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Fiscal Policy, the Real Exchange Rate and Commodity Prices

Prepared by Carmen M. Reinhart \*

Authorized for Distribution by Peter Wickham

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Abstract

The role of the international commodity market in transmitting disturbances is considered in a model that incorporates commodities as an input in production. The analysis employs a three-country framework: a liquidity-constrained commodity supplier and two industrial countries that import the commodity, export differentiated manufactured goods and hold the outstanding debt of the commodity exporter. In this setting the impact of changes in fiscal policy, commodity supplies, and the real interest rate are assessed. Particular attention is paid to the responses of the real exchange rate, commodity prices, and the international distribution of debt to the various shocks.

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## I. Introduction

In the 1980s marked changes in the fiscal deficits of industrial countries were accompanied by sharp swings in key relative prices, including real exchange rates and real commodity prices. These developments, as well as the debt crisis, stimulated a reassessment of the role of fiscal policy, particularly in multi-country settings, and led many economists to revisit the Mundell-Fleming two-country model (Mundell (1968)). Frenkel and Razin (1984), for example, incorporated an intertemporal dimension by modeling the consumer choice problem with infinitely-lived households. They examined the linkage between fiscal policy and the real rate of interest, and assessed the international transmission mechanism of fiscal policies in a short-run framework that took output levels as given. Subsequently, Frenkel and Razin (1986) reexamined these issues in a setting where individuals face an uncertain lifetime. Buiter (1986) and Giovannini (1988) extended this framework to incorporate capital accumulation, thus endogenizing output levels. <sup>1/</sup> Obstfeld (1989), enriched the analysis by dropping the assumption of complete specialization that characterized these models and by introducing the production of labor-intensive nontradable goods. The common objective of the latter group of growth models was to illustrate how changes in fiscal policy affect relative prices and resource allocation both domestically and internationally.

In Frenkel and Razin (1984 and 1986), as in the earlier work by Mundell, the channel for the international transmission of fiscal policy is via demand, as output supplies are exogenously given. In the growth models, the international transmission of fiscal disturbances also works through the supply side, via its impact on factor markets. All these models excluded monetary considerations, but, parallel to this literature, the international effects of fiscal policies in monetary models was assessed by, among others, Frenkel and Mussa (1985), Frenkel and Razin (1987), Guidotti and Végh (1988), and Stockman (1985).

These papers commonly utilize a two-country framework in which the countries share similar consumption patterns, production technology, or both. The events of the 1980s, however, suggest that an expansion of this two-country setting is needed to consider the international transmission of fiscal disturbances to trading partners with very different characteristics, particularly the marked difference between developed and developing countries. Consider, for instance, the summary statistics in Table 1, which illustrate the range in economic performance between the United States, the other major industrial countries, and the developing nations. This paper attempts to explain these divergences in performance, giving particular

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<sup>1/</sup> In Buiter (1986), the investment function incorporates costs of adjustment, while in Giovannini (1988) it does not.

Table 1. Selected Economic Developments

	1976-80	1981-85
U.S. government expenditure as a percentage of GNP (period average)	28.7	31.8
U.S. budget deficit as a percentage of GNP (period average)	2.9	4.7
U.S. real exchange rate <u>1/</u> (percentage change)	-2.0	45.1
Real non-oil commodity prices <u>2/</u> in U.S. dollars (percentage change)	2.3	-41.9
U.S. Real GDP (percentage change)	18.3	13.5
Real GDP of non-oil, primary commodities exporters (percentage change)	27.2	6.2
Real GDP of all industrial countries (percentage change)	18.3	12.9

Source: International Financial Statistics Yearbook and World Economic Outlook, 1990.

1/ IMF index based on export unit values.

2/ IMF all-commodity index deflated by the U.S. CPI.

attention to the observed inverse relationship between real commodity prices (in U.S. dollars) and the U.S. real exchange rate. 1/

The present paper, like Frenkel and Razin (1984 and 1986), considers a nonmonetary economy without capital, but, as in the growth models, it provides a supply channel of transmission by introducing an internationally-traded, nonstorable commodity input. Unlike these previous models, which consider a two-country world, the analysis presented here follows Krugman (1983) by employing a three-country framework: a liquidity-constrained commodity supplier that has no further access to the international credit markets, and two industrial countries that import the commodity, export differentiated manufactured goods and hold the outstanding debt of the commodity exporter. The inclusion of commodities is similar to Findlay and Rodriguez (1977), although the analysis here is not restricted to the small-country case. The three-country framework allows specific attention to be paid to the international transmission of fiscal policy between trading partners that have different production and indebtedness profiles.

