we show the optimal paths of U.S. monetary and fiscal policy in the cooperative regime. Now, the initial U.S. money contraction is 7 percent in the first year, with no initial fiscal expansion. Nominal interest rates in the U.S. rise to 15.4 percent, a high level, but far below the 21.1 percent level reached in the non-cooperative case. The dollar also appreciates by less, now 4.3 percent rather than 5.5 percent.

The effects of a move from non-cooperation to cooperation are significant for the LDCs. Comparing Tables 17 and 18, we find the LDC import volumes drop by 11.1 percent in the wake of non-cooperative disinflation, and by only 8.8 percent in the course of cooperative disinflation. LDC nominal interest payments on the external debt are almost $21b higher in 1984 in the case of non-cooperative disinflation. In the next section we offer a more careful accounting of the welfare effects of the shift to cooperation.

IV. Macroeconomic Policies in the U.S. and OECD, and LDC Economic Welfare

Standard trade theory prescribes a simple measure of the welfare effects of external shocks. Consider an initial path of LDC exports, imports, and foreign borrowing. When interest rates and trade prices change, we can ask how large an income transfer the LDCs would require to allow them to purchase the initial import basket, with unchanged levels of real exports and real foreign indebtedness. This income transfer measures the "compensating variation" that keeps the LDCs as well off as before the external changes.

In particular, we have the following equations:

(25) (a) $DEBT_{t+1} = (DEBT_t - CA^L_t)/(1+n)$

(b) $DEBT_t = A^U_{Lt} + A^P_{Lt} + A^O_{Lt} + B^U_{Lt} + B^O_{Lt}$

(c) $$CA^L_t = -r^U_t(A^U_L + A^P_L)_t - r^O_t(A^O_L)_t - v^U_t B^U_{Lt} - v^O B^O_{Lt} + \Lambda^L_t(C^U_{Lt} + C^O_{Lt} + C^P_{Lt}) - C^L_{Ut} - \Lambda^O C^L_{Ot} - \Lambda^P C^L_{Ot}$$

Now, suppose that the time path of $DEBT_t$ is unchanging, so that the path of CA^L_t is fixed. Consider the increased costs of purchasing the quantities C^L_{Ut}, C^L_{Ot} and C^L_{Pt}, for given real exports $C^U_{Lt} + C^O_{Lt} + C^P_{Lt}$, when r^U_t, r^O_t, v^U_t, v^O_t, Λ^L_t, Λ^O_t and Λ^P_t change. By differentiating (25)(c), we find $d\tau = dr^U_t(A^U_L + A^P_L)_t + dr^O_t(A^O_L)_t + dv^U_t(B^U_L)_t + dv^O_t(B^O_L)_t - d\Lambda^L_t(C^U_{Lt} + C^O_{Lt} + C^P_{Lt}) + d\Lambda^O_t C^L_{Ot} + d\Lambda^P_t C^L_{Pt}$ where $d\tau$ is the real transfer (in units of U.S. output) required to permit the LDC to purchase its original consumption basket. By re-arrangement we have:

(26) $$\begin{aligned} d\tau = {} & dr^U_t(A^U_L + A^P_L)_t + dr^O_t(A^O_L)_t + dv^U_t(B^U_L)_t + dv^O_t(B^O_L)_t \\ & - (d\Lambda^L_t/\Lambda^L_t)(\Lambda^L_t C^U_{Lt} + \Lambda^L_t C^O_{Lt} + \Lambda^L_t C^P_{Lt}) \\ & + (d\Lambda^O_t/\Lambda^O_t)[(\Lambda^O_t C^L_{Ot})/(C^L_{Ut} + \Lambda^O_t C^L_{Ot} + \Lambda^P_t C^L_{Pt})](C^L_{Ut} + \Lambda^O_t C^L_{Ot} + \Lambda^P_t C^L_{Pt}) \\ & + (d\Lambda^P_t/\Lambda^P_t)[(\Lambda^P_t C^L_{Pt})/(C^L_{Ut} + \Lambda^O_t C^L_{Ot} + \Lambda^P_t C^L_{Pt})](C^L_{Ut} + \Lambda^O_t C^L_{Ot} + \Lambda^P_t C^L_{Pt}) \end{aligned}$$

Note that $(\Lambda_t^O C_{Ot}^L)/(C_{Ut}^L+\Lambda_t^O C_{Ot}^L+\Lambda_t^P C_{Pt}^L)$ is the share of LDC imports from the OECD, or s_O^L. A similar expression can be found for the share of LDC imports from OPEC s_P^L. $[(d\Lambda_t^O/\Lambda_t^O)s_O^L + (d\Lambda_t^P/\Lambda_t^P)s_P^L]$ is the percentage change in the (real) import price index of the LDCs, that is in the price of imports deflated by U.S. prices. Let Λ_t^M be this real import price, with $d\Lambda_t^M/\Lambda_t^M = [(d\Lambda_t^O/\Lambda_t^O)s_O^L + (d\Lambda_t^O/\Lambda_t^P)s_P^L]$. Then, by one more rearrangement, we find:

$$(27) \qquad d\tau = dr_t^U(A_L^U+A_L^P)_t + dr_t^O A_{Lt}^O + dv_t^U B_{Lt}^U + dv_t^O B_{Lt}^O - (d\Lambda_t^L/\Lambda_t^L)TB_t^L + [(d\Lambda_t^M/\Lambda_t^M) - (d\Lambda_t^L/\Lambda_t^L)](C_{Ut}^L+\Lambda_t^O C_{Ot}^L+\Lambda_t^P C_{Pt}^L)$$

$$\text{where } TB_t^L = (\Lambda_t^L C_{Lt}^U+\Lambda_t^L C_{Lt}^O+\Lambda_t^L C_{Lt}^P) - (C_{Ut}^L+\Lambda_t^O C_{Ot}^L+\Lambda_t^P C_{Pt}^L)$$

From (27), we find that the required transfer (or compensating variation) has three components. First, when real interest rates rise, the transfers must increase by the change in real interest rates times the appropriate components of real debt. Second, when real export prices in terms of U.S. goods, Λ^L, increase, the transfer is <u>reduced</u> if the debtor country is running surpluses ($TB^L > 0$), and is <u>increased</u> if the debtor country is running deficits. Third, the transfer must be raised when the terms of trade deteriorates, i.e. $d\Lambda_t^M/\Lambda_t^M - d\Lambda_t^L/\Lambda_t^L > 0$, by the percentage of the terms-of-trade deterioration times the value of total imports. The total "loss" to the LDCs is measured by the sum of these three effects.

