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INTERNATIONAL TRADE, INDEBTEDNESS, AND WELFARE REPERCUSSIONS AMONG SUPPLY-CONSTRAINED ECONOMIES UNDER FLOATING EXCHANGE RATES

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ABSTRACT

Almost all developed economies at some time during the 1970s seemed supply-constrained. Even much of measured excess capacity was arguably redundant due to energy price shocks, environmental policy, and other structural flux of the 1970s. Little analytical work has been carried out on the macroeconomics of open economies under such supply constraints. This paper attempts a beginning. Its focus is on the international transmission of various macroeconomic shocks, and on their implications for the current account, capital account, and exchange rate. The paper captures both the foreign repercussions and the terms-of-trade effects of various shocks.

Conclusions are based on an analytical model that assigns behavior to each of two regions relating to one nontradeable input, one tradeable output, and one tradeable financial asset. International exchange between the two regions is characterized by sequential "temporary equilibria," each consistent with economically and institutionally constrained optimization, yet each simultaneously consistent with failure of output and input markets to clear. International transactions take place in capital markets and through a foreign exchange market that do clear continuously through flexible exchange rates.

The abstract reduced form of the model is derived, then applied empirically, using parameters and initial values that incorporate data and consensus beliefs about the U.S. and the rest of the world in the 1970s. The most important conclusions of the exercise are:

(1) Floating exchange rates fail to insulate either supply-constrained economy from unanticipated shocks in the other. International transmission is direct -- the impacts on the two regions of any shock have the same sign.

(2) Exchange rates and the terms of trade between the supply-constrained economies are moderately sensitive to incomes policies and changes in technology/productivity trends (elasticities of 0.5 to 1.5 in absolute value) and relatively insensitive to fiscal policy and distributionally neutral wage-price guidelines. Wage-favoring incomes policies, liquidity-financed fiscal expansion, tighter wage-price guidelines, and slackening of technology/productivity growth all cause depreciation of the domestic currency and deterioriation of the terms of trade.

(3) These same shocks all promote "internationalization" of commodity and financial markets. Export volume, import volume, claims on foreigners, and indebtedness to them all grow as a result, sometimes by significant amounts (elasticities as high as 1.5 in response to each shock taken independently of the others, and larger elasticities in response to combinations of shocks).

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I. INTRODUCTION

The analytical foundation of traditional international macroeconomics has been as shaken by recent events as that of closed-economy macroeconomics. Its usefulness has been clouded by enduring stagflation, globally parallel declines in capital formation and productivity trends, synchronous cyclical movements even under floating exchange rates, and puzzling volatility and unpredictability of exchange rates.

One of several problems with traditional international macroeconomics is that it often supposes stylized equilibrium states of the world, with thoroughgoing market-clearing. Yet its concerns have much more the flavor of "disequilibrium" states of the world, especially during the past fifteen years, with measures of excess capacity, unemployment, inflationary gaps, labor shortages, and current-account flux suggesting enduring excess supply or demand.

A "disequilibrium" characterization seems especially appropriate to the recurrent global overheating in the 1970s, coupled with widespread recourse to wage-price guidelines and incomes policies. To the extent that such policies were successful (President Carter's were enforced by Federal purchasing threats, for example), output markets have been frequently supply-constrained (with transactions rationed or deferred), and input markets have featured unemployment or shortages depending on whether incomes policies over- or undervalued factors of production.

During the late 1970s, almost all developed economies seemed supply-constrained. Even much of measured excess capacity was arguably redundant

due to energy price shocks, environmental policy, and other structural flux of the 1970s. In the U.S., labor markets seemed similarly supply-constrained even in the presence of unprecedented unemployment, because of the large number of job-seekers who were "structurally unemployed" -- possessing skills or preferences that made them a non-competing group for vacant positions at ruling wages. In European labor markets, by contrast, excess supply seemed more aptly to characterize the 1970s, given the rapid 1972-74 run-up in real wages that was preserved by inertia and indexation (International Monetary Fund (1980), Chapter 1).

Little analytical work has been carried out on the macroeconomics of open economies under such constraints, despite the intriguing correlation of widespread wage-price guidelines, exchange-rate volatility, and the explosion of international trade and investment relative to other economic activity in the early 1970s. This paper attempts a beginning. Its focus is on transmission of various macroeconomic shocks between output-supply-constrained economies and on their implications for the current account, capital account, and exchange rate. For empirical relevance the paper abandons the small-country and fixed-exchange-rate assumptions that have characterized antecedent related research.[1] Unlike the latter, the analysis in this paper treats both the foreign repercussions and the terms-of-trade effects of various shocks.

Section II of the paper describes an analytical model that assigns behavior to each of two regions relating to one nontradeable input, one tradeable output, and one tradeable financial asset. International exchange

between the two regions is characterized by sequential "temporary equilibria," each consistent with economically and institutionally constrained optimization, yet each simultaneously consistent with failure of some markets to clear. International transactions take place through a foreign exchange market that does clear continuously through flexible exchange rates.

Section III and the Appendices describe the reduced form of the model and apply it empirically, using parameters and initial values that incorporate data and consensus beliefs about the U.S. and the rest of the world in the late 1970s. The most important conclusions of the exercise are:

(1) Floating exchange rates fail to insulate either supply-constrained economy from unanticipated shocks in the other. Their international transmission is direct -- the impacts of any shock on the two regions are qualitatively similar. Cross-region spillover effects are, however, quantitatively small relative to the own-region effects.

(2) Exchange rates and the terms of trade between the supply-constrained economies are moderately sensitive to incomes policies and changes in technology/productivity trends (elasticities of 0.5 to 1.5 in absolute value). They are relatively insensitive to fiscal policy and to distributionally neutral wage-price guidelines (elasticities of 0.0 to 0.2 except that the terms of trade are moderately sensitive to the wage-price guidelines). Wage-favoring incomes policies, liquidity-financed fiscal expansion, tighter wage-price guidelines, and slackening of technology/productivity growth all cause depreciation of the domestic currency and deterioration of the terms of trade.

(3) One percent changes in incomes policies and technology/productivity trends in the supply-constrained economies have quantitative impacts on <u>all</u>

variables that are generally 3 to 5 times the impact of one percent changes in government spending or in distributionally neutral wage-price guidelines.

(4) Wage-favoring incomes policies, liquidity-based fiscal expansion, tighter wage-price guidelines, and slackening of technology/productivity growth all promote "internationalization" of commodity and financial markets. Export volume, import volume, claims on foreigners, and indebtedness to them can grow significantly in response to each (elasticities up to 1.5), and especially so in response to several taken together.

II. AN ABSTRACT MODEL

The abstract model that we work with is a structurally symmetric generalization of Malinvaud (1977). Malinvaud explores a closed economy with one input (labor), one output (goods), and one asset (money, also the numeraire). His focus is on the temporary equilibrium attained when economic agents optimize subject to quantity constraints consistent with sluggish prices and the absence of barter.

Our model posits for each economy one input (with others, entrepreneurship and fixed physical capital, implied), one output, one asset (liquid wealth or money), each unique to that economy. Input markets are bounded by national borders; output markets and asset-holding span them. All international transactions are financed through a foreign exchange market with a potentially flexible exchange rate. The model pushes beyond other "internationalizations" of Malinvaud's model by Dixit (1978) and Neary (1979): (i) by eschewing their small-country assumption (which allows them to ignore the terms of trade and foreign repercussions that are an important focus of our work, and to lump exportables and importables into one aggregate "commodity"); and (ii) by analyzing floating in the foreign exchange market in addition to their fixed-exchange-rate regimes.

Each of the two trading economies is subject to potential price sluggishness or government policies that cause output and input markets to clear only slowly compared to foreign-exchange and financial capital "markets". When this happens, the short side of the input or output market rules, in the sense that the volume of transactions carried out matches the smaller of supply and demand. Frustrated sellers or buyers on the

long side of such markets are induced by their rationing there to alter their demands for and supplies of different goods elsewhere, alterations that are referred to as "spillover effects."