In this setting, the impacts of a tax-financed permanent change in government spending on the real exchange rate, real commodity prices, output, and the international distribution of debt are considered. The focus is on the reallocative effects of tax-financed fiscal policy à la Metzler (1949), rather than debt-financed increases in government spending. The analysis extends the work of Reinhart (1988) in two directions. First, it takes into account the intertemporal nature of the consumer choice problem, so that the role of wealth effects stemming from changes in asset supplies and/or the international redistribution of existing assets is explicitly considered. Second, the past accumulation of external debt by developing countries is factored in the analysis, as is the impact of debtor countries facing credit rationing in international capital markets. Additionally, the role of the maturity of that debt is highlighted by an extension to the model.

The following section describes the model, while Section III uses the model to analyze the effects of changes in fiscal policy and of a change in world commodity supplies. Section IV considers the impact of a change in the rate of time preference in the basic model under two scenarios: first, when the inherited stock of debt is variable-rate and has instantaneous-maturity; second, when the debt is in the form of consols with a fixed coupon payment. Section V presents some conclusions and discusses possible extensions.

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1/ This correlation has been examined by Dornbusch; see Dornbusch (1985), for example.

## II. The Model

There are three countries--the "home" country, which we will refer to as country A, a "foreign" country, B, and the commodity supplier, country C. Countries A and B, which represent industrial economies, employ two factors in the production process: labor, which is country specific (there is no cross-country migration), and a nonstorable commodity which is internationally traded and imported by both countries. The developing country, C, employs only labor in producing its commodity export. Following the usual neoclassical assumptions, the supplies of the non-traded input, labor, are predetermined in all three countries. This assumption also fixes the supply of the commodity. As in Buiter (1986) and Giovannini (1988), full specialization in production is assumed. Country A produces good 1, while country B produces good 2. These two goods are assumed to be imperfect substitutes and their relative price is defined by  $R = p_1/p_2$ , which will be referred to as the real exchange rate.

The commodity supplier is assumed at some point in the past to have floated a "development bond" but it can no longer issue new debt. This bond, which was denominated in terms of good 1, is the only asset in the system and is held entirely by the residents of the industrial countries, who receive interest payments. The assumption that the commodity supplier is shut out of the credit markets plays a significant role in the analysis. In a model such as this, which assumes infinitely-lived households all sharing common intertemporal preferences, this limitation in the credit markets introduces an important asymmetry between the industrial lenders and the developing borrowers. Consumption choice in the former is indeed intertemporal in nature while the latter is limited to maximizing utility on a period-by-period basis. For an empirical evaluation of the relevance of liquidity constraints in the behavior of consumers in developing countries see Haque and Montiel (1989) and Rossi (1988).

### 1. Households

All three countries are inhabited by infinitely-lived households who possess perfect foresight and maximize

$$U_t = \int_{t=0}^{\infty} u[c_{1t}, c_{2t}] \exp[-\delta t] dt$$

where  $\delta > 0$  is the subjective rate of time preference common to all three countries,  $c_1$  and  $c_2$  represent consumption of goods 1 and 2 respectively, and

$$u[c_1, c_2] = \alpha \ln c_1 + (1-\alpha) \ln c_2, \quad 0 < \alpha < 1.$$

Household preferences are assumed to be identical across countries, and good 1, the good in which the debt is denominated, will be the chosen numeraire.

In the home country, A, households receive wage income from current production, pay lump-sum taxes to the government,  $\tau^A_t$ , and receive interest income on their holdings of the bond,  $B^A_t$ . If  $r^A_t$  is the interest rate (in terms of good 1), the flow budget constraint of the representative household in country A is given by:

$$DB^A = y^A_t - m^A_t(q/p_1)_t - \tau^A_t + r^A_t B^A_t - c^A_{1t} - c^A_{2t}/R_t, \quad (1)$$

where the "D" defines the time derivative,  $y^A_t$ , is the output of good 1,  $m^A_t(q/p_1)_t$ , is the value of the commodity import in terms of the home good, with  $m^A_t$  denoting the volume and  $(q/p_1)_t$  the relative price of the commodity in terms of the home good. The initial holding of the bond,  $B^A_0$ , is assumed to be positive.