In Table 19, we provide some calculations of $d\tau$ (or total loss) for various policy changes. In order to make the calculations, we start with a baseline scenario given at the bottom of the table. In particular, we need values for TB_t^L, $(C_{Ut}^L+\Lambda_t^L C_{Ot}^L+\Lambda_t^P C_{PT}^L)$, and the components of $DEBT_t$, which are then

Table 19: Effects of External Shocks on LDC Utility

(1979 $b)

Shock	Year	Total Loss	Loss due to Change in Export Price	Loss due to Change in TOT	Loss due to Change in Interest Rate
U.S. Fiscal Expansion	1984	0.1	-0.2	-1.8	2.1
	1985	0.8	-0.2	-1.5	2.5
	1986	2.0	-0.2	-1.1	3.3
	1987	3.0	-0.2	-0.8	4.5
U.S. Monetary Contraction	1984	1.6	-0.1	-0.2	1.9
	1985	1.5	0.0	0.0	1.5
	1986	1.1	0.0	0.2	0.9
	1987	0.3	0.0	0.2	0.1
OECD Fiscal Expansion	1984	0.5	0.3	-0.5	0.7
	1985	1.5	0.3	-0.6	1.8
	1986	2.8	0.2	-0.6	3.1
	1987	4.4	0.2	-0.4	4.5
OECD Monetary Contraction	1984	1.1	0.0	0.9	0.2
	1985	0.5	0.0	0.4	0.2
	1986	-0.2	-0.1	0.0	-0.1
	1987	-0.9	0.0	-0.4	-0.5
Noncooperative -Cooperative	1984	16.4	0.0	-4.2	20.6
	1985	11.3	0.0	-2.5	13.8
	1986	11.0	0.0	-2.0	13.0
	1987	10.5	0.0	-1.6	12.1

Source: See text for method of decomposition. The baseline simulation assumes the following quantities (1984 $bill).

	Trade Balance	Imports	Net Debt
1984	-10.5	347.0	594.8
1985	-10.9	354.1	612.6
1986	-11.2	364.7	631.0
1987	-11.6	375.7	649.9

multiplied by the price and interest rate changes. For instance, we assume that LDC net debt rises from \$595b to \$650b (\$1984) between 1984 and 1987. The trade balance moves from -\$10.5b to -\$11.6b. The import bill rises from \$344b to \$376b.

According to the table, a U.S. fiscal expansion reduces LDC welfare by \$0.1b in the first year (i.e. requires a transfer of that amount as a compensating variation). First, Λ^L falls, and since the LDCs have $TB^L < 0$ along the baseline path, the result is a favorable "export price" effect of \$0.2b. In addition, the terms of trade improves, reducing the required transfer by \$1.8b. Finally, interest rates rise, with $dr_t^U D_t$ = \$2.1b in 1984. The net transfer required is therefore -\$0.2b - \$1.8b + \$2.1b = \$0.1b. Note that a U.S. monetary expansion, as opposed to fiscal expansion, would raise LDC welfare, since the dominating interest rate effect would be beneficial. As shown in the table, a U.S. monetary contraction is very harmful, in terms of interest rates initially, and subsequently also in terms of export prices and the terms of trade.

It is important to recognize that a U.S. fiscal expansion is more beneficial to the LDCs than an OECD fiscal expansion. This is despite the fact that LDC debt is \$ denominated, and the OECD fiscal expansion causes both a nominal and real dollar depreciation. In fact, as shown, an OECD fiscal expansion lowers LDC welfare by \$0.5b in the first year, whereas the same stimulus from the U.S. reduces LDC welfare by \$0.1b. The main differences are that the OECD expansion raises Λ^L while the U.S. expansion reduces it and the terms of trade of LDCs improves more under the U.S. fiscal expansion. Even though the OECD expansion has much less effect on the U.S. real interest rate than does the U.S. expansion, the terms of trade and export price effects dominate the utility loss.

An OECD monetary contraction has less of a negative effect on the LDCs because of the smaller effect on U.S. interest rates. The OECD decline in money causes the dollar to depreciate, and actually reduces U.S. real interest rates.

The final set of numbers refers to the LDC loss in utility from non-cooperative as opposed to cooperative policies between the U.S. and the OECD. As we have already shown, non-cooperation induces a policy stance of loose fiscal and tight monetary policies, and extremely high real and nominal interest rates. We saw in Tables 17 and 18 that r^U_{1984} is more than 5 percentage points higher in the non-cooperative regime. As seen in Table 19, this translates into a welfare loss of \$16.4b in 1984, falling to \$11.3b in 1985, and \$11b in 1986.

It is important to reconcile the utility measurements of Table 19 with an alternative view that holds the U.S. fiscal expansion to be beneficial to the LDCs, by raising LDC exports. The calculations of Table 19 measure the increased costs of imports plus debt servicing, due to changes in interest and prices, <u>for a given level of export volumes</u>. Implicit in the calculation is the assumption that changes in export <u>volumes</u> have no first-order utility effects. Thus, even though the rise in G^u stimulates LDC exports, that fact is given no weight in the welfare calculation.