Each economy is populated by three groups of agents: households, firms, and government. Households and firms act as price-takers, although the economy as a whole (being large) influences the world price for the unique commodity it produces. The foreign currency price of each country's output is flexible to the extent that the exchange rate is.[2] Governments have the capacity to alter prices and wages by legislative decree. Expectations of future prices and wages are formed taking this into account, but only unanticipated shocks are examined below.

Households are buyers in two markets, for the outputs of firms in both countries. They are sellers in one market, for inputs to domestic firms. The only such input is labor services, the supply of which is fixed exogenously. Households may be constrained in any of these markets in principle, as buyers of either good or as sellers of labor. If rationed as buyers in a product market, households will tend to increase demands in other markets. If rationed as sellers in the labor market, i.e., if unemployed, households will tend to reduce demands in other markets. These are spillover effects of rationing. Households hold liquid financial claims denominated in both domestic and foreign currencies. If such claims pay interest, the interest rate is taken to be invariant given the assumptions of stable wage-price trajectories and a fixed physical capital stock mentioned above. These claims are the means of transferring purchasing power to the future. Households are never rationed in their acquisition of liquid assets, making them and whatever deferred purchases they represent a sink

for current spillover effects.

Firms are sellers in one market, selling their (domestic) output to households in both countries and to the domestic government, and buyers in one market, purchasing only domestic labor services. Firms may be rationed as buyers of labor, in which case their output will be less than they would like, or as sellers of output, in which case the spillover effect is a reduction in their demand for labor services. Firms hold domestic financial claims in an amount equal to current profits (the reward to the implied factors, entrepreneurship and fixed capital), which are then fully distributed to household-shareholders in the subsequent period (see below).

Governments purchase domestic output only (government imports are neglected), and are never rationed. They finance their purchases by creating new domestic money or other liquid assets. Taxes and transfers (including any interest payments on liquid debt) are assumed to balance.

The optimizing behavior of the three groups of agents is expressed in algebraic detail as follows:

Households: Households maximize utility that is defined over current and future[3] consumption of commodities.

$$\underset{X_{ii},X_{ji},M_{ii},M_{ji}}{\text{Max}} \quad V_i(X_{ii}, X_{ji}, M_{ii}, M_{ji});$$

where $i = 1,2$ as $j = 2,1$; and

V_i = an index of household welfare;

X_{ii} = domestic consumption of domestic output;

X_{ji} = domestic consumption of imports;

M_{ii} = household stocks of domestic liquid assets;

M_{ji} = household stocks of foreign liquid assets, net (i.e., net foreign-currency claims).

Household stocks of domestic liquid assets at the beginning of each period are equal to the amount then in existence less the sum of holdings by foreign households and holdings by domestic firms for subsequent distribution to domestic households (see below):

(1) $$M_{ii}^o = L_i^o - (M_{ij}^o + \pi_i^o); \quad \text{where}$$

L_i = country i's stock of financial assets outstanding;

π_i = profits of firms, distributed to household/shareholders the period after firms earn them;

zero superscripts denote beginning-of-period values.

When households are not rationed in any market, the maximization is carried out subject only to the budget constraint:

(2.1) $$p_1X_{11} + rp_2X_{21} + M_{11} + rM_{21} = w_1\bar{N}_1 + \pi_1^o + M_{11}^o + rM_{21}^o$$

(2.2) $$(p_1/r)X_{12} + p_2X_{22} + M_{12}/r + M_{22} = w_2\bar{N}_2 + \pi_2^o + M_{12}^o/r + M_{22}^o$$

where:

p_i = the nominal domestic price of the commodity produced in country i;

r = the exchange rate, the price of country 2's financial assets in units of country 1's financial assets;

w_i = country i's wage rate;

$\bar{N}_i$ = country i's labor force (exogenous), implicitly aggregating across identical households;

When households are rationed as sellers of labor services, excess supply and unemployment characterize labor markets, and $w_i\bar{N}_i$ is replaced in (2) by $w_i\bar{N}_i\ (1 - u_i)$, where:

$u_i = 1 - N_i/\bar{N}_i$ = country i's unemployment rate; and

N_i = employment in country i, again implicitly aggregating across identical households.

Households may be rationed in principle as buyers of country 1's commodity, or of country 2's commodity, or of both. Excess demand then exists in commodity markets. In these cases, household maximization is further constrained in that consumption cannot exceed available supplies:[4]

$$C_{11} + C_{12} \leq Y_1 - G_1 \ ; \tag{3.1}$$

$$C_{21} + C_{22} \leq Y_2 - G_2 \ ; \tag{3.2}$$

where

C_{ij} = rationed (constrained) consumption of country i's output by country j's residents;

Y_i = domestic output;

G_i = government purchases of domestic output.

Firms: Firms maximize current profits, π, as in

$$\underset{N_i,Y_i}{\text{Max}}\ \pi_i(N_i,Y_i), \tag{4}$$

implicitly aggregating across identical firms. When firms are not rationed in any market, the maximization in (4) is carried out subject only to the (aggregate) production function:

$$(5) \qquad Y_i = Y_i(N_i)$$

When firms are rationed as buyers of labor services, excess demand and labor shortages characterize labor markets, and $\bar{N}_i$ (the labor force) replaces N_i (employment) in (5). When firms are rationed as sellers of commodities, incipient excess supply characterizes output markets. Optimizing firms will produce only what they can sell ($X_{ii} + X_{ij} + G_i$, which is predetermined from their point of view), and will employ the minimal amount of labor necessary to do so:

$$(6) \qquad N_i = Y_i^{-1}(X_{ii} + X_{ij} + G_i);$$

where $Y_i^{-1}(\quad)$ is the inverse of the production function in (5), and X_{ii}, X_{ij} take into account any rationing of good j.

Government: Governments do not optimize, but are responsible in their fiscal, monetary, price, and incomes policies for the values of four important exogenous variables: G_i, L_i, p_i, w_i. Fiscal, monetary, and price-control policies are necessarily interdependent. Choice of any two implies the third, as revealed in the government's budget constraint:

$$(7) \qquad p_i G_i = L_i - L_i^o .$$

The Foreign Exchange Market. The foreign exchange market is a financial market that is the locus for trade between the two countries' financial assets and that establishes their relative price (r). This price, the exchange rate, is never sluggish, and therefore the foreign exchange market always clears.[5] These observations are reflected in the familiar requirement that variation in the exchange rate brings about budget-constraint consistency such that a nation's aggregate current account and

capital account sum to zero:

$$(8) \qquad 0 = [p_1 X_{12} - r p_2 X_{21}] + [(M_{12} - M_{12}^o) - r(M_{21} - M_{21}^o)]$$

where

X_{12} should be replaced by C_{12}, and X_{21} by C_{21}, if households are rationed in the corresponding commodities markets;

$M_{ij} - M_{ij}^o$ = trade in financial assets during the period.

It is this market-clearing condition that confirms the link between firms' financial-asset stocks and current profits, mentioned above.[6]

III. AN APPLICATION TO A U.S./REST-OF-WORLD REGIME OF BINDING OUTPUT SUPPLY CONSTRAINTS

As outlined in the introduction, the model of Section II can be usefully applied to global settings of recent vintage (the 1970s), that may also characterize the near future. "Supply constrained" economies are those with measured and "repressed" inflation (Malinvaud (1977)) in markets for their output, where the elements repressing inflation, i.e., rationing or deferring demand, might include contractual sluggishness and any price guidelines or incomes policies of a central government. These same elements plus explicit wage guidelines might lead labor markets to be similarly supply-constrained, but can conceivably cause excess supply as well, for which case the label "classical unemployment" is usually applied (Malinvaud (1977)), and Europe in the 1970s cited as an example.