Maintaining good 1 as the numeraire, the representative household in country B maximizes utility subject to:

$$DB^B = y^B_t/R_t - m^B_t(q/p_1)_t + r^A_t B^B_t - c^B_{1t} - c^B_{2t}/R_t. \quad (2)$$

The liquidity constraint faced by the commodity exporter reduces the budget constraint to,

$$y^C(q/p_1)_t = r^A_t B^C + c^C_{1t} + c^C_{2t}/R_t, \quad (3)$$

where  $B^C$ , is the constant outstanding stock of debt and  $y^C$ , is the exogenously given level of output.

Combining  $u(\cdot)$  with the relevant budget constraint, introducing the costate variables,  $\mu^i_t$ ,  $i = A, B$ , and  $C$ , leads to Hamiltonians of the form,

$$H^A = \int_{t=0}^{\infty} [\alpha \ln c^A_{1t} + (1-\alpha) \ln c^A_{2t}] \exp[-\delta t] dt + \mu^A_t [y^A_t - m^A_t(q/p_1)_t - \tau^A_t + r^A_t B^A_t - c^A_{1t} - c^A_{2t}/R_t]. \quad \underline{1}/ \quad (4)$$

The first order conditions yield relationships between consumption of goods 1 and 2 that hold at each instant in time:

$$c^i_{2t} = \frac{(1-\alpha)c^i_{1t}R_t}{\alpha}, \quad \text{for } i = A, B, C. \quad (5)$$

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1/ To economize on space, the expressions for countries B and C are omitted. In the case of country C, the maximization problem reduces to a static Langrangean.

Substituting (5) back into the relevant budget constraint yields the following expressions for consumption of the home good in countries A, B, and C, respectively.

$$c^A_{1t} = \alpha[y^A_t - m^A_t(q/p_1)_t - r^A_t + r^A_t B^A_t - DB^A] \quad (6a)$$

$$c^B_{1t} = \alpha[y^B_t/R_t - m^B_t(q/p_1)_t + r^A_t B^B_t - DB^B] \quad (6b)$$

$$c^C_{1t} = \alpha[y^C_t(q/p_1)_t - r^A_t B^C_t] \quad (6c)$$

Dynamics are determined to place consumption in countries A and B along the optimal paths given by the Euler equations:

$$Dc^A_{1t} = c^A_{1t}(r^A_t - \delta) \quad (7a)$$

$$Dc^B_{1t} = c^B_{1t}(r^A_t - \delta) \quad (7b)$$

## 2. Production and market clearing conditions

Since employment is assumed constant, output can be expressed exclusively in terms of the commodity input. The production functions for countries A and B are given by,

$$y^A_t = \gamma \ln(m^A_t) \quad \gamma > 0, \quad (8a)$$

$$y^B_t = \epsilon \ln(m^B_t) \quad \epsilon > 0. \quad (9b)$$

Since the commodity is nonstorable and there is no capital, profit maximization is done on a period-by-period basis. Demands for the commodity input derived from setting marginal product equal to marginal cost leads to:

$$m^A_t = \gamma / (q/p_1)_t \quad (10a)$$

$$m^B_t = \epsilon / [(q/p_1)_t R_t]. \quad (10b)$$

Closing the system requires specifying the behavior of the public sector. To focus on the reallocation effects of government spending, it is assumed that the government runs a balanced budget and that the lump-sum tax levied on the households of the home country,  $r^A_t$ , is directed entirely to the purchase of the home good, as in Metzler (1949). These purchases are denoted by  $g^A_{1t}$ . All markets clear continuously; the equilibrium conditions for the commodity, good 1, and good 2 respectively are given by,

$$y^C_t = m^A_t + m^B_t \quad (11)$$

$$y^A_t = g^A_{1t} + c^A_{1t} + c^B_{1t} + c^C_{1t} \quad (12)$$

$$y^B_t = c^A_{2t} + c^B_{2t} + c^C_{2t} \quad (13)$$

while asset market clearing requires that all debt be held,

$$B^C = B^A_t + B^B_t \quad (14)$$

### 3. Solution and properties of the model

The solution for relative prices is obtained by imposing market clearing in three of the four markets and invoking Walras' Law for the fourth. The appropriate substitutions in equation (11) obtains an expression for the domestic real commodity price,  $(q/p_1)_t$ , in terms of the real exchange rate and the exogenously determined supply of commodities,