According to the standard trade measurement, the price of exports measures the opportunity cost of exports, so that a \$1 increase in exports (at given prices) reduces the production of other goods (e.g. non-tradeables or leisure) by $1. Thus, changes in export volumes merely reflect a substitution of one output for another, at equal social value on the margin.

If the LDC economy is underemployed, however, the change in exports need not crowd out otherwise production (or leisure) of equal value. Indeed, if the lDC governments are other unable to stimulate their under-employed economies, and if the value of leisure is zero, then each $1 increase in export volumes might reflect a net increase of even more than $1 in welfare.

These considerations suggest a modified welfare measures such as $d\hat{\tau} = d\tau + \theta\Lambda^L d(C_L^O+C_L^U+C_L^P)$. Here θ represents the fraction at which the rise in export volumes is evaluated. We plan to explore measures such as $d\hat{\tau}$ in further work.

V. The Gains to a Coordinated Response to the 1979 OPEC Oil Shock

In this section we use the model to assess the potential gains to coordinating policies between the US and OECD in response to an OPEC price shock of the magnitude experienced in 1979. The model was recalibrated using data on trade shares and asset stocks for 1979. These new trade and asset matrices are given in Tables 20 and 21. Note that the ratio of OECD to US GDP is 1.88 in 1979 compared with 1.39 for 1983. Most of this difference is due to valuation effects of an appreciating dollar.

Table 20: Trade Shares 1979

($b 1979)

Exports from	Exports to U.S.	OECD	LDC	OPEC
U.S.	--	113.6 (.048)	51.6 (.022)	14.5 (.006)
OECD	110.7 (.046)	--	146.1 (.061)	60.6 (.025)
LDC	53.3 (.022)	119.9 (.050)	--	53.5 (.022)
OPEC	47.3 (.020)	118.8 (.050)	77.5 (.033)	--

Table 21: Ratio of Net Asset Holdings to U.S. GDP

(End of 1978)

	Claim held by				
	US		OECD		OPEC
Claim on	private	official	private	official	
US private	-	-	.049	-	.046
US official	.21	-	-	-	-
OECD private	-	-	-	-	.026
OECD official	-	-	.395	-	-
OPEC	-	-	-	-	-
LDCs	.032	.039	.006	.016	.015

We assume that the U.S. inherits an inflation rate of 9.8% and the OECD inherits an inflation rate of 8%. The model is shocked with a rise in the price of OPEC exports of 94% in 1979 (this is the change in the real U.S. price of

Saudi Oil between 1979(1) and 1980(1) given in IFS Statistics). The objective of the US and OECD governments is to reduce inflation and the output gap to zero as set out in the section III.

In Tables 22 and 23 we compare the non-cooperative and cooperative equilibria. Of course, these comparisons depend on a particular assumed utility function in each country, and so they are not, strictly speaking, historical simulations. In fact, the utility functions are probably a bit too anti-inflationary in their implications to mimic the actual policies that were undertaken. Nonetheless, we believe that the results give at least an order of magnitude of the results to be achieved through more active policy coordination. Notice that in this section all results are in constant $1979.

As we found above, the optimal policy mix in both regions in response to an inflationary impulse is a sharp monetary contraction and a fiscal expansion to offset the output decline. The policy mix for the U.S. is shown in Figure 4. M^U is cut by 18% in 1979 followed by a return to faster monetary growth by 1981. Fiscal policy is extremely expansionary with the deficit rising by 7.5% of GDP. The mix in the OECD is less extreme with a monetary contraction of 15% and a fiscal expansion of 3.5% of OECD GDP (or 6.3% of US GDP). Given the assumed parameters the dollar exchange rate appreciates 11% in 1979. The U.S. nominal interest rate rises to 25.8% in 1979 (short-term rates in fact rose above 20 percent in 1980 in the U.S. but not to 25%).

Under a regime of cooperation, with the U.S. and OECD receiving equal weight in overall utility, both the U.S. and the OECD reach higher levels of intertemporal utility. In Figure 5 we show the optimal paths of U.S. monetary

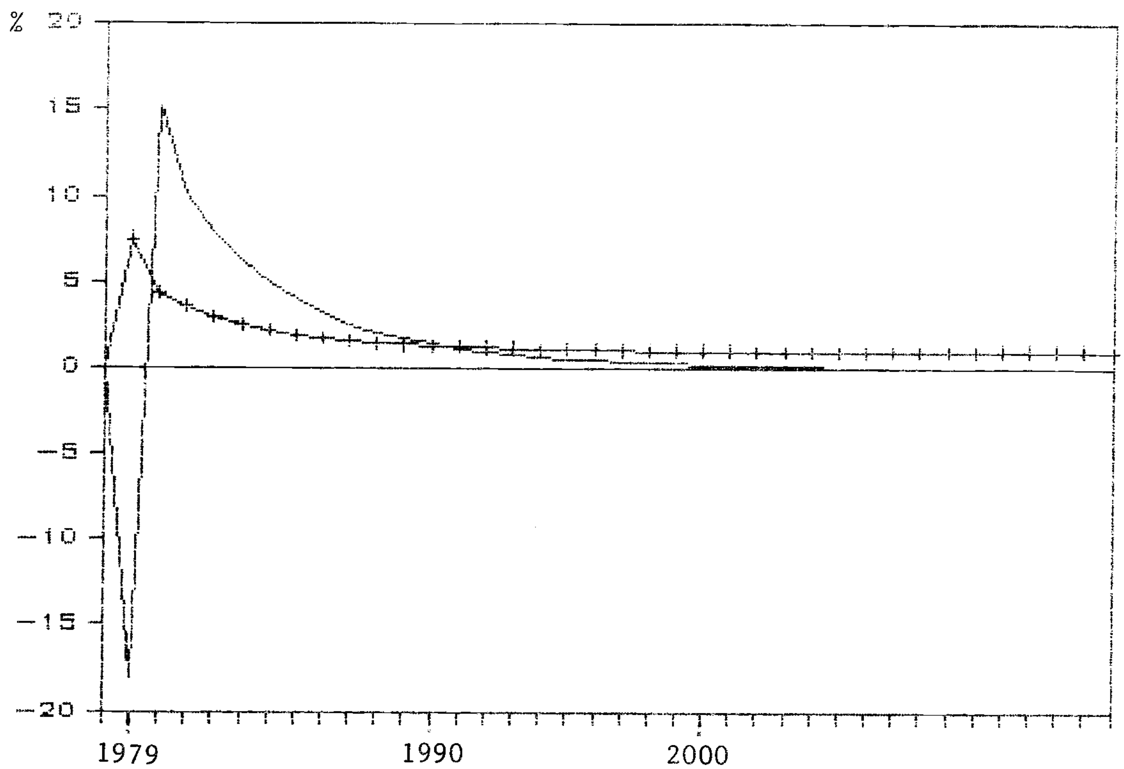
Table 22: Effects of Non-Cooperative Response to OPEC Shock