In this setting both commodity and factor markets will fail to clear, the first being characterized by excess demand, and the second by either excess supply or demand. All these excesses will spill over into markets that are not subject to rationing. These will include financial and foreign exchange markets that seem realistically to clear continuously. Spillovers into financial markets are more accurately thought of as spillovers into future purchases, one counterpart to deferred purchases in current periods.

Since price controls and guidelines are not traditionally applied to exports and imports, excess commodity demand domestically will also spill over into current imports, a spillover that will be accommodated readily by foreign suppliers who are not constrained in export sales and

pricing. Thus although domestic buyers may find themselves rationed, foreign buyers (importers) will not. This last phenomenon has the potential to create infinitely profitable arbitrage, since the prices that suppliers receive on foreign sales can rise relative to those they are allowed on domestic sales. But since export markets for most suppliers are usually smaller than domestic markets, modest reallocations of sales toward exports will generally be sufficient to reduce the export price to its traditional relationship to domestic price,[7] and the arbitrage opportunity will be eliminated. This elimination of infinite arbitrage profits should be immediate and continuous, even when overall markets do not clear. (Suppliers will, of course, make profits on infra-marginal sales adjustments due to arbitrage, thus justifying the arbitrage.)

There is more than a suggestion in this discussion that supply-constrained regimes may be afflicted with volatile responses of exports, imports, capital movements, and exchange rates to wage-price guidelines and other familiar policies. And indeed the potential for volatile international transactions and exchange rates can be confirmed in the abstract using the appropriate version of the model of Section II. But any such demonstration is worthless if these spillovers could not even in principle be quantitatively important determinants of observed volatility. Empirically sensible measures of their impact are not immediately clear.

To address both the empirical and the abstract concerns, we describe below the results from investigating a "central-value version" of Section II's model. Parameter values were chosen "centrally" in the sense that

they reflect well-established empirical regularities: approximate medium-term invariance of budget and factor shares to most changes, and the tendency of estimated own-price and income elasticities of demand to center (in absolute value) around one. Log-linear utility and production functions yield precisely these properties, and, as side benefits, both empirical measurability (shares) and analytical tractability:[8]

$$(9.1) \qquad V_1(X_{11}, X_{21}, M_{11}, M_{21}) = v_1 + \alpha_1 \log X_{11} + \beta_1 \log X_{21} + \gamma_{11} \log M_{11} + \gamma_{21} \log M_{21};$$

$$(9.2) \qquad V_2(X_{12}, X_{22}, M_{12}, M_{22}) = v_2 + \alpha_2 \log X_{12} + \beta_2 \log X_{22} + \gamma_{12} \log M_{12} + \gamma_{22} \log M_{22};$$

as the specific forms of $V_i(\ )$ to be considered, where α's, β's, and γ's denote budget shares, and v's denote constants, and

$$(10) \qquad \log Y_i = \log a_i + \delta_i \log N_i$$

as the specific form of (5), where δ_i denotes a factor share and a_i denotes a constant.

Maximization subject to the constraints that characterize supply-constrained economies as described above, in which all consumers are rationed, yet only in their respective domestic markets, yields the following system of equations. For country 1's commodity exports and imports (2's imports and exports, respectively), effective demands are:

$$(11.1) \qquad p_1X_{12} = \left(\frac{\alpha_2}{1-\beta_2}\right)(r)\quad(w_2N_2 + \pi_2^o + M_{12}^o/r + M_{22}^o - p_2C_{22});$$

$$(11.2) \qquad p_2X_{21} = \left(\frac{\beta_1}{1-\alpha_1}\right)(1/r)\ (w_1N_1 + \pi_1^o + M_{11}^o + rM_{21}^o - p_1C_{11}).$$

Spillover effects on trade as a result of domestic rationing are reflected in the first and last terms on the right-hand side of (11). If wages and prices could vary to clear markets, then the denominators $1-\beta_2$ and $1-\alpha_2$ would be replaced by 1, and the p_iC_{ii} terms would vanish. Unrationed international commodity trade in turn feeds back on domestic output rationing, as reflected in the last term of the domestic demand equations, given the assumed constraints:

$$(12) \qquad C_{ii} = Y_i - G_i - X_{ij}\ .$$

This sets commodity trade apart from international capital movements, which are subject to spillover influences from domestic output rationing, but do not feed back on it. Net international claims (stocks) are given by:

$$(13.1) \qquad M_{12} = \left(\frac{\gamma_{12}}{1-\beta_2}\right)(r)\quad(w_2N_2 + \pi_2^o + M_{12}^o/r + M_{22}^o - p_2C_{22});$$

$$(13.2) \qquad M_{21} = \left(\frac{\gamma_{21}}{1-\alpha_1}\right)(1/r)\ (w_1N_1 + \pi_1^o + M_{11}^o + rM_{21}^o - p_1C_{11}).$$

The exchange rate is sensitive to the spillover effects of domestic rationing on trade and capital movements, as well as reflecting its standard role in valuing relative asset stocks (implicit in the M_{21}^o and M_{12}^o influences below):[9]

$$(14) \qquad r = \frac{\left(\frac{\beta_1+\gamma_{21}}{1-\alpha_1}\right)(w_1N_1 + \pi_1^o + M_{11}^o + rM_{21}^o - p_1C_{11}) - rM_{21}^o}{\left(\frac{\alpha_2+\gamma_{12}}{1-\beta_2}\right)(w_2N_2 + \pi_2^o + M_{12}^o/r + M_{22}^o - p_2C_{22}) - M_{12}^o/r} .$$

In the absence of rationing and spillovers, the exchange rate would reflect only the relative nominal output trends and valuation of national financial asset stocks, in a manner familiar from the monetary/portfolio approach to floating exchange rates.[10]

Wages (w_i), prices (p_i), government spending (p_iG_i), and beginning-of-period values (superscript o) are exogenously fixed by assumption. When firms are rationed in the labor market (repressed inflation), then employment (N_i) and output supply (Y_i) are fixed by the exogenous labor force ($\bar{N}_i$) and by the rule that quantities are dictated by the short side of the market. When households are rationed in the labor market (classical unemployment), then employment and output vary as determined by the production function and the labor demand curve implied by profit maximization.[11] In any event, other variables that are determined endogenously and simultaneously by the system include commodity trade (X_{12}, X_{21}), rationed domestic purchases (C_{11}, C_{22}), international financial claims (M_{12}, M_{21}) and the exchange rate (r).[12]

The simultaneity of the system would be reduced in a fixed exchange-rate regime, as discussed in Appendix A. Reduced-form equivalents of (11) through (14) are derived in Appendix B. Empirical approximations to the reduced form of (11)-(14) are calculated

in Appendix C. Parameters and initial values were chosen to create a stylized but "central-value" representation of the U.S. and the rest of the world in the late 1970s. The discussion below is based on this empirically stylized reduced form, the elements of which are summarized in Table 1.

The multipliers of exogenous variables on endogenous are displayed in elasticity form in Table 2. The table is divided, the left-hand side recording the impact of shocks in country 1, the "stylized U.S.," and the right-hand side recording those in country 2, the "stylized rest-of-the-world."[13] Each column on each side represents a different experiment:

Columns labelled "$-w_i,p_i$" display the impacts of an unanticipated one percent tightening of wage/price guidelines in some overall price controls program.

Columns labelled "w_i" display the impacts of an unanticipated incomes policy that favors labor by one percent (specifically a policy that allows wages to rise one percent faster than prices).[14] Without intending to prejudice we will occasionally refer to such policies below as "progressive" incomes policies.

Columns labelled "a_i" display the impacts of an unanticipated one percent increase in growth due to disembodied technological progress.[15]

Columns labelled "g_i" display the impacts of unanticipated one-percent fiscal expansion, financed either by monetization or by borrowing in liquid financial instruments (see equation (7)).

TABLE 1

STYLIZED EMPIRICAL CORRESPONDENTS TO THE PARAMETERS AND REPRESENTATIVE VALUES OF EQUATIONS (11) THROUGH (14)

Stylized U.S.	Stylized Rest-of-World
Shares	
$\alpha_1 = 0.49$	$\alpha_2 = 0.03$
$\beta_1 = 0.06$	$\beta_2 = 0.57$
$\gamma_{11} = 0.42$	$\gamma_{12} = 0.02$
$\gamma_{21} = 0.03$	$\gamma_{22} = 0.38$
Trillions of U.S. Dollars	
$p_1Y_1 = 2.369$	$r^o p_2Y_2 = 4.738$
$p_1G_1 = 0.476$	$r^o p_2G_2 = 0.953$
$w_1N_1 = 1.796$	$r^o w_2N_2 = 3.591$
$\pi_1^o = 0.517$	$r^o \pi_2^o = 1.034$
$M_{11}^o = 1.238$	$M_{12}^o = 0.174$
$r^o M_{21}^o = 0.138$	$r^o M_{22}^o = 1.966$

Source: Appendix C

TABLE 2

POLICY AND OUTPUT ELASTICITIES IN
SUPPLY-CONSTRAINED OPEN ECONOMIES:

PERCENTAGE EFFECTS ON
ENDOGENOUS VARIABLES
(ROW HEADINGS) OF A ONE PERCENT
CHANGE IN EXOGENOUS VARIABLES
(COLUMN HEADINGS)

Column Heading Legend:

$-w_i, p_i$ = one percent tighter wage/price guidelines in region i with distributional neutrality ($dw_i/w_i = dp_i/p_i = -0.01$).

w_i = one percent looser wage guideline for given price guideline ($dw_i/w_i = 0.01$)

a_i = one percent technological improvement, measured by total factor productivity ($da_i/a_i = 0.01$)

g_i = one percent increase in government spending ($dg_i/g_i = 0.01$)

Exogenous Changes in...

	... Stylized U.S.				... Stylized Rest-of-World			
	$-w_1, p_1^*$	w_1^{**}	a_1	g_1	$-w_2, p_2^*$	w_2^{**}	a_2	g_2
Dollar price of foreign currency (r)	0.04	0.69	-0.91	0.18	-0.05	-0.92	1.21	-0.24
U.S. terms of of trade (p_1/rp_2)	-1.04	-0.69	0.91	-0.18	1.05	0.92	-1.21	0.24
U.S. real welfare (p_1Y_1 deflated by price index of p_1, rp_2)	-0.10	-0.07	0.09	-0.02	0.10	0.09	-0.12	0.02
Foreign real welfare (p_2Y_2 deflated by price index of $p_2, p_1/r$)	0.05	0.03	-0.05	0.01	-0.05	-0.05	0.06	-0.01

	Exogenous Changes in...							
	...Stylized U.S.				...Stylized Rest-of-World			
	$-w_1, p_1^*$	w_1^{**}	a_1	g_1	$-w_2, p_2^*$	w_2^{**}	a_2	g_2
Real U.S. commodity exports (X_{12})	1.03	0.68	-0.89	0.18	0.02	0.31	-0.42	0.08
Real U.S. commodity imports (X_{21})	0.02	0.32	-0.42	0.08	1.05	0.89	-1.18	0.24
Dollar value of U.S. exports (p_1X_{12})	0.03	0.68	-0.89	0.18	0.02	0.31	-0.42	0.08
Dollar value of U.S. imports (rp_2X_{21})	0.06	1.01	-1.33	0.26	-0.00	-0.03	0.03	-0.00
Foreign-currency value of U.S. exports (p_1X_{12}/r)	-0.01	-0.01	0.02	-0.00	0.07	1.23	-1.63	0.32
Foreign-currency value of U.S. imports (p_2X_{21})	0.02	0.32	-0.42	0.08	0.05	0.89	-1.18	0.24
U.S. liabilities to foreigners (M_{12})	0.03	0.61	-0.79	0.16	0.02	0.28	-0.37	0.07
U.S. real claims on foreigners (M_{21})	0.02	0.27	-0.35	0.07	0.04	0.74	-0.98	0.20
Foreign-currency value of liabilities to foreigners (M_{12}/r)	-0.01	-0.08	0.12	-0.02	0.07	1.20	-1.58	0.31

Exogenous Changes in...

	... Stylized U.S.				... Stylized Rest-of-World			
	$-w_1, p_1^*$	w_1^{**}	a_1	g_1	$-w_2, p_2^*$	w_2^{**}	a_2	g_2
Dollar value of real claims on foreigners (rM_{21})	0.06	0.96	-1.26	0.25	-0.01	-0.18	0.23	-0.04
Real domestic purchases in U.S. (C_{11})	-0.14	-0.10***	1.55	-0.31	-0.00	-0.04	0.06	-0.01
Real domestic purchases in rest-of-world (C_{22})	-0.00	-0.02	0.03	-0.01	-0.06	-0.06***	1.41	-0.28

*The impact of one percent looser price guidelines, with no change in wage guidelines ($dp_i/p_i = 0.01$), can be obtained by adding the entries in the $-w_i, p_i$ column to those in the w_i column, then reversing the sign. These results would represent the impacts from an unanticipated incomes policy within wage-price guidelines that favored "capital" instead of labor. For the parameters underlying the table (specifically $\delta_i = 0.757$), a one percent increase in price with no change in wage represents an increase in returns to "capital" of 4.12 percent.

**For every experiment except those in the w_i columns, there are no employment (N_i) or output (Y_i) effects even when households are rationed in labor markets, so that firms are on their labor demand curves, and employment is negatively responsive to the real wage (w_i/p_i). This is because neither equiproportional wage-price guidelines ($-w_i, p_i$), technological improvement (a_i), nor fiscal policy (g_i), alters the real wage (w_i/p_i). w_i policy, by contrast, does, and hence causes N_i and Y_i to fall when there is excess supply in labor markets (not otherwise). One percent looser wage guidelines in either region, for given price guidelines ($dw_i/w_i = 0.01$) causes employment to fall (and unemployment to rise) 4.12 percent, and causes output to fall 3.12 percent. Such employment-output adjustments do not alter the elasticites recorded in the w_i columns, except in the case of C_{ii}, for reasons outlined in Appendix C.

***These entries are appropriate only to the case of supply constraint (excess demand) in the labor market. When, by contrast, households are rationed in the labor market and firms are on their labor demand curves, the appropriate entries are: for C_{11}, -4.55 for C_{22}, -4.22

It is an interesting property of the log-linear utility and production functions employed to establish central values that the results of Table 2 are, with two exceptions, invariant to whether the labor market features excess demand or excess supply. In the former case, employment (N_i) and output (Y_i) are unaffected by any of the shocks (being fixed at $\bar{N}_i$ and $Y_i(\bar{N}_i)$; in the latter, both respond negatively to an increased wage (w_i), but in a quantitatively offsetting way.[16]

Table 2 reveals the following conclusions:

(1) Cleanly floating exchange rates do not insulate either supply-constrained region from shocks in the other. They would have done so only if financial claims on foreigners and indebtedness to them had been zero. With positive international claims and indebtedness, each exogenous change causes exchange-rate-related capital gains and losses on national portfolios that alter real demands for goods and assets.

(2) The international transmission of shocks between supply-constrained regimes under floating exchange rates is direct. Each policy, and productivity-based growth as well, generates an effect abroad that is qualitatively similar to that at home. Additional rationing at home causes increased spillover purchases of unconstrained imports from foreign producers (at flexible prices) and these ration out additional foreign buyers. In symmetric fashion, relief from domestic rationing creates repercussions abroad that relieve foreign rationing as well. Such "rationing repercussions" increase the sensitivity of domestic shortages to any given domestic policy or change.

(3) The quantitative size of this international transmission is important only for real welfare (national purchasing power). Otherwise, own-country influences are generally 3 to 40 times larger than cross-country influences.[17] The results provide little practical support for international policy coordination that is rooted in avoiding the import of foreign vice (e.g.

imported rationing and inflationary pressure) or in encouraging the import of foreign virtue (e.g. locomotive or convoy approaches).

(4) The quantitative impacts of what might be loosely called "supply-side" policies -- towards factor shares (w_i columns) and growth (a_i columns) -- are, with a few exceptions, from 3 to 5 times larger than the quantitative impacts of more traditional wage-price controls ($-w_i, p_i$) and fiscal initiatives (g_i).

(5) Distributionally neutral wage-price guidelines, "progressive" (in the sense of favoring wages) incomes policies, and liquidity-based fiscal expansion all have qualitatively similar effects. All such policies weaken a nation's currency in the foreign exchange market, with consequent terms-of-trade deterioration and a decline in its standard of living (as measured by national purchasing power). (The impacts on real national welfare are, however, quantitatively small.) Technology-based output growth, by contrast, strengthens a nation's currency, improves its terms of trade and standard of living, and loosens up the ration that constrains domestic purchasers, thereby reducing shortages and order backlogs.[18] Under fixed exchange rates the national welfare effects of these policies are hidden in official-reserve changes, as Appendix A implies.

(6) Tighter wage-price controls, more "progressive" incomes policies, and fiscal expansion all ration domestic consumers more tightly (reduce C_{ii}), as one would expect. And...

(7) ...frustrated purchasing power spills over toward unconstrained imports of commodities (rp_2X_{21} for 1; p_1X_{12}/r for 2) and toward claims on future commodities (M_{11} and rM_{21} for 1; M_{22} and M_{12}/r for 2); ...

(8) ... such international spillovers of purchasing power cause

exchange-rate depreciation that, in turn, causes ...

(9) ...real exports of both commodities and ownership of domestic assets (X_{ij} and M_{ij} stocks for country i) to vary positively with wage-price controls, "progressive" incomes policies, and fiscal expansion, counter to casual intuition, but consistent with the remarkable burgeoning of export volume and international liabilities during the inflation-prone early 1970s in which each of these policies enjoyed some unanticipated prominence.

(10) Finally, because these policies cause spillover increases in imports and claims on foreigners, as well as exports and liabilities to them,[19] they could all be characterized as increasing the "internationalization" of commodity and financial capital markets, in a way that again seems consistent with observation in the 1970s.

(11)-(15) Conversely to (6)-(10), technological progress, productivity growth, and supply expansion shrink supply constraints and rationing dramatically, leading to currency appreciation, larger imports and exports, symmetric changes in international asset positions, and declining "internationalization" of world commodity and asset markets.

APPENDIX A

REDUCED FORM OF AND CONCLUSIONS FROM MODEL UNDER FIXED EXCHANGE RATES

If the exchange rates were fixed between two supply-constrained economies as described in the text, then equations (11)-(13) could describe them, with (14) being overruled by the authorities' exchange-rate target, enforced by the requisite foreign-exchange-market intervention.[A1] The reduced form of the system is recorded below, and is established by solving (11) and (12) simultaneously for X_{12}, X_{21}, C_{11}, and C_{22}, then using these solution values to solve (13) recursively for M_{12} and M_{21}:

$$(11.1A) \qquad p_1X_{12} = \left(\frac{1}{\Delta}\right)\left(\frac{\alpha_2}{1-\beta_2}\right)\left[\left(\frac{\beta_1}{1-\alpha_1}\right)\bar{Z}_1 + r\bar{Z}_2\right];$$

$$(11.2A) \qquad p_2X_{21} = \left(\frac{1}{\Delta}\right)\left(\frac{\beta_1}{1-\alpha_1}\right)\left[\bar{Z}_1/r + \left(\frac{\alpha_2}{1-\beta_2}\right)\bar{Z}_2\right];$$

where

$$\Delta = \left(\frac{\beta_1}{1-\alpha_1}\right)\left(\frac{\alpha_2}{1-\beta_2}\right) - 1, \text{ negative in sign;}$$

$$\bar{Z}_1 = p_1Y_1 - p_1G_1 - w_1N_1 - \pi_1^o - M_{11}^o - rM_{21}^o;$$

$$\bar{Z}_2 = p_2Y_2 - p_2G_2 - w_2N_2 - \pi_2^o - M_{12}^o/r - M_{22}^o$$

$$(12.1A) \qquad p_1C_{11} = -\left(\frac{1}{\Delta}\right)\left[p_1Y_1 - p_1G_1 - \left(\frac{\beta_1}{1-\alpha_1}\right)\left(\frac{\alpha_2}{1-\beta_2}\right)\left(w_1N_1 + \pi_1^o + M_{11}^o + rM_{21}^o\right) + \left(\frac{\alpha_2}{1-\beta_2}\right) r\bar{Z}_2\right];$$

$$(12.2A) \qquad p_2C_{22} = -\left(\frac{1}{\Delta}\right)\left[\left(\frac{\beta_1}{1-\alpha_1}\right)\bar{Z}_1/r + p_2Y_2 - p_2G_2 - \left(\frac{\beta_1}{1-\alpha_1}\right)\left(\frac{\alpha_2}{1-\beta_2}\right)\left(w_2N_2 + \pi_2^o + M_{12}^o/r + M_{22}^o\right)\right].$$

$$(13.1A) \qquad M_{12} = \left(\frac{\gamma_{12}}{\alpha_2}\right) p_1X_{12} \qquad \text{from (11.1A);}$$

$$(13.2A) \qquad M_{21} = \left(\frac{\gamma_{21}}{\beta_1}\right) p_2X_{21} \qquad \text{from (11.2A).}$$

Table A1 records selected results from a "central-value" version of equations (11A)-(13A),[A2] where the parameters underlying the calculations are those described in Table 1 of the text and in Appendix C. Table A1 is directly comparable to Table 2 of the text, the former giving results under rigidly fixed exchange rates and the latter under cleanly floating exchange rates.

The conclusions from Table A2 are qualitatively the same as those from Table 2. Even the absolute size of the quantitative differences is not great, suggesting that supply-constrained economies as large and "closed" as these do not respond very differently to unanticipated shocks from exchange-rate system to exchange-rate system. Two differences are notable, however, and are summarized in the following:

(1) Floating exchange rates do provide a measure of insulation. Under floating, domestic shortages and rationing are less affected by foreign influences than under fixed exchange rates.

(2) Under floating exchange rates, wage-price guidelines, incomes policy, growth/technology flux, and fiscal/monetary initiatives all have less pronounced effects on imports of goods and ownership of assets, and more pronounced effects on exports of goods and ownership of assets than under fixed exchange rates. Exchange rate adjustment wipes out a large portion of the import effect and creates most of the export effect.

TABLE 1

SELECTED POLICY AND OUTPUT ELASTICITIES IN SUPPLY-CONSTRAINED OPEN ECONOMICS UNDER FIXED EXCHANGE RATES:

PERCENTAGE EFFECTS ON ENDOGENOUS VARIABLES (ROW HEADINGS) OF A ONE PERCENT CHANGE IN EXOGENOUS VARIABLES (COLUMN HEADINGS)

	Stylized U.S.				Stylized Rest-of World			
	$-w_1, p_1^*$	w_1^{**}	a_1	g_1	$-w_2, p_2^*$	w_2^{**}	a_2	g_2
Real U.S. commodity exports (X_{12})	1.01	0.06	-0.08	0.02	0.05	1.10	-1.45	0.29
Real U.S. commodity imports (X_{21})	0.05	0.93	-1.23	0.25	1.01	0.13	-0.17	0.03
U.S. liabilities to foreigners (M_{12})	0.01	0.05	-0.07	0.02	0.04	0.98	-1.29	0.26
U.S. real claims on foreigners (M_{21})	0.04	0.83	-1.09	0.22	0.01	0.12	-0.15	0.03
Real domestic purchases in the U.S. (C_{11})	-0.14	-0.01^{***}	1.44	-0.29	-0.01	-0.15	0.20	-0.04
Real domestic purchases in rest-of-world (C_{22})	-.0.00	-0.06	0.08	-0.02	-0.07	-0.01^{***}	1.35	-0.27

*, **, ***See notes to Table 2 of the text.

APPENDIX B

REDUCED FORM OF MODEL UNDER CLEANLY FLOATING EXCHANGE RATES

When exchange rates are allowed to float cleanly between the two supply-constrained economies described by the model, the exchange rate (r) that appears in equations (11)-(13) of the text and in equations (11A)-(13A) of Appendix A is endogenous. Its value is determined from equation (14) of the text, rearranged to express r as a function of C_{11} and C_{22}, then solved simultaneously with (11) and (12) for r, X_{12}, X_{21}, C_{11}, and C_{22}. The resulting expressions can be used to solve (13) recursively for M_{12} and M_{21}:

$$(11.1B)\qquad p_1X_{12} = Z_1 \cdot \frac{\left(\frac{\beta_1}{1-\alpha_1}\right)\left(1+\frac{\gamma_{21}}{\beta_1}\right) - \frac{M^o_{12}}{Z_1} - \left(\frac{\beta_1}{1-\alpha_1}\right)\frac{M^o_{21}}{Z_2} + \left(1-\frac{\gamma_{21}}{1-\alpha_1}\right)\frac{M^o_{12}}{Z_1}\frac{M^o_{21}}{Z_2}}{\varepsilon_1 - \left(\frac{1-\beta_2}{\alpha_2}\right)\left(\varepsilon_1 - \frac{\gamma_{12}}{\alpha_2}\Delta\right)\frac{M^o_{21}}{Z_2}}$$

$$(11.2B)\qquad p_2X_{21} = Z_2 \cdot \frac{\left(\frac{\alpha_2}{1-\beta_2}\right)\left(1+\frac{\gamma_{12}}{\alpha_2}\right) - \left(\frac{\alpha_2}{1-\beta_2}\right)\frac{M^o_{12}}{Z_1} - \frac{M^o_{21}}{Z_2} + \left(1-\frac{\gamma_{12}}{1-\beta_2}\right)\frac{M^o_{12}}{Z_1}\frac{M^o_{21}}{Z_2}}{\varepsilon_2 - \left(\frac{1-\alpha_1}{\beta_1}\right)\left(\varepsilon_2 - \frac{\gamma_{21}}{\beta_1}\Delta\right)\frac{M^o_{12}}{Z_1}}$$

where

$$\Delta = \left(\frac{\beta_1}{1-\alpha_1}\right)\left(\frac{\alpha_2}{1-\beta_2}\right) - 1, \text{ negative in sign;}$$

$$\varepsilon_1 = \left(\frac{\beta_1}{1-\alpha_1}\right)\left(1+\frac{\gamma_{21}}{\beta_1}\right) - \left(1+\frac{\gamma_{12}}{\alpha_2}\right), \text{ negative in sign;}$$

$$\varepsilon_2 = \left(\frac{\alpha_2}{1-\beta_2}\right)\left(1+\frac{\gamma_{12}}{\alpha_2}\right) - \left(1+\frac{\gamma_{21}}{\beta_1}\right), \text{ negative in sign;}$$

$$Z_1 = p_1Y_1 - p_1G_1 - w_1N_1 - \pi^o_1 - M^o_{11}, \text{ negative in sign;}$$

$$Z_2 = p_2Y_2 - p_2G_2 - w_2N_2 - \pi^o_2 - M^o_{22}, \text{ negative in sign.}$$

$$(12.1B)\quad p_1 C_{11} = p_1 Y_1 - p_1 G_1 - p_1 X_{12} \quad \text{from (11.1B)}$$

$$(12.2B)\quad p_2 C_2 = p_2 Y_2 - p_2 G_2 - p_2 X_{21} \quad \text{from (11.2B)}$$

$$(13.1B)\quad M_{12} = \left(\frac{\gamma_{12}}{\alpha_2}\right) p_1 X_{12} \quad \text{from (11.1B);}$$

$$(13.2B)\quad M_{21} = \left(\frac{\gamma_{21}}{\beta_1}\right) p_2 X_{21} \quad \text{from (11.2B);}$$

$$(14B)\quad r = \frac{Z_1 \cdot \left\{\left(\frac{\beta_1}{1-\alpha_1}\right)\varepsilon_2 + \left[\left(\frac{\alpha_2}{1-\beta_2}\right)\varepsilon_1 - \Delta\right]\frac{M_{12}^o}{Z_1}\right\}}{Z_2 \cdot \left\{\left(\frac{\alpha_2}{1-\beta_2}\right)\varepsilon_1 + \left[\left(\frac{\beta_1}{1-\alpha_1}\right)\varepsilon_2 - \Delta\right]\frac{M_{21}^o}{Z_2}\right\}}$$

Table 2 and the accompanying discussion is based on the central-value version of the reduced-form system (11B)-(14B). The presence of the terms $\frac{M_{12}^o}{Z_1}$ and $\frac{M_{21}^o}{Z_2}$ is quite striking, because it is solely their influence that undermines the insulation properties of cleanly floating exchange rates.

In the absence of any international financial claims or liabilities ($M^o_{12} = M^o_{21} = 0$), floating exchange rates would guarantee insulation: X_{12}, C_{11}, and M_{12} would depend on the country 1 variables in Z_1 alone, and not on Z_2; X_{21}, C_{22}, and M_{21} would depend on Z_2 alone, and not on Z_1. A peculiarity of such insulation would be that each supply-constrained region could independently influence its real exports and the domestic-currency value of its liabilities to foreigners, but would have no ability to influence its real imports or the foreign-currency value of its claims on foreigners.

APPENDIX C

DATA SOURCES AND NOTES FOR CENTRAL-VALUE VERSION OF MODEL

Sources for Data in Table 1:[C1]

p_1Y_1: U.S. gross national product in 1979 ($2.369 trillion).

p_1G_1: U.S. government spending on goods and services in 1979 ($0.476 trillion).

w_1N_1: U.S. share of national income represented by employee compensation in 1979 applied to p_1Y_1 (1.459/1.925 times $2.369 trillion).

$\pi_1^o + M_{11}^o$: U.S. liquid[C2] wealth at the end of 1978 (measured by "L") - M_{12}^o (see below) ($1.930 trillion - $0.174 trillion).

$r^oM_{21}^o$: U.S.-owned foreign currency and foreign short-term[C2] assets at the end of 1978, from U.S. Department of Commerce, Survey of Current Business, August 1979, p. 56, lines 12, 20, and 22 and 23 ($0.138 trillion).

$r^op_2Y_2$, $r^op_2G_2$, $r^ow_2N_2$: twice the value of their U.S. counterparts.

M_{12}^o: foreign-owned U.S. currency and short-term[C2] assets at the end of 1978, from U.S. Department of Commerce, Survey of Current Business, August 1979, p. 56, lines 39, 41, and 43 ($0.174 trillion).

$r^o\pi_2^o + r^oM_{22}^o$: arbitrary value of rest-of-world liquid[C2] wealth chosen to be somewhat less than p_2Y_2/p_1Y_1, in order to reflect maintained hypothesis (see footnote 13 to the text) that rest-of-world is less wealthy relative to income than the U.S.; dollar value of foreign "L" less $r^oM_{21}^o$ set equal to $3.000 trillion.

α_1, β_1, γ_{11}, γ_{21}: established from simultaneous solution of the budget share equations consistent with constrained maximization of the log-linear utility function (9.1) from the text --

$$\frac{\gamma_{11} + \gamma_{21}}{\alpha_1 + \beta_1} = \frac{\pi_1^o + M_{11}^o + r^o M_{21}^o}{p_1 Y_1 - p_1 X_{12} + r p_2 X_{21}} = \frac{1.756 + 0.138}{2.373} ;$$

$$\frac{\gamma_{11}}{\gamma_{21}} = \frac{\pi_1^o + M_{11}^o}{r^o M_{21}^o} = \frac{1.756}{0.138} ;$$

using data above;

$\frac{\alpha_1}{\beta_1}$ = ratio of U.S. budget share for domestic purchases to U.S. budget share for imports = approximately 8;

$$\alpha_1 + \beta_1 + \gamma_{11} + \gamma_{21} = 1$$

α_2, β_2, γ_{12}, γ_{22}: established from simultaneous solution of the budget share equations consistent with constrained maximization of the log-linear utility function (9.2) from the text --

$$\frac{\gamma_{12} + \gamma_{22}}{\alpha_2 + \beta_2} = \frac{M_{12}^o + r^o \pi_2^o + r^o M_{22}^o}{r^o p_2 Y_2 - r^o p_2 X_{21} + p_1 X_{12}} = \frac{0.174 + 3.000}{4.733} ;$$

$$\frac{\gamma_{22}}{\gamma_{12}} = \frac{r^o \pi_2^o + r^o M_{22}^o}{M_{12}^o} = \frac{3.000}{0.174} ;$$

using data above;

$\frac{\beta_2}{\alpha_2}$ = ratio of rest-of-world budget share for domestic purchases to rest-of-world budget share for imports from the U.S. = approximately 17.

$$\alpha_2 + \beta_2 + \gamma_{12} + \gamma_{22} = 1.$$

D_1, D_2 (implied values of inflationary gaps (shortages or deferred purchases) from data above): \$0.151, \$0.297, each approximately 6 percent of $p_1 Y_1$ or $r^o p_2 Y_2$, respectively (see footnote 12 to the text).[C3]

Excess Supply or Demand in the Labor Market: Invariance of the International Trade Results to the Issue

It will be shown that Z_i, on which all but two of the reduced-form results rest in Appendix B, has the same elasticity with respect to w_i regardless of the type or size of non-market-clearing in the labor market.

Z_i's are defined by

$$Z_1 = p_1Y_1 - p_1G_1 - w_1N_1 - \pi_1^o - M_{11}^o;$$

$$Z_2 = p_2Y_2 - p_2G_2 - w_2N_2 - \pi_2^o - M_{22}^o .$$

When firms are rationed in labor markets, so that employment (N_i) is fixed at $\bar{N}_i$ by supply, and output at $Y_i(\bar{N}_i)$, the elasticity of Z_i with respect to w_i (say E_{Z_i,w_i}) is given by:

$$E_{Z_i,w_i} \equiv \frac{\partial Z_i}{\partial w_i} \cdot \frac{w_i}{Z_i} = \frac{w_iN_i}{Z_i}$$

When households are rationed in labor markets, employment (N_i) is determined by firms' labor demand curves, which have a real-wage elasticity of $1/(\delta_i - 1)$ for log-linear production functions such as (10).[C4] Output (Y_i) is determined by employment, with an employment elasticity of δ_i for log-linear production functions such as (10), making output indirectly elastic to real wages to a degree given by the product of the last two elasticities: $\delta_i/(1 - \delta_i)$. Making use of simple rules for elasticity operators ($E_{AB} = E_A + E_B$; $E_{A+B} = AE_A/(A+B) + BE_B/(A+B)$), it can be readily seen that the elasticity of Z_i with respect to w_i is the same as above:

$$E_{Z_i,w_i} = p_iY_iE_{Y_i,w_i}/Z_i - w_iN_i(E_{w_i,w_i} + E_{N_i,w_i})/Z_i$$

$$= \frac{P_iY_i}{Z_i}\ \frac{\delta_i}{\delta_i - 1} - \frac{w_iN_i}{Z_i}\left(1 + \frac{1}{\delta_i - 1}\right)$$

$$= -\frac{\delta_i}{1-\delta_i}\left(\frac{p_iY_i - w_iN_i}{Z_i}\right)$$

which, remembering that δ_i is labor's share of p_iY_i given log-linear production functions

$$= -\frac{w_iN_i}{p_iY_i - w_iN_i}\left(\frac{p_iY_i - w_iN_i}{Z_i}\right)$$

$$= -\frac{w_iN_i}{Z_i}$$

as above. A similar progression will yield the same result for $\bar{Z}_i$, on which the reduced-form results rest in Appendix A.

FOOTNOTES

[1]Related efforts that apply temporary-equilibrium or "disequilibrium" insights to international macroeconomics include Brito and Richardson (1975, 1977), Cuddington (1979, 1980), Dixit (1978), Gordon (1977), Grossman, Hanson, and Lucas (1977), Owen (1979), Neary (1979), and Steigum (1979).

[2]On the usefulness of the assumptions of price-taking agents and "price-setting" large open economies, see Muellbauer and Portes (1978, pp. 817-818).

[3]Financial assets are the means by which consumption can be transferred between the present and the future. Current household stocks of assets thus vary directly, ceteris paribus, with intended future consumption, and can be taken to represent it. That is one reason why they appear in the household utility function. Another is any intrinsic "utility value" that they may have. Expectations are, as mentioned, assumed to be stable because of our principal focus in this paper on shocks that are difficult or impossible to anticipate.

[4]When both countries' households are rationed in either goods market, then rationing rules must be defined to allocate available supplies $(Y_i - G_i)$ between domestic and foreign buyers. Such rationing rules further constrain the household maximization process. For examples: (i) ration according to historical shares -- $(C_{ii}/C_{ij}) = (C_{ii}/C_{ij})^o$; (ii) ration the larger purchaser only -- $C_{ii} = \min (X_{ii}, (0.5) \text{ times } (Y_i - G_i))$, $C_{ij} = Y_i - G_i - C_{ii}$; (iii) discriminate against foreign buyers -- $C_{ii} = \min (X_{ii}, Y_i - G_i)$, $C_{ij} = Y_i - G_i - C_{ii}$.

[5]Instantaneous clearing in the foreign exchange market remains characteristic even under "fixed" exchange rates and managed floating, once account is taken of both private (firm and household) and official (government) supplies and demands. Excess <u>private</u> supply of or demand for foreign exchange still exist in this case, however, and hence a "balance of payments" can be defined. But the exchange rate is nevertheless flexible, and responsive to both government intervention and private action.

[6]This can be seen by summing the household and government budget constraints ((2) and (7)), adding and subtracting exports of goods (p_1X_{12} if unconstrained) and rearranging the result in order to apply the substitution of $(M_{12} - M_{12}^o) - r(M_{21} - M_{21}^o)$ for $-p_1X_2 + rp_2X_{21}$ from (8):

$$\pi_i - \pi_i^o = (L_i - L_i^o) - (M_{ii} - M_{ii}^o) - (M_{ij} - M_{ij}^o) .$$

from which, using (1):

$$\pi_i = L_i - (M_{ij} + M_{ii}) .$$

[7]There are many reasons why export prices will differ in equilibrium from domestic prices, including taxes, transport costs, and price discrimination (Kravis and Lipsey (1971, 1977)). The text describes how price controls and extraordinary sluggishness can cause the actual wedge between export and domestic prices to diverge temporarily from the equilibrium wedge, creating supplier arbitrage that restores the equilibrium wedge. Note that this would imply that uncontrolled export prices would change at the same rate as domestic prices subject to control. In the U.S., between 1971 and mid-1980, the ratio of U.S. export unit values to wholesale prices rose at an average annual rate of only 0.7 percent per year (International Monetary Fund, International Financial Statistics).

[8]The use of specific and empirically plausible functions in this way has illustrative precedent as a means of easing computational burdens and alleviating indeterminacy in both the disequilibrium-macroeconomics literature (Malinvaud (1977), Muellbauer and Portes (1978, Appendix), Ito (1978)) and in the exchange rate-dynamics literature (Dornbusch (1976), Flood (1979)).

[9](14) is obtained by substituting (11) and (13) into (8) and partially solving for r -- "partially solving" in the sense that r remains on the right-hand side of (14) as well, in both numerator and denominator.

[10]This can be seen in (14) by observing that the $P_i C_{ii}$'s would vanish without rationing, and the $w_i N_i$'s could be rewritten is nominal output ($p_i Y_i$) less current profits, where current profits are exactly equal to firms' stocks of financial assets. See equation (1) and footnote 6 above.

[11]We do not highlight these for reasons cited in footnote 12. But they are easily calculated - see note** to Table 2.

[12]We have ignored certain other endogenous variables, such as domestic asset stocks (M_{11}, M_{22}) and measures of the "inflationary gap" because of the international focus of our paper. They are easily examined, however, using the results from Table 2, because they are recursively determined with respect to the impacts recorded there. They, too, are influenced fundamentally by spillovers, even with respect to their functional determinants, making conclusions that rely on "stable" behavior (e.g., the demand for cash balances or the Phillips curve) doubtful at best. Each country's aggregate "inflationary gap" or "shortage" (D_1,D_2) would be best measured by the excess of notional demand facing its domestic producers over available supply:

$$D_1 = \alpha_1(w_1 N_1 + \pi_1^o + M_{11}^o + r M_{21}^o) + X_{12} + G_1 - Y_1;$$

$$D_2 = \beta_2(w_2 N_2 + \pi_2^o + M_{12}^o/r + M_{22}^o) + X_{21} + G_2 - Y_2.$$

It is worth noting the implicit international interdependence of inflationary gaps in these equations. The unconstrained X_{12} and X_{21} should be obtained

from equations (11), and will reflect spillovers. Hence D_1 will depend through X_{12} on rationing in country 2 (C_{22}, which will be reflected in D_2), and D_2 will depend likewise on rationing in country 1 (C_{11}, which will be reflected in D_1). International transmission of rationing, gaps, and shortages is discussed below and in Appendix A.

[13]Comparisons of the left-hand side results to their counterparts on the right-hand side provide an elementary sensitivity analysis for the calculations. All of the results are quantitatively robust to the one change in parameters implicit in focussing on one region compared to the other. The two stylized regions are asymmetric in that: (i) the U.S. is wealthier relative to its income than the rest of the world (about 20% better endowed with liquid wealth relative to income); (ii) the U.S. is more "open" than the rest of the world taken together (trade is about 10 percent of output, rather than 5 percent; liquid liabilities to foreigners are around 9 percent of liquid wealth, rather than 4 percent); and (iii) the U.S. is a net debtor on liquidity account (net international indebtedness equal to roughly 2 percent of liquid wealth) whereas the rest of the world is a net creditor (net claims on the U.S. equal to roughly 1 percent of rest-of-world liquid wealth).

[14]Note * to Table 2 describes the way to determine the impacts of an incomes policy that favors profits.

[15]The impacts of a guidelines program that allowed permissible wage increases to exceed permissible price increases by the amount that productivity increases exceeded a critical value (maybe zero) can be calculated by adding the entries in the "w_i" column to those in the "a_i" column. It will be observed that this kind of productivity-conditioned incomes policy has qualitatively opposite effects to unconditional incomes policies that favor wages.

[16]See Appendix C below and note ** to Table 2.

[17]This conclusion has nothing to do with "small-country effects." The two regions are in ratio roughly 1:2 in size. See footnote 13.

[18]The effect of a region's output growth on its inflationary gap (D_i from footnote 12) is negative and substantial -- revealed in elasticities of 15 or so in absolute value.

[19]Note that Table 2's entries also suggest that wage-price guidelines, "progressive" incomes policies, fiscal expansion, and technological sluggishness will "weaken" a nation's current account. Under floating exchange rates, there would be a concomitant "improvement" in the capital account ($(M_{12} - M_{12}^{o}) - r(M_{21} - M_{21}^{o})$ for country 1; $(M_{21} - M_{21}^{o}) - (M_{12} - M_{12}^{o})/r$ for country 2)) that is not directly revealed in Table 2 because of its focus on asset <u>stocks</u> rather than asset flows. It is worth noting that all shocks cause real commodity exports (X_{ij} for country i) to move parallel with commodity imports (X_{ji} for country i), and also to move parallel with stocks of liabilities to foreigners (M_{12}), which themselves move parallel with the stock of claims on foreigners (M_{21}). This seems to suggest the possibility of simultaneous surpluses (or deficits) on both "real" current account and capital account. Such "real" changes are of course consistent with cleanly floating exchange rates, and are actually accommodated by them to bring about market-clearing in the foreign exchange market through re-valuation of commodity trade and through capital gains or losses on existing portfolio positions (M_{12}^{o} and M_{21}^{o}).

FOOTNOTES TO APPENDIX A

[A1] Intervention in the foreign exchange market (purchases of or sales from official currency hoards) would necessarily alter stocks of liquidity available to the public, and would have to be added to or subtracted from the right-hand side of equation (8) (the government's budget constraint). Official-reserve transactions with the public would also provide a sink for any excess stock supply/demand of liquidity, additional to those discussed in footnote 6.

[A2] Table A1 records only elasticities of X_{12}, X_{21}, M_{12}, M_{21}, C_{11}, and C_{22} with respect to various shocks. These are all "real" magnitudes. The corresponding elasticities for domestic-currency values of the same variables are either identical or differ numerically by 1. The corresponding elasticities for foreign-currency values are, under fixed exchange rates, equal to those for domestic-currency values. Terms-of-trade and welfare effects are not immediately relevant under fixed exchange rates, since current- and capital-account changes are financed out of official reserves (although one might attach welfare significance to such changes in reserves, and reserve losses may just postpone the exchange-rate, terms-of-trade and welfare effects described in Table 2 of the text).

FOOTNOTES TO APPENDIX C

C1 Except where noted, data was taken from Board of Governors of the Federal Reserve System, Federal Reserve Bulletin, May 1980.

C2 Measures of liquid wealth were chosen because of the belief that it, rather than illiquid wealth, would be the sink for spillover effects due to temporary non-market-clearing. For the same reason, only it appears explicitly in household budget constraints (equations (2) of the text), and as an influence on the exchange rate (equation (8) of the text).

C3 This proportion may seem unduly large, since given log-linear utility functions (unit-price-elastic demand functions), and given repressed inflation and the fixed output supply ($\bar{Y}_i$) that would accompany excess demand in the labor market, 6 percent gaps would correspond to sluggish or controlled prices that were roughly 6 percent below market-clearing levels. Given classical unemployment, however, with excess supply in the labor market and output supply elasticities of roughly 3 ($\delta_i/(1-\delta_i)$, as shown below) with respect to price, 6 percent gaps would correspond to holding prices only 1.5 percent below market-clearing levels. And in any event: (i) outright shortages represent only a fraction of inflationary gaps, the remainder being accounted for by delivery delays; (ii) shortfalls of current production over "normal" demand may be considerably smaller than 6 percent, which is a proportion that is mushroomed by previous periods' accumulated shortages, deferred purchases, and spillover effects.

C4 Employment is determined by setting labor's marginal product equal to its real wage; which for (10) implies:

$$\frac{\partial Y_i}{\partial N_i} = \delta_i a_i N_i^{\delta_i - 1} = \frