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Fiscal Policy, the Real Exchange Rate, and Commodity Prices

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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. [JEL F41, F42]

THE 1980S witnessed marked changes in the fiscal deficits of the major industrial countries and large fluctuations in real rates of interest and key relative prices, including real exchange rates and world commodity prices. The increased volatility in the economic environment, as well as a world debt crisis, stimulated a reassessment of the role of fiscal policies. The increasing integration of capital markets, which insures that policies undertaken by the major economies have repercussions on the rest of the world, made a multicountry setting necessary.

For much of the literature on the international transmission of fiscal policies, a frequent point of departure has been the Mundell-Fleming two-country model (Mundell (1968», which considered *intratemporal* choices among goods and assets. **In** this setting, a fiscal expansion appre-

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ciates the real exchange rate, which, in turn, increases the demand for the products of trading partners-the transmission abroad is positive. Frenkel and Razin (1984) revisited this framework and incorporated an *intertemporal* dimension by modeling the consumer choice problem with infinitely lived, rational agents. They examined the linkage between fiscal policy and the intertemporal price of consumption-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. The impact of fiscal policy in the Frenkel-Razin framework is ambiguous, depending on the consumption patterns of the public and private sectors in both countries, as well as their spending propensities.

To bypass the world of "Ricardian equivalence," where there is no difference between the individual and aggregate rate of time preference, Frenkel and Razin (1986) subsequently re-examined these issues in a setting where individuals face an uncertain lifetime, as in Blanchard (1985). In addition to intratemporal and intertemporal preferences, they found that the impact of fiscal policy depends on its timing. Buiter (1987) and Giovannini (1988) extended this framework to incorporate capital accumulation, thus endogenizing output levels and giving factor markets a key role in the international transmission of shocks.[1] The inclusion of capital allowed these models to examine the impact fiscal policy and public debt management have on aggregate supply at both the country-specific and world levels. Obstfeld (1989) enriched the analysis by dropping the assumption of complete specialization that characterized these models, introducing the production of labor-intensive, nontradable goods; in his model the impact of public spending, at home and abroad, depended crucially on whether the government purchased the traded or the nontraded good. All of these models illustrate how changes in fiscal policy affect relative prices and resource allocation, domestically and internationally.

In Frenkel and Razin (1984, 1986), as in the earlier Mundell (1968) work, the channel of international transmission of fiscal policy is via demand, since 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 of these models excluded monetary considerations, but parallel to this literature the international effects of fiscal policies in monetary models were assessed by Frenkel and Mussa (1984), Frenkel and Razin (1987), Guidotti and Vegh (1988), and Stockman (1986), among others.

[1] Buiter's (1987) investment function incorporates costs of adjustment, while Giovannini's (1988) does not.

These papers commonly assume a two-country world, in which the countries are similar in consumption patterns, production technology, or both. The countries considered in these models may be borrowers or lenders, but in any case face no constraints in international capital markets. 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 differences between developed and developing countries. Although preferences and even technology may not differ considerably, in recent years developed and developing countries have not had equal access to international capital markets. Consider, for instance, the summary statistics in Table 1, which underscore the differences in economic performance among the United States, the other major industrial countries, and the developing nations. This paper attempts to explain this dispersion, giving particular attention to the borrowing constraints faced by developing countries and other stylized facts, in particular, the observed inverse relationship between real commodity prices (in U.S. dollars) and the U.S. real exchange rate (see Dornbusch (1985)).

This paper, like Frenkel and Razin (1984, 1986), presents a nonmonetary economy without capital, but as in the growth models, a supply

Table 1. *Selected Economic Developments*

Economic Indicator	Years	Years
	1976–80	*1981–5*
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[a] (percentage change)	-2.0	45.1
Real non-oil commodity prices[b] 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

Sources: International Monetary Fund (1990a, 1990b).
[a] International Monetary Fund index based on export unit values.
[b] International Monetary Fund all-commodity index deflated by the U.S. consumer price index.

channel of transmission is established by the introduction of an internationally traded, nonstorable commodity input.. Although world output is fixed, its distribution across countries varies with shocks to international factor markets. Unlike the previous models, which consider a two-country world, this analysis follows Krugman (1983) and employs 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 in the analysis is similar to Findlay and Rodriguez (1977), although this study goes beyond their small-country case. The three-country framework reveals how the international transmission of fiscal policy differs across trading partners that have a diverse production structure and, more important, a different indebtedness profile.