		1979	1980	1981	1982
US GDP ($79)	%	-11.5	-9.2	-7.5	-6.1
US GDP ($79)	$b	-274.0	-226.0	-188.9	-158.4
US INFLATION	D	12.4	7.6	6.1	4.9
US INTEREST RATE	D	20.8	14.4	11.7	9.6
EXCHANGE RATE ($/E)	%	-11.0	-7.1	-2.7	1.8
OECD GDP	%	-10.5	-6.9	-4.7	-3.2
OECD INFLATION	%	12.5	4.4	3.0	2.0
OECD INTEREST RATE	D	16.1	9.7	7.0	5.2
LDC IMPORTS ($)	%	-2.8	8.4	17.8	26.0
LDC IMPORTS ($)	$b	-8.0	24.7	54.3	81.8
LDC IMPORTS (vol)	%	-19.8	-17.4	-15.6	-13.8
LDC EXPORTS ($)	%	1.9	11.9	21.5	29.9
LDC EXPORTS ($)	$b	4.3	27.7	51.8	74.1
LDC EXPORTS (vol)	%	-10.1	-9.3	-7.9	-6.7
LDC CA ($)	% OF US GDP	-1.0	-0.8	-0.6	-0.5
LDC CA ($)	$b	-24.5	-19.4	-15.8	-13.3
LDC IN ON DEBT ($)	% OF US GDP	0.8	0.6	0.5	0.4
LDC IN ON DEBT ($)	$b	18.3	13.6	12.5	11.6
US CA ($)	% OF US GDP	-3.2	-2.7	-2.4	-2.1
US CA ($)	$b	-75.1	-66.8	-61.1	-55.7
LDC CAP GAIN ON DEBT ($)	% OF US GDP	1.1	0.8	0.7	0.5
LDC CAP GAIN ON DEBT ($)	$b	25.2	20.6	16.8	13.9
PRICE OF LDC EXPORTS IN $US	%	12.0	21.1	29.5	36.6
LDC TOT	%	-5.0	-4.6	-4.0	-3.3
OPEC TOT	%	49.1	50.3	51.1	51.7

Table 23: Effects of Cooperative Response to OPEC Shock

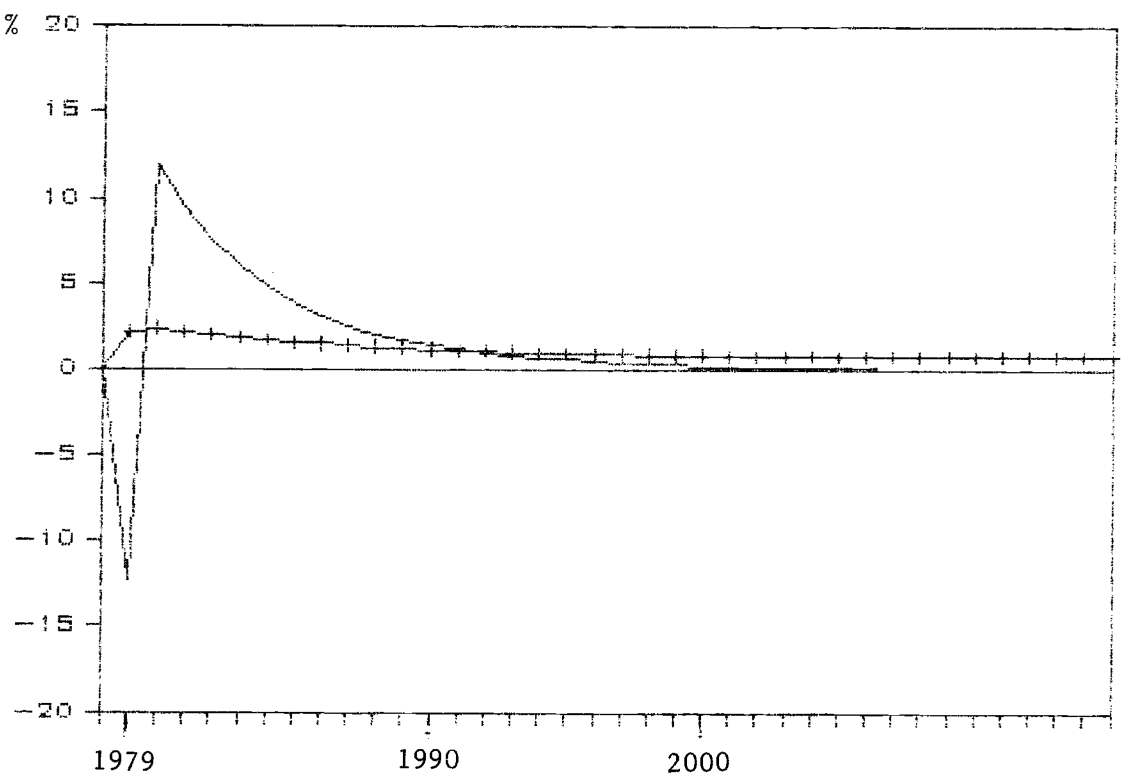
		1979	1980	1981	1982
US GDP ($79)	%	-11.5	-9.3	-7.5	-6.1
US GDP ($79)	$b	-274.6	-227.0	-189.5	-158.7
US INFLATION	D	12.5	7.6	6.1	5.0
US INTEREST RATE	D	14.2	11.7	9.6	8.0
EXCHANGE RATE ($/E)	%	-9.5	-5.6	-1.0	3.7
OECD GDP	%	-10.6	-7.0	-4.7	-3.2
OECD INFLATION	%	12.4	4.3	2.9	1.9
OECD INTEREST RATE	D	9.9	6.3	3.9	2.3
LDC IMPORTS ($)	%	-0.7	10.0	19.7	28.0
LDC IMPORTS ($)	$b	-2.1	29.6	59.9	88.1
LDC IMPORTS (vol)	%	-18.8	-16.8	-14.9	-13.1
LDC EXPORTS ($)	%	0.5	11.9	22.0	30.7
LDC EXPORTS ($)	$b	1.2	27.7	52.9	76.1
LDC EXPORTS (vol)	%	-11.7	-10.0	-8.4	-6.9
LDC CA ($)	% OF US GDP	-1.0	-0.8	-0.6	-0.5
LDC CA ($)	$b	-24.2	-19.4	-15.7	-13.4
LDC IN ON DEBT ($)	% OF US GDP	0.4	0.3	0.3	0.3
LDC IN ON DEBT ($)	$b	9.0	8.5	7.8	7.3
US CA ($)	% OF US GDP	-2.6	-2.4	-2.1	-1.9
US CA ($)	$b	-62.9	-59.6	-54.1	-48.7
LDC CAP GAIN ON DEBT ($)	% OF US GDP	1.1	0.8	0.7	0.5
LDC CAP GAIN ON DEBT ($)	$b	25.2	20.8	17.0	14.0
PRICE OF LDC EXPORTS IN $US	%	12.2	21.8	30.4	37.6
LDC TOT	%	-5.9	-5.0	-4.2	-3.5
OPEC TOT	%	49.3	50.4	51.2	51.8