$$d(q/p_1)/(q/p_1) = -(m^B/y^C) dR/R - dy^C/y^C. \quad (15)$$

This market clearing condition produces an inverse correlation between real commodity prices and the real exchange rate. Such a correlation has been found in the U.S. data by Dornbusch (1985), Morrison and Wattleworth (1987) and Gilbert (1989), among others; however, there is far less agreement in this literature about the magnitude of the coefficient linking the real exchange rate to commodity prices, which equation (15) suggests should lie between zero and minus one. Many of the cited studies estimate a higher reduced form coefficient (see Gilbert (1989)).

Substituting 6a-6c into the market-clearing condition for good 1, (12), and using the results from (15), a reduced-form expression for the real exchange rate,  $R$ , is obtained.

$$dR/R = \{(1-\alpha)R\}/\Phi dg^A_1 + \{[\alpha-(m^A/y^C)]R(q^A/p_1)\}/\Phi dy^C \quad (16)$$

where  $\Phi = \epsilon(m^A/y^C) + \alpha y^B > 0$ .

As (15) and (16) show, relative prices depend on the exogenously given commodity endowment and government spending. Since preferences are identical across countries, relative prices do not depend on the international distribution of wealth. However, because consumption levels in countries A and B, (6a and 6b), depend on the distribution of the internationally traded asset,  $B^A_t$ , the solution to the system requires that the path of the interest rate on the bond,  $r^A_t$ , be established. As in Guidotti and Végh (1988), it can be shown that the interest rate will equal the subjective rate of time preference,  $\delta$ , for all  $t$ . The continuous equality between the rate of time preference and the world interest rate has the implication that asset distribution at any point in time will equal the initial endowment, ( $B^A_t = B^A_0$  for all  $t$ ), and adjustment to disturbances occurs instantaneously.

To establish this, consider the market clearing condition for good 1. Since the market clears at each point in time, changes in demand over any point in time must sum to zero, that is

$$0 = Dc_{1t}^A + Dc_{1t}^B + Dc_{1t}^C.$$

The first two terms on the right-hand-side are given by the Euler conditions, while last follows from differentiating equation (6c) with respect to time. 1/ Making these substitutions arrives at:

$$0 = c_{1t}^A(r_t^A - \delta) + c_{1t}^B(r_t^A - \delta) - \alpha B^C D r^A, \quad (17)$$

Since consumption in the industrial countries moves together (sign of  $Dc_{1t}^A = \text{sign of } Dc_{1t}^B$ ), market clearing requires that consumption in country C move in the opposite direction. 2/ This, however, requires that  $r^A$  follow an unstable dynamic equation when linearized about the steady state.

Under the assumption of rationality, or more precisely, perfect foresight, agents would rule out explosive paths and choose the interest associated with the stable dynamics--that is, an interest rate equal to the constant subjective rate of time preference. Thus, stability rules out intrinsic dynamics and the system is characterized by instantaneous adjustment from one steady state to another.

The reduced forms for consumption in each country are given by,

$$dc_{1t}^A = \{-\alpha^2 [y^{B+\epsilon} (m^A/y^C)]\}/\Phi dg_{1t}^A + \{\alpha^2 \gamma (y^{B+\epsilon})\}/\Phi dy^C \quad (19a)$$

$$dc_{1t}^B = \{-\alpha(1-\alpha) [y^{B-\epsilon} (m^B/y^C)]\}/\Phi dg_{1t}^A + \{\alpha(q^A/p_1) [\alpha(m^B/y^C)(y^{B+\epsilon}) - y^B(\alpha - (m^A/y^C))]\}/\Phi dy^C \quad (19b)$$

$$dc_{1t}^C = \{-\alpha(1-\alpha)\epsilon\}/\Phi dg_{1t}^A - \{\alpha\epsilon[\alpha - (m^A/y^C)](q^A/p_1)\}/\Phi dy^C \quad (19c)$$

while output in countries A and B are,

$$dy^A = \{(1-\alpha)\epsilon(m^A/y^C)\}/\Phi dg_{1t}^A + \{\alpha\gamma(y^{B+\epsilon})\}/\Phi dy^C \quad (20a)$$

$$dy^B = -\{(1-\alpha)\epsilon[(m^A/y^C)R]\}/\Phi dg_{1t}^A + \{\epsilon R[\alpha y^B/R + (1-\alpha)\gamma]\}/\Phi dy^C \quad (20b)$$

### III. Policy Changes and Supply Shocks in the Basic Model

In this section two shocks are considered that fit the stylized facts of the 1980s. In particular, shocks that parallel the fiscal expansion in

1/ The intuition behind consumption dynamics of households in country C,  $Dc_{1t}^C = -\alpha B^C D r^A$ , is straightforward. Unless country C residents opt to default on their debt servicing, consumption must be declining when the interest rate is rising and vice-versa.

2/ Output of good 1,  $Y^A$ , has no intrinsic dynamics as it only depends on relative prices, which adjust instantaneously.

the U.S. and the sharp increase in the volume of commodity exports of the developing countries are examined.

1. An increase in government spending

In this simple trade model, the government of country A finances its purchases of the home good by levying a lump-sum tax on households. The impact of government spending on relative prices, output, and consumption comes entirely from its role in the reallocation of demand, as in Metzler (1949). A permanent increase in government spending tilts demand in favor of the home good and drives up its relative price. The real exchange rate,  $R_t$ , appreciates and real commodity prices,  $(q/p_1)_t$ , fall. The decline in real commodity prices increases the home country's demand for the commodity input, and output in country A expands. At the same time, commodity costs for country B,  $(q/p_1)_t R_t$ , rise with the fiscal expansion (the decline in commodity prices will be a fraction on the increase in the real exchange rate, equation (15)), leading to a decline in its output. Thus, the international transmission of a fiscal expansion in Country A is negative.

Household consumption in all three countries declines. In the home country, output is higher but the higher taxes that finance the increase in spending reduce household disposable income. 1/ In the second industrial country, B, disposable income falls, owing to lower production and a deterioration in the terms of trade. The commodity exporter, also faces a deterioration in its terms of trade that reduces the value of its output, or put differently, that increases the burden of debt servicing. 2/ All these results obtain if the government's propensity to consume the home good exceeds that of the representative household.

The changes in relative prices and consumption do not depend on an international redistribution of wealth among countries with different temporal and intertemporal preferences as in the "transfer problem" considered by Frenkel and Razin (1984), among others. As in Obstfeld (1989), who assumes the countries are populated by households with identical preferences, the channel of transmission is the international factor market.

This simple model can describe the direction of movement in relative prices and even the differentials in economic performance, observed during the early 1980s (see Tables 1 and 2). 3/ However, the model, which imposes balanced current accounts, falls well short of explaining the marked swings in the current accounts of industrial and developing countries that also characterized the past decade. Most likely, the absence of debt-

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1/ As (20a) illustrates, the government spending "multiplier" is less than one.

2/ Recall the debt is denominated in terms of the good whose relative price has risen.

3/ Although we can only make statements about output levels, as this is not a growth model.

financed public expenditure, as well as a monetary sector, accounts for this limitation in the analysis.

Table 2. Commodity Supply and Related Data

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	1975-80	1981-85
Terms of trade of non-oil, primary commodity exporting countries (percent change)	-2.2	-15.0
	1977-82	1983-87
Commodity supply index (percent change)	5.3	20.0
Export volume of 15 heavily indebted countries (percent change)	17.9	25.3

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Source: International Financial Statistics Yearbook and World Economic Outlook, 1990.

2. An expansion in world commodity supplies

During the 1980s the terms of trade of developing commodity suppliers deteriorated markedly while their real debt servicing costs rose. <sup>1/</sup> This unfavorable combination of events brought about efforts in many developing countries to increase the volume of their exports, so as to make up for the shortfall in revenues. However, as many of the commodity exporters responded similarly, the outcome was an expansion in world commodity supplies, which further aggravated the decline in their relative price. As Morrison and Wattleworth (1987) note, this supply expansion played a significant role in explaining the observed weakness in relative commodity prices in 1984-86, as the demand for commodities in industrial countries was already recovering rapidly.

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<sup>1/</sup> For a model that links the terms of trade to debt, as well as for a discussion of key stylized facts in this area, see Aizenman and Borensztein (1988).

In the basic model, the impact of a permanent expansion in world commodity supply,  $y^C$ , is quite straightforward. As with the fiscal shock, the adjustment is instantaneous. The expansion in commodity exports reduces the real price of the commodity,  $(q/p_1)_t$ , by an equal amount, (equation 15), while the impact on the real exchange rate is ambiguous. If the proportion of good one that is consumed,  $\alpha$ , is higher than the share of the stock of the commodity input required to produce it,  $(m^A/y^C)$ , the relative price of good one increases. The reverse is true if  $\alpha - (m^A/y^C) < 0$ . In both instances, the cost of the commodity input declines, thereby increasing output in the industrial countries, A and B. 1/ The higher levels of output, assuming they are not taxed away, increase disposable income and boost consumption in the commodity-importing countries (equations 19a and 19b). For the commodity supplier, the value of its output in terms of good one remains unchanged, as the expansion in volume is exactly offset by a decline in price. *With debt-servicing costs constant, the impact on country C's consumption is ambiguous, falling (rising) as the real exchange rate appreciates (depreciates).* The gap between the value of output of the developed countries,  $y^A + y^B/R$ , and the developing country,  $y^C(q/p_1)$ , widens.

#### IV. The Rate of Time Preference and the Nature of the Debt

One of the more unrealistic features of the model is the assumption of an exogenous, common, and constant rate of time preference. Frenkel and Razin, (1984 and 1987) allow for different discount factors across countries while Buiter (1986), Frenkel and Razin (1986), Giovannini (1988), and Obstfeld (1989) all follow Blanchard (1985), and assume that individuals face an uncertain duration of life. While the latter assumption relaxes the Ricardo-Barro equivalence of debt issue and taxation, the steady-state solution of these models still require that the real interest rate be determined by, although not necessarily be set equal to, an aggregate and exogenous rate of time preference. An alternative approach that endogenizes the subjective utility discount factor is presented in Obstfeld (1981). 2/

In the analysis that follows, an attempt is used to capture the spirit of an "endogenous" rate of time preference by considering the impact of changes in the rate of time preference under alternative debt scenarios. 3/ The motivation for this exercise lies in the events of the 1980s. Although the rate of time preference is not observable, the combination of significantly higher (ex-post) real rates of interest and declining savings

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1/ In the case where the real exchange rate appreciates, the output expansion in country B is smaller than when the real exchange rate depreciates.

2/ For a survey of this literature see Obstfeld (1989).

3/ This exercise was also analyzed by Giovannini (1988) for the small open-economy case.

rates world-wide suggests a shift in favoring consumption today--an increase in the rate of time preference.

Table 3. Real Interest Rates and Savings Trends

	1976-80	1981-85	
Ex-post real interest rate <u>1/</u> (period average)	0.51	5.78	
Savings rates:			
Industrial countries: households <u>2/</u>	9.5	8.1	
Developing countries: national <u>3/</u>	26.9	22.7	
	1973-75	1980-82	1987
Memorandum item:			
Percent of total long-term debt at floating rates for the 15 heavily indebted countries	11.4	34.4	51.4

Source: International Financial Statistics Yearbook and World Economic Outlook, 1990, Aghevli, Boughton, Montiel, Villanueva, and Woglom, (1990), and World Development Report, 1989.

1/ Defined as the 6-month LIBOR rate less the annual inflation rate in industrial countries.

2/ Aggregate of Canada, the Federal Republic of Germany, Japan, the United Kingdom, and the United States.

3/ Household data was not available. Averages are for 1976-81 and 1982-85.

1. A change in the rate of time preference in the basic model

Retaining the assumption that the representative household in all three countries share a common discount factor, we consider a permanent change in the rate of time preference. As with the other shocks considered, the adjustment is instantaneous. For households in country C, this increased impatience cannot be translated into a change in consumption, as a binding liquidity constraint prevents its residents from engaging in consumption smoothing. In the developed countries, households would not be willing to

hold the existing stock of debt at an interest rate that is below their now higher subjective discount factor, so asset market clearing will require that the real interest rate increases sufficiently so as to insure all debt is willingly held. This rise in the interest rate increases interest income for the residents of A and B and finances a higher level of consumption.

For the debt constrained citizens of Country C, consumption adjusts according to  $Dc^C = -\alpha B^C D r^A$ , so in order to meet the higher level of interest payments (for a given level of output), households must reduce their consumption. In the new steady state, the commodity supplier will have a larger merchandise trade surplus offsetting its deficit in the capital account.

## 2. A variant of the basic model with fixed rate debt

It is the assumption that all their outstanding debt yields an instantaneously adjusted variable interest rate that produces the starkly negative implications for the welfare of the debtor country when the impatience coefficient rises. Despite the rapid increases in recent years in the share of total developing-country debt that is variable rate, nearly 50 percent of the outstanding stock of debt of the 15 most heavily indebted countries was still at fixed rates as of 1987 (Table 3). 1/ In this section we consider an alternative scenario, that--although it is quickly becoming less descriptive of the stylized facts of developing country debt--provides a benchmark to which the previous results can be compared.

Consider the polar case where the "development bond",  $B^C$ , is a consol promising a fixed stream of coupon payments (in terms of good 1) to its holders. In this case, country C's budget constraint is given by

$$y^C(q/p_1)_t = kB^C + c^C_{1t} + c^C_{2t}/R_t, \quad (21)$$

where  $k$  represents the fixed coupon payment in terms of good 1 and  $B^C$  now represents the number of bonds outstanding. As (21) illustrates, the fixed coupon payments insulate the debtor's consumption from fluctuations in the rate of interest, which now has two components: coupon payments and capital gains/losses. Defining  $v_t$  as the price of the bond (in terms of good one), the instantaneous rate of interest is given by,

$$r^A_t = (k/v_t) + Dv/v, \quad (22)$$

where  $Dv/v$  represents the changes in the price of the bond--capital gains or losses. The budget constraint for the creditor countries are:

$$DB^A = y^A_t - m^A_t(q/p_1)_t - r^A_t + (k/v_t)(v_t B^A_t) - c^A_{1t} - c^A_{2t}/R_t \quad (23)$$

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1/ Latest year for which this statistic is available.

$$DB^B = y^B_t/R_t - m^B_t(q/p_1)_t + (k/v_t)(v_t B^B_t) - c^B_{1t} - c^B_{2t}/R_t. \quad \underline{1}/ \quad (24)$$

As (21) indicates, a permanent increase in the common discount rate would leave consumption in the debtor country unchanged, since neither output nor its debt-servicing payments have changed. In the new steady state we know that: (a) the interest rate will be equal to the now higher rate of time preference; and (b) the value of the bond will be stationary,  $Dv/v=0$ . These imply that when the impatience coefficient rises, the price of the bond,  $v_t$ , will have to decline instantaneously. Households in countries A and B would like to reduce their holding of C's debt to consume more. This provides no incentive to trade and, instead, after the change in tastes, the value of debt,  $v_t B^A_t$  falls, while the yield,  $k/v_t$ , rises by the same proportion. Consequently, the consumption of the debt holders also remains unchanged. In the case where the debtor country faces a liquidity constraint, the existence of fixed rate debt helps insulate the consumer against fluctuations in interest rates.

## V. Conclusion

A simple multi-country model where individuals are infinitely lived but some agents face a liquidity constraint can provide insight in explaining the fluctuations of key relative prices and the disparate economic performance among developed and developing countries. In particular, the framework is useful for assessing the role the international commodity market plays in transmitting a variety of shocks.

There are, however, a series of simplifying assumptions that limit the model's usefulness for analyzing the international transmission of fiscal disturbances in recent years. The absence of a second asset, whether in the form of capital, money, or more interestingly, an industrial-country bond, is a major drawback. The inclusion of bond-financed deficits in an uncertain lifetime framework, such as Blanchard (1985), is an extension that would alter the basic model's unrealistic result of continual current account balance.

Additional extensions to the basic model could also be along the lines of Antonnini (1987). This line of research would allow for storability of the commodity input, adding an intertemporal dimension to the firms' profit maximization problem and enriching the dynamics. Work in this direction would also allow for an additional channel through which the government could influence the prices of internationally-traded commodities by its purchases and sales of inventory stocks. Finally, it would be useful to consider endogenizing the rate of time preference along the lines described

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1/ It is evident that the price of the bond,  $v_t$ , cancels out of the budget constraint, but for the time being, we will retain it to facilitate illustrating what happens when intertemporal preferences change.

by Obstfeld (1989), which would allow the initial level of consumption (which could be quite different across countries) to play a role in influencing the discount factor applied to future utility.

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