In this setting, the impact is considered of a permanent change in fiscal policy on the real exchange rate, real commodity prices, output, and the international distribution of debt.. The focus is on the reallocative effects of fiscal policy à la Metzler (1949), since it considers tax-financed, 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, it introduces a role for the debt of developing countries and highlights how the presence of financial constraints alters the response of the system to a variety of shocks.

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

I. The Model

There are three countries—the "home" country, which I 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 production: labor, which, is country specific (that is, 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 nontraded input, labor, are predetermined in all three countries. This assumption also fixes the supply of the commodity. As in Buiter (1987) and Giovannini (1988), full specialization in production is assumed. Country A produces good 1, and country B produces good 2. These two goods are assumed to be imperfect substitutes, and their relative price is defined by $R = P1/p2$, which I refer to as the real exchange rate.

It is assumed that the commodity supplier at some point in the past floated a "development bond" but 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. The former's consumption choice is indeed intertemporal in nature, while the latter is limited to maximizing utility on a period-by-period basis. Whereas in Frenkel and Razin (1986) and in the growth models of Buiter, Giovannini, and Obstfeld, the nonneutrality of public debt arose from the "myopic" behavior of households, here it stems from an exogenous rigidity in the form of a liquidity constraint..

The role accorded to liquidity constraints in explaining consumer behavior in closed economy settings is not new.[2] Their relevance in explaining the consumption patterns of households with low net worth that cannot trade future assets with current liabilities has found considerable empirical support in several industrial countries (Hayashi (1987) provides a survey of this literature). Studies of a broad variety of developing countries by Haque and Montiel (1989) and Rossi (1988) also find evidence of liquidity constraints, suggesting that the closed economy patterns across households may well have their parallels in a multicountry setting.

[2] See Hall (1989) for a general discussion.

Households

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

$$V_t = \int_0^\infty u[c_{1t}, c_{2t}]\exp[-\delta t]dt,$$

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

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

As in Obstfeld (1989), household preferences are assumed to be identical across countries, and good 1, the good in which the debt is denominated, will be the numeraire. In the horne country A, households receive wage income from current production, pay lump-sum taxes to the government, τ_t^A, and receive interest income on their holdings of the bond, B_t^A. If r_t^A is the interest rate (in terms of good 1), the flow budget constraint of the representative household in country A is given by

$$DB^A = y_1^A - m_t^A (q/p)' - \tau_t^A + r_t^A B_t^A - c_{1t}^A - c_{2t}^A/R'' \tag{1}$$

where the D defines the time derivative; y_t^A is the output of good 1; and $m_t^A (q/p)'$ is the value of the commodity import in terms of the horne good and the initial holding of the bond, $B_0^A > 0$.

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

$$DB^B = y_t^B/R_t - m_t^B (q/p)' + r_t B_t^B - c_{1t}^B - c_{2t}^B/R_t. \tag{2}$$

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

$$y^C (q/p)' = r_t^C B^C + c_{1t}^C + c_{2t}^C/R'', \tag{3}$$

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

Combining $u(.)$ with the relevant budget constraint and introducing the costate variables, λ_t^i (where $i = A, B,$ and C) leads to Hamiltonians of the form[3]

[3] To economize on space, the expressions for country B and country C are omitted. In the case of country C, the maximization problem reduces to a static Langrangian.

$$H^A = \int_0^{\infty}[\alpha \ln c_t + (1-\alpha)\ln c_{2t}]\exp[-\theta t]\,dt$$

$$+ \lambda_t[y_t - m_t(q/p_1)_t - c_{1t} + r B_t - B_{t+1} - c_{2t}/R_t]. \qquad (4)$$

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

$$c_{2t} = \frac{(1-\alpha)}{\alpha} c_{1t} R_t \qquad \text{for } i = A, B, C. \qquad (5)$$