Figure 4: U.S. Macroeconomic Policy Under Non-Coordinated Response to OPEC Price Shock



Money Growth ———————— Fiscal Deficit (% of GDP) +—+—+—+—

Figure 5: U.S. Macroeconomic Policy Under Coordinated Response to OPEC Price Shock



Money Growth ———————— Fiscal Deficit (% of GDP) +—+—+—+—

and fiscal policy. The monetary contraction in the U.S. is cut by a third of what it was under non-cooperation. Also the fiscal expansion is now only 2.2% of U.S. GDP compared to 7.5% under noncooperation. Nominal interest rates in the U.S. rise to 19.2% which is still a large rise but more than 6% less than under non-cooperation. The dollar appreciation is also reduced to 9.5%.

Again we find a large gain for the LDCs from the move to cooperation between the US and OECD. Cooperation reduces the loss in LDC real imports by 1% although it worsens the LDC terms of trade. The big gain for the LDCs is again through the effects of lower interest rates and a less appreciated dollar on debt repayments. In 1979 alone, cooperation would save the LDCs $9.3b in interest repayments. The utility calculations that we developed in section IV can again be used to measure the overall gain for the LDCs. Consider the measure of gain to cooperation given in Table 24:

Table 24: Gains Due to Cooperation

(1979 $b)

		Gain due to		
Year	Total Gain	Export Price	TOT	Interest Rate
1979	6.9	-0.1	-2.3	9.3
1980	3.7	-0.3	-1.0	5.1
1981	3.5	-0.4	-0.7	4.7
1982	3.2	-0.5	-0.5	4.2

The baseline simulation assumes the following quantities (1979 $b):

Trade Balance	Imports	Net Debt
-52.9	287.4	257
-54.5	296.0	265
-56.1	304.9	273
-57.8	314.1	281

VI. Impact of a Change in the U.S Fiscal/Monetary Mix

In this section we examine the implications of a shift in U.S. policy towards smaller fiscal deficits and more expansionary monetary policy commencing in 1984. We consider two cases. The first is a sustained cut in U.S. fiscal deficits of 2% of U.S GDP per year brought about by a cut in real spending. M^U is increased by a sustained 1.7% to offset the contractionary effect of the fiscal stance on real output (in the first year). The second simulation is a gradual reduction of fiscal deficits of 1% of U.S. GDP in 1984 and 2% in 1985 brought about by a cut in spending. We again choose a path for monetary policy which offsets the initial impact of the fiscal policy on real output. All results are presented as deviation from our assumed base path.

- Sustained Change in the U.S. Fiscal Monetary Mix

The results for the sustained 2% (of U.S. GDP) cut in U.S. fiscal deficits accompanied by a relaxation of monetary policy are shown in Table 25. These results are presented as deviations from a baseline simulation. Our approximation for monetary accomodation is simply a one step rise in the path of M^U, that approximately offsets the fiscal contraction in the first year.

U.S. GDP rises slightly in 1984 but declines in subsequent periods because monetary policy is not sufficiently expansionary in later years to offset the contraction induced by fiscal policy. The change in policy mix has the expected effect on the US interest rate, which falls by 1.8 percentage points in 1984 and continues to fall thereafter. By 1990 the reduction is 2.9% in the nominal interest rate and 2.5% in the real rate. The U.S. current account improves by $31.3b in 1984 and remains improved. The U.S. dollar depreciates by 8.1% in

Table 25: Effects of a U.S. Fiscal Contraction and Monetary Expansion

		1984	1985	1986	1987
US GDP ($84)	%	0.2	-0.8	-1.1	-1.1
US GDP ($84)	$b	5.5	-28.3	-44.0	-43.6
US INFLATION	D	0.5	0.5	0.1	-0.2
US INTEREST RATE	D	-1.8	-1.9	-2.1	-2.3
EXCHANGE RATE ($/E)	%	8.1	8.0	8.2	8.3
OECD GDP	%	-1.8	-0.4	0.8	1.5
OECD INFLATION	%	-0.4	-1.3	-1.0	-0.4
OECD INTEREST RATE	D	-1.6	-1.9	-2.0	-1.9
LDC IMPORTS ($)	%	4.4	4.7	5.4	6.1
LDC IMPORTS ($)	$b	15.0	16.4	19.6	22.7
LDC IMPORTS (vol)	%	-1.2	-0.2	0.9	1.7
LDC EXPORTS ($)	%	2.1	2.3	2.9	3.4
LDC EXPORTS ($)	$b	6.8	7.7	10.0	11.8
LDC EXPORTS (vol)	%	-2.3	-1.7	-1.0	-0.7
LDC CA ($)	% OF US GDP	0.0	-0.1	0.0	0.0
LDC CA ($)	$b	-0.2	-4.0	-1.5	0.3
LDC IN ON DEBT ($)	% OF US GDP	-0.2	-0.2	-0.2	-0.2
LDC IN ON DEBT ($)	$b	-7.4	-7.5	-7.9	-8.8
US CA ($)	% OF US GDP	0.9	0.7	0.8	1.0
US CA ($)	$b	31.3	27.9	32.5	38.4
LDC CAP GAIN ON DEBT ($)	% OF US GDP	0.0	0.1	0.0	0.0
LDC CAP GAIN ON DEBT ($)	$b	0.0	3.6	0.8	-1.5
PRICE OF LDC EXPORTS IN $US	%	4.4	4.0	4.0	4.0
LDC TOT	%	-1.2	-0.8	-0.5	-0.3
OPEC TOT	%	-0.4	0.0	0.4	0.6

1984 and stays weaker than in the base simulation. Because of the dollar depreciation, inflation rises by a half percentage point in 1984 and 1985.

Consider the impact on the rest of the world. As expected the U.S. policy has a beggar thy neighbour impact on the OECD. OECD GDP falls by 1.8% in 1984 due to the appreciation of the ECU. The OECD recession is short-lived though, as falling world interest rates stimulate OECD domestic demand. OECD inflation is also reduced by .4% in 1984. From 1986 the OECD is in a position of lower inflation and higher output than under the base path.

The gains to the LDCs are more immediate. The depreciation of the dollar and lower interest rates reduces the burden of the debt. This is offset by a deterioration in the terms of trade due to the initial contraction in OECD demand for LDC goods. In Table 26 we calculate the gain in LDC utility using the technique discussed in section IV.

Table 26: Gains Due to Change in U.S. Policy Mix

(1984 $b)

		Gain due to		
Year	Total Gain	Export Price	TOT	Interest Rates
1984	2.9	-0.5	-4.0	7.4
1985	4.2	-0.4	-3.0	7.5
1986	5.8	-0.4	-1.9	8.0
1987	7.3	-0.4	-1.2	9.0

As this table illustrates the LDC gains increase over time as interest rates continue to fall and the LDC terms of trade improve. Thus, even though the U.S. GDP growth is reduced, the LDCs benefit according to our welfare criteria.

• Gradual change in the US Fiscal/Monetary Mix

The second U.S. policy switch that we consider consists of a 1% (of U.S. GDP) reduction in the real fiscal deficit in 1984 and a 2% cut from 1985 onwards (with a corresponding cut in real spending). We also assume a monetary path which dampens the contractionary effect of fiscal policy on real output. In this case we assume no change in M^U relative to baseline in 1984 and a rise of 2%, 3%, 5.3%, 6.1%, 6.8% and 7.0% with 7% maintained relative to baseline in all subsequent years from 1990. The results are shown in Table 27.

It is interesting to note that despite the fiscal cut and no change in monetary policy in 1984, U.S. GDP rises in 1984. This is the result of the forward looking behaviour in the model. Agents are aware of the future fiscal contraction and monetary expansion. The future exchange rate depreciation is brought into the present by a shift out of dollars into ECU in anticipation of the depreciation of the dollar. The effect of the large U.S. depreciation on stimulating foreign demand for U.S. goods is larger than the direct effect of the fiscal contraction. This seems to occur because part of the exchange rate change reflects anticipated spending changes which do not appear until 1985. The larger depreciation is reflected in higher U.S. inflation. Interest rates also rise by .6% initially due to the increase in inflation, but quickly decline from 1985 as the anticipated fiscal cut occurs. The U.S. current account improves in 1984 and continues to improve. The initial gain in U.S. GDP from the higher exchange rate depeciation is reflected in a larger initial loss in OECD GDP. Again it is only 2 years before OECD GDP has returned to its base path level.

Table 27: Gradual U.S. Fiscal Contraction/Monetary Expansion

		1984	1985	1986	1987
US GDP ($84)	%	0.6	0.4	-0.5	-1.0
US GDP ($84)	$b	23.0	13.7	-20.2	-40.5
US INFLATION	D	0.7	1.0	1.0	0.7
US INTEREST RATE	D	0.6	-0.8	-2.1	-3.8
EXCHANGE RATE ($/E)	%	11.2	13.9	16.3	18.1
OECD GDP	%	-2.4	-1.1	0.5	1.8
OECD INFLATION	%	-0.5	-1.8	-1.7	-1.1
OECD INTEREST RATE	D	-2.1	-3.0	-3.5	-3.6
LDC IMPORTS ($)	%	5.4	8.0	10.7	13.3
LDC IMPORTS ($)	$b	18.5	28.0	38.7	49.8
LDC IMPORTS (vol)	%	-2.4	-1.0	0.7	2.5
LDC EXPORTS ($)	%	4.9	5.8	7.1	8.1
LDC EXPORTS ($)	$b	15.7	19.1	24.2	28.4
LDC EXPORTS (vol)	%	-2.0	-2.1	-1.9	-1.8
LDC CA ($)	% OF US GDP	0.0	-0.2	-0.2	-0.2
LDC CA ($)	$b	-0.9	-7.8	-8.9	-7.9
LDC IN ON DEBT ($)	% OF US GDP	-0.0	-0.2	-0.3	-0.4
LDC IN ON DEBT ($)	$b	-1.5	-6.4	-11.0	-17.0
US CA ($)	% OF US GDP	0.9	1.1	1.4	1.7
US CA ($)	$b	34.6	40.3	52.4	67.2
LDC CAP GAIN ON DEBT ($)	% OF US GDP	0.0	0.2	0.2	0.1
LDC CAP GAIN ON DEBT ($)	$b	0.0	6.1	6.4	4.7
PRICE OF LDC EXPORTS IN $US	%	6.9	7.9	9.0	9.9
LDC TOT	%	-1.0	-1.0	-0.9	-0.9
OPEC TOT	%	-0.7	-0.2	0.4	0.9

In this case, the LDC terms of trade deterioration exceeds the interest rate effect in the first year of the policy change, so that LDC welfare in 1984 actually falls. However, from 1985 onward, the large benefits from lower U.S. interest rates are then realized. The calculations of LDC welfare are presented in Table 28.

Table 28: Gains to LDCs Due to a Change in U.S. Policy Mix

(1984 $b)

		Gain due to		
Year	Total Gain	Export Price	TOT	Interest Rates
1984	-2.6	-0.7	-3.4	1.5
1985	2.1	-0.8	-3.7	6.5
1986	7.0	-0.8	-3.4	11.2
1987	13.2	-0.8	-3.4	17.4

As can be seen from the results of this section the effects of the change in U.S. fiscal/monetary mix depend importantly on the timing of the policy changes. An anticipated reduction in future fiscal deficits can initially reduce OECD and LDC welfare through the effect on the current exchange rate. However, the gains to the LDCs from lower world interest rates emerge quickly.

VII. Conclusion

We have produced a small-scale model of LDC-OECD macroeconomic interactions, that highlights the importance of OECD macroeconomic policies for the external trade and financing of developing countries. The model allows us to distinguish the effects of monetary versus fiscal policies, as well as policies in the U.S. versus the rest of the OECD. The key stock-flow relationships are carefully observed, and expectations in the asset markets are rational.

Given the objectives of macroeconomic policy that we specify, we highlight an aspect of the gains to coordinating policies between the U.S. and the rest of the OECD not previously remarked upon. That is the substantial gains to the less developed countries which can emerge from coordination among the developed countries. We have shown that in inflationary periods, non-cooperative policies in the developed countries lead to high world interest rates which may be reduced, to the benefit of the LDCs, by successful coordination.

The analysis in this paper can be usefully extended in several directions. In future work we plan to estimate more of the structural equations although we feel that the parameters we choose in this paper represent a broad consensus of other econometric results. It is also important to examine the sensitivity of the results to changes in these parameters. Another useful extension would be to model the internal structure of the LDCs and to get a measure of the welfare effects of various policies for individual countries within the LDCs. The welfare measure that we developed in this paper could be modified to allow for the presence of unemployed factors in the LDCs.

Appendix

Policy Multipliers from the DRI, MCM and EPA Models

Tables A1-A9 outline the multipliers for monetary and fiscal policy in the DRI (Data Resources, Inc.), MCM (Federal Reserve Board Multicountry) and EPA (Japanese Economic Planning Agency) models. These provide a useful benchmark for comparison with the multipliers presented in Tables 12 and 13 in the text.

1. Fiscal Multipliers

The multipliers for fiscal policy are shown in Tables A1 to A4. The impact multipliers for GNP in these models range from 1.2 to 2.0 with the three year average multiplier ranging from .83 to 1.9. These compare with an impact multiplier of .8 and a three year average multiplier of .87 in our model. The smaller multiplier we find is not surprising given the importance of portfolio adjustments and greater flexibility of the exchange rate in our model. The exchange rate appreciation of 3.5% in our model is substantially greater than in the larger models and is partly reflected in a larger decline in the U.S. current account. The responses of other variables to a fiscal expansion are broadly consistent with those found in the larger models.

2. Monetary Multipliers

The monetary policy multipliers are outlined in Tables A5-A9. A monetary stimulus has a smaller impact effect on GNP in the larger models than we find. These is also a wide divergence of results in the larger models for the monetary shocks although the shocks are only approximately consistent across models. In DRI a monetary stimulus changes GNP by twice the amount found in the MCM and EPA models, with impact multipliers of .8, .3, and .4 respectively compared with 1.1 in our model. The three year average multipliers for GNP are .4 in EPA, .8 in DRI and .6 in MCM which compares with .7 in our model. A monetary expansion (contraction) also stimulates (dampens) GNP for a longer period in the larger models with interest rates remaining below (above) the base path for a longer period.