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:

$$c_t = \alpha[y_t - m_t(q/p_1)_t - c_{1t} + r B_t] \qquad (6a)$$

$$c_t = \alpha[y_t + R_{t-1} B_t - m_t(q/p_1)_t + r B_t] \qquad (6b)$$

$$c_t = \alpha[y_t + (q/p_1)_t - r B_t]. \qquad (6c)$$

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

$$Dc_t = c_t(r - \theta) \qquad (7a)$$

$$Dc_t = c_t(r - \theta). \qquad (7b)$$

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

$$y_t = -\gamma \ln(m_t) \qquad -\gamma > 0 \qquad (8)$$

$$y_t = \epsilon \ln(m_t) \qquad \epsilon > 0. \qquad (9)$$

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

$$m_t^A = \gamma/(q/p_1)_t \qquad (10a)$$

and

$$m_t^B = \epsilon/[(q/p_1)_t R_t]. \qquad (10b)$$

Given the functional forms assumed, world demand for the commodity is characterized by a rectangular hyperbola.

Closing the system requires specifying the behavior of the public sector. To focus on the reallocative effects of government spending, the government is assumed to run a balanced budget and the lump-sum tax levied on the households of the home country, $T\sim$, is assumed to be directed entirely to the purchase of the home good, as in Metzler (1949).[4] These purchases are denoted by $g\sim$. All markets clear continuously; the equilibrium conditions for the commodity, good 1, and good 2, respectively, are given by

$$yf = m\sim + m\sim \tag{11}$$

$$y\sim = gt, + et, + eft + e\sim \tag{12}$$

and

$$y\sim = e\sim + e\sim + e\sim. \tag{13}$$

Clearing of the asset market requires that all debt be held:

$$Be = B\sim + B\sim. \tag{14}$$

Solution and Properties of the Model

Relative prices are solved for by imposing market clearing in three of the four markets and invoking Walras' law. The appropriate substitutions in equation (11) yield an expression for the domestic real commodity price, $(q/p)''$, in terms of the real exchange rate and the exogenously determined supply of commodities:

$$d(q/p_1)/(q/p_1) = -[\epsilon/(\gamma R + \epsilon)]\, dR/R - dy^C/y^C. \tag{15}$$

This market-clearing condition lies at the heart of the inverse correlation between real commodity prices (in U.S. dollars) and the U.S. real exchange rate found in the data by Dornbusch (1985), Morrison and Wattleworth (1988), and Gilbert (1989). This theoretical model suggests that this sensitivity of commodity prices to the real exchange rate should depend on the relative elasticities of industrial country output with respect to commodity prices, and so would lie between 0 and -1. There is far less agreement in the empirical literature about the magnitude of this

[4]The significance of assuming that the government only purchases the domestically produced good will become more evident in the next section when a change in fiscal policy is considered.

coefficient, but many of the studies cited estimate it to be higher (see Gilbert (1989»).

Substituting equations (6a)-(6c) into the market-clearing condition for good 1 (equation (12)) and using the results from equation (15) yields a reduced-form expression for the real exchange rate:

$$dR/R = \{(1 - a) R\}/Cf> dg~ + \{aE - (1 - a)\text{-}\gamma R\}/Cf> dyc/yc, \qquad (16)$$

where

$$Cf> = E"\gamma R/(\text{-}\gamma R, + E) + a\gamma B > 0.$$

As equations (15) and (16) show, relative prices depend on the exogenously given commodity endowment and government spending. Note that the numerator of the government multiplier, $(1 - a)$, measures the difference between public and private preferences for good 1. The assumption, thus far, has been that the government only consumes the domestically produced good-its propensity to consume good lout of tax receipts is unity-while the private sector consumes a.

Since preferences are identical across countries, relative prices do not depend on the international distribution of wealth. However, because consumption in countries A and B (equations (6a) and (6b)) depends on the distribution of the internationally traded asset, B, the solution to the system requires that the path of the interest rate on the bond, r, be established. Following Guidotti and Vegh (1988), I subsequently show that in this system the interest rate will equal the subjective rate of time preference, 8, for all t. The continuous equality between the rate oftime preference and the world interest rate has the implication that asset distribution at any point in time will equal the initial endowment, $(B = B~$ 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, and as equations (15) and (16) show, relative prices and output adjust instantaneously, changes in demand over any period of time must sum to zero; that is

$$0 = \text{Deft} + Dee + De~.$$

The first two terms on the right-hand side are given by the Euler conditions, while the last follows from differentiating equation (6c) with respect to time.[5] Making these substitutions leads to

$$0 = \text{eft}(~ - 8) + \text{ee}(~ - 8) - aBcDrA. \qquad (17)$$

5The intuition behind consumption dynamics of households in country C, $De^C = -o.BcD~$, 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.

Since consumption in the industrial countries moves together (sign of $Dc:C$ = sign of $Dc\sim$), market clearing requires that consumption in country C move in the opposite direction.[6] This, as equation (17) illustrates, requires that rA follow an unstable dynamic equation when linearized around 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

$$dct = \{\_a^2[yB + E(mAlyC)]\}/<I>dgt + \{a^2\text{-}y(yB + E)\}/<I>dyClyC \quad (18a)$$

$$dcf = \{-a(1 - a)[yB - e(mBlyC)]\}/<I>dgt + \{a(q|pl)[a(mBlyC)(yB + E) - yB(a - (mA/yC)\}/<I>dyClyc \quad (18b)$$

$$dcf = \{-a(1 - a)e\}/<I>dgt - \{ae[a - (mAlyC)](q|pl)\}/<I>dyClyc, \quad (18c)$$

and output in countries A and B is given by

$$dyA = \{(I - a)e(mAlyC)\}/<I>\,dgt + \{a\text{-}y(yB + E)\}/<I>dyClyC \quad (19a)$$

$$dyB = -\{(I - a)E[(mAlyC) R)\}/<I>\,dgt + \{eR[ayBlR + (1 - a)\text{-}y\}/<I>dyClyC. \quad (19b)$$

II. Policy Changes and Supply Shocks in the Basic Model

In this section two of the shocks that fit the stylized facts of the 1980s are considered. In particular, shocks that parallel the fiscal expansion in the United States and the sharp increase in the commodity exports of the developing countries are examined.

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.

[6] Output of good 1, yA, has no intrinsic dynamics since it depends only on relative prices, which adjust instantaneously.

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'', appreciates, and real commodity prices, $(q\ lpl)''$, 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, $(q\ lpl),R''$, rise with the fiscal expansion, leading to a decline in its output. Thus, the international transmission of a fiscal expansion in country A is negative.

Household consumption in the industrial countries declines. In the home country output is higher, but the higher taxes that finance the increase in spending reduce household disposable income. In the second industrial country, B, disposable income falls, owing to lower production and a deterioration in the terms of trade. The commodity exporting country also faces a deterioration in its terms of trade that reduces the value of its output, or alternatively expressed, that increases the burden of debt servicing.[7] Households in country C would like to maintain their level of consumption and, in the absence of a liquidity constraint, would have been able to do so by borrowing from country A or (country B). Instead, their inability to borrow forces the entire adjustment on consumption, which also falls. In effect, the liquidity constraint has a shadow price that functions as an interest rate, so that when it is binding, the consumer behaves as if he or she faced a higher interest rate.

All of these results obtain if the government's propensity to consume the home good exceeds that of the representative household. If, for instance, the government consumes both goods in the same proportion as households, then the numerator of the government multiplier in equation (16) would be (a - a), and relative prices would remain unchanged, since private consumption of good 1 in country A falls by $-a\text{-}1$, while public consumption increases by the same amount (recall that the government maintains a balanced budget).[8] As a result, world spending on both goods remains unchanged.

This simple model can describe the observed direction of movement in relative prices and even the differential economic performance of the early 1980s (see Tables 1 and 2).[9] However, the model, which imposes

[7] Recall the debt is denominated in terms of the good whose relative price has risen.

[8] In this case, the market-clearing condition for good 2 (equation (13», would be revised to include an additional term, g~, representing government purchases of that good.

[9] Although one can only make statements about output levels, since this is not a growth model..

Table 2. *Commodity Supply and Related Data*

(Percent change)

Price and Quantity Indicators	1975–80	1981–85
Terms of trade of non-oil, primary commodity exporting countries	−2.2	−15.0
	1977–82	1983–87
Commodity supply index	5.3	20.0
Export volme of 15 heavily indebted countries	17.9	25.3

Sources: International Monetary Fund (1990a, 1990b).

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

Expansion in World Commodity Supply

During the 1980s the terms of trade of developing commodity suppliers deteriorated markedly while their real debt-servicing costs rose.[10] This unfavorable combination led many developing countries to try to increase the volume of their exports, so as to make up for the shortfall in revenues. However, since many 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 (1988) note, this supply expansion played a significant role in explaining the observed weakness in relative commodity prices in 1984–86, despite the rapidly recovering demand for commodities in industrial countries.

In the basic model, the impact of a permanent expansion in world commodity supply, yC, follows intuition. As with the fiscal shock, the adjustment is instantaneous. The expansion in commodity exports reduces the real price of the commodity, $(q/p)'$ (equation (15)), while the impact of the real exchange rate is ambiguous, since it depends on tastes and technology. As the numerator of the multiplier of the commodity stock (equation (16)) makes clear, if good 1 is consumed in a higher proportion than good 2 (that is, $a > (1 - a)$), other things equal, then

10For 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).

the increase in world output increases world demand for good 1 by more than it increases demand for good 2, driving its relative price higher.. If production of good 2 uses the commodity input more intensively than good 1 (that is, $\varepsilon > \gamma$), other things equal, then the production of good 2 rises relative to the output of good 1, and its relative price declines (that is, R goes up). In either case, the cost of the commodity input declines, thereby increasing output in the industrial countries A and B.[11] The higher levels of output, assuming they are not taxed away, increase disposable income and boost consumption in the commodity importing countries (equations (18a) and (18b».

For the commodity supplier, the value of its output may increase or decrease, depending on the ambiguous real exchange rate response. World demand for the commodity input is characterized by a rectangular hyperbola; if no other relative prices change, country C's revenues remain unchanged, since the output increase is exactly offset by a price decline (equation (15»). If the real exchange appreciates, world commodity demand declines, since the decline in country B's commodity costs is smaller.. In such a scenario, the decline in commodity prices (in terms of good 1) more than offsets the increase in output, and the value of country C's output declines. With debt-servicing costs constant, a fall in consumption absorbs the shock. In this case, the gap between the value of output of the developed countries and the developing coun~ry widens.

III. Rate of Time Preference and Nature of the Debt

One of the more unrealistic and uninteresting features of the model is the assumption of an exogenous, common, and constant rate of time preference. Frenkel and Razin (1984, 1987) allow for different discount factors across countries, while Buiter (1987), Frenkel and Razin (1986), Giovannini (1988), and Obstfeld (1989) all follow Blanchard (1985) in assuming that individuals face an uncertain duration of life. Although the latter assumption relaxes the Ricardo-Barro equivalence of debt issue and taxation, the steady-state solution of these models still requires that the real interest rate be determined by, although not necessarily 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).[12]

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

[12] For a survey of this literature, see Obstfeld (1990).

Table 3. *Real Interest Rates and Savings Trends*

Interest and Savings Rate Indicators	Period 1976-80	1981-85
Ex post real interest rate[a] (period average)	0.51	5.78
Saving rates		
Industrial countries: households[b]	9.5	8.1
Developing countries: national[c]	26.9	22.7

Sources: International Monetary Fund (1990a, 1990b), Aghevli and others (1990), and World Bank (1989).

Note: Total long-term debt at floating rates for the 15 heavily indebted countries for 1973–75, 1980–82, and 1987 was 11.4 percent, 34.4 percent, and 51.4 percent, respectively.

[a] Defined as the six-month LIBOR rate less the annual inflation rate in industrial countries.

[b] Aggregate of the United States, Japan, Germany, the United Kingdom, and Canada.

[c] Household data were not available; averages are for 1976–81 and 1982–85.

In the analysis that follows, an attempt is made 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.[13] 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 rates worldwide suggests a shift toward favoring consumption today-an increase in the rate of time preference. I subsequently consider how the system's adjustment to a higher real rate of interest is influenced by the nature of the existing debt stock, namely, whether the debt bears a fixed or variable rate (see Table 3).

Change in Rate of Time Preference in the Basic Model

As with the other shocks considered, a permanent change in the rate of time preference results in an instantaneous adjustment. For households in country C, this increased preference for consuming today cannot be translated into an increase in consumption, since 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. Accordingly, asset market clearing

13This exercise was also analyzed by Giovannini (1988) for the small open economy case.

will require that the real interest rate increase sufficiently, so as to insure that all debt is willingly held. This rise in the interest rate increases interest income for residents of A and B and finances a higher level of consumption.

For the debt-constrained citizens of country C, consumption adjusts according to $Dc^e = -aBcDr$-. Therefore, 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 the deficit in the capital account.

A Variant of the Basic Model with Fixed-Rate Debt

The assumption that all debt yields an instantaneously adjusted variable interest rate produces the starkly negative implications for consumption and welfare of the debtor country when the discount factor, which anchors the world interest rate, rises. Despite rapid increases in recent years in the share of developing country debt that is variable rate, as of 1987 nearly 50 percent of the stock of debt of the 15 most heavily indebted countries was still at fixed rates (Table 3). An alternative scenario is considered here, which although less descriptive of the stylized facts of developing country debt, provides a benchmark against which the previous results can be compared.

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

$$yC(qfpl)' = kB^C + ct + C\sim fR_{\prime\prime}, \qquad (20)$$

where k represents the fixed coupon payment in terms of good 1, and B^C now represents the number of bonds outstanding. As equation (20) 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 or losses. Defining v, as the price of the bond (in terms of good 1), the instantaneous rate of interest is given by

$$r\sim = (kfv,) + Dvfv, \qquad (21)$$

where $Dvfv$ represents the changes in the price of the bond—capital gains or losses. The budget constraints for the creditor countries are[14]

[14] It is evident that the price of the bond, v", cancels out of the budget constraint, but it will be retained for the time being to facilitate illustrating what happens when intertemporal preferences change.

$$DBA = y\tilde{} - m\tilde{} (qlpl)' - \text{ɪr}'(+ (klvt)(v,B\tilde{}) - e\tilde{} - e\tilde{}lR, \quad (22)$$

$$DB^B = y\tilde{}/R, - m\tilde{}(qlpl)t + (klvt)(v,B\tilde{}) - eft - e\tilde{}lR,. \quad (23)$$

As equation (22) 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 (1) the interest rate equals the now higher rate of time preference; and (2) the value of the bond will be stationary, $Dvlv = 0$. These situations imply that when the rate of time preference rises, the price of the bond, v'', instantaneously declines. Households in countries A and B would like to reduce their holding of country C's debt to consume more. This provides no incentive to trade and, instead, after the change in tastes, the value of debt, $vtB\tilde{}$, falls, while the yield, klv'', 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 offixed-rate debt helps insulate the consumer against fluctuations in interest rates.

IV. Conclusion

A simple multicountry model where individuals are infinitely lived but some agents face a liquidity constraint can provide some insight into fluctuations of key relative prices and the disparate economic performance among developed and developing countries that have characterized recent years. As in Giovannini (1988) and Obstfeld (1989), this framework highlights the important role of international factor markets, in this case the commodity market, in transmitting a variety of shocks.

The analysis has highlighted how an expansive fiscal policy in a large country can have negative output and consumption consequences for trading partners with different indebtedness and production profiles. In the second industrial country disposable income falls, owing to lower production and a deterioration in the terms of trade. The commodity exporting country also faces a deterioration in its terms of trade that reduces the value of its output, or increases the burden of debt servicing. Households in the commodity producing country would like to maintain their level of consumption and, in the absence of a liquidity constraint, would have been able to do so by borrowing from its trading partners. Instead, their inability to borrow forces the entire adjustment upon consumption, which also falls.

It has also been shown how the system's adjustment to a higher real rate of interest is influenced by the nature of the existing debt stock, namely, whether the debt bears a fixed or variable rate. In the case where

all debt is variable rate, a rise in the interest rate increases interest income for the residents of the industrial countries and finances a higher level of consumption. For the debt-constrained citizens of the developing country, consumption has to decline in order to meet the higher level of interest payments. The new steady state requires that the commodity supplier have a larger merchandise trade surplus to offset the wider deficit in the capital account.. By contrast, if the debt is a consol with a fixed coupon payment, an increase in the common discount factor leaves consumption of both debtors and lenders 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.

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 interesting, an industrial country bond that allows for debt-financed fiscal deficits, is a major drawback. The inclusion of bond-financed deficits in an uncertain lifetime setup, 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 be along the lines of Antonnini (1987), which by allowing for storability of the commodity input, adds an intertemporal dimension to firms' profit-maximization problem. Such an emendation provides 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 as in Obstfeld (1990), which allows the initial level of consumption (which could be quite different across countries) to playa role in influencing the discount factor applied to future utility.

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