Table A1: Fiscal Policy Multipliers for the MCM Model

Fiscal Policy: Sustained increase in govt spending = 1% GNP(77:1)

Variable		1977	1978	1979
US GNP ($72)	%	1.5	.9	.1
US GNP ($72)	$bl	20.6	13.0	1.5
US CPI	%	.0	.3	.6
US INTEREST RATE	D	.7	1.9	2.0
EXCHANGE RATE($/E)	%	-.3	-.9	-.4
US TRADE BAL	$bl	-4.5	-4.1	-.4
US TB/GNP	%	-.2	-.2	.0
US CURRENT A/C BAL	$bl	-5.2	-6.9	-3.7
US CA/GNP	%	-.3	-.3	-.2

Table A2: Fiscal Policy Multipliers for the EPA Model

Fiscal Policy: Sustained increase in govt spending = 1% GNP(76:1)

Variable		1976	1977	1978
US GNP ($72)	%	2.0	2.0	1.8
US GNP ($72)	$bl	26.1	27.8	26.5
US CPI	%	.6	1.4	2.1
US INTEREST RATE	D	1.0	1.4	1.7
EXCHANGE RATE($/E)	%	-.6	-.7	-.3
US TRADE BAL	$bl	-2.1	-5.5	-6.4
US TB/GNP	%	-.1	-.2	-.3
US CURRENT A/C BAL	$bl	-1.5	-4.5	-5.1
US CA/GNP	%	-.1	-.2	-.2

Table A3: Fiscal Policy Multipliers for the DRI Model

Fiscal Policy: Sustained increase in govt spending = 1% GNP(84:1)
M1 accommodating

Variable		1984	1985	1986
US GNP ($72)	%	1.4	1.5	1.5
US GNP ($72)	$bl	21.9	25.7	25.4
US CPI	%	.2	.5	.8
US INTEREST RATE	D	.3	.4	.6
EXCHANGE RATE($/E)	%	-.2	-.4	-.6
US TRADE BAL	$bl	-1.7	-3.7	-5.0
US TB/GNP	%	.0	-.1	-.1
US CURRENT A/C BAL	$bl	-1.6	-3.5	-4.9
US CA/GNP	%	.0	-.1	-.1
M1	%	.5	.8	1.0
M3	%	.0	.0	.0

Table A4: Fiscal Policy Multipliers for the DRI Model

Fiscal Policy: Sustained increase in govt spending = 1% GNP(84:1)
M1 non-accommodating

Variable		1984	1985	1986
US GNP ($72)	%	1.2	1.0	.7
US GNP ($72)	$bl	19.4	16.7	12.0
US CPI	%	.1	.3	.4
US INTEREST RATE	D	1.1	1.3	1.7
EXCHANGE RATE($/E)	%	-.8	-2.0	-3.5
US TRADE BAL	$bl	-.9	-1.8	-2.9
US TB/GNP	%	.0	.0	.0
US CURRENT A/C BAL	$bl	-.7	-1.5	-2.7
US CA/GNP	%	.0	.0	.0
M1	%	.0	.0	.0
M3	%	-.6	-1.3	-1.9

Table A5: Monetary Policy Multipliers for the MCM Model

Monetary Policy: Sustained 200 point decrease in US Discount Rate

Variable		1977	1978	1979
US GNP ($72)	%	.3	.8	.7
US GNP ($72)	$bl	4.1	11.5	10.4
US CPI	%	.1	.2	.4
US INTEREST RATE	D	-1.2	-.9	-.6
EXCHANGE RATE($/E)	%	1.0	1.1	1.0
US TRADE BAL	$bl	-.8	-2.2	-1.8
US TB/GNP	%	.0	-.1	-.1
US CURRENT A/C BAL	$bl	.4	-1.0	-1.4
US CA/GNP	%	.0	.0	-.1

Table A6: Monetary Policy Multipliers for the EPA Model

Monetary Policy: Sustained 200 point increase in US Discount Rate

Variable		1976	1977	1978
US GNP ($72)	%	-.3	-.4	-.3
US GNP ($72)	$bl	-3.4	-5.9	-4.2
US CPI	%	-.1	-.3	-.4
US INTEREST RATE	D	.5	.2	.2
EXCHANGE RATE($/E)	%	-.7	-1.0	-1.2
US TRADE BAL	$bl	.2	.5	.0
US TB/GNP	%	.0	.0	.0
US CURRENT A/C BAL	$bl	.5	.7	.2
US CA/GNP	%	.0	.0	.0

Table A7: Monetary Policy Multipliers for the EPA Model

Monetary Policy: Sustained 1% fall in M1

Variable		1976	1977	1978
US GNP ($72)	%	-.4	-.4	-.3
US GNP ($72)	$bl	-5.2	-5.9	-4.2
US CPI	%	-.1	-.3	-.4
US INTEREST RATE	D	.6	.2	.2
EXCHANGE RATE($/E)	%	-.9	-1.2	-1.2
US TRADE BAL	$bl	.3	.6	-.2
US TB/GNP	%	.0	.0	.0
US CURRENT A/C BAL	$bl	.5	.7	.1
US CA/GNP	%	.0	.0	.0

Table A8: Monetary Policy Multipliers for the DRI Model

Monetary Policy: Sustained 200 point decrease in US Discount Rate

Variable		1984	1985	1986
US GNP ($72)	%	.1	.3	.3
US GNP ($72)	$bl	1.9	5.3	5.2
US CPI	%	.0	.1	.2
US INTEREST RATE	D	-.4	-.2	.0
EXCHANGE RATE($/E)	%	.3	.5	.6
US TRADE BAL	$bl	-.4	-.9	-1.0
US TB/GNP	%	.0	.0	.0
US CURRENT A/C BAL	$bl	-.5	-.9	-.9
US CA/GNP	%	.0	.0	.0
M1	%	.2	.2	.2

Table A9: Monetary Policy Multipliers for the DRI Model

Monetary Policy: Sustained 1% rise in M1

Variable		1976	1977	1978
US GNP ($72)	%	.8	1.0	.7
US GNP ($72)	$bl	12.8	16.4	12.1
US CPI	%	.1	.4	.6
US INTEREST RATE	D	-1.9	-.7	-.7
EXCHANGE RATE($/E)	%	1.9	2.7	3.6
US TRADE BAL	$bl	-2.6	-2.4	-1.4
US TB/GNP	%	-.1	.0	.0
US CURRENT A/C BAL	$bl	-3.0	-2.4	-1.4
US CA/GNP	%	-.1	.0	.0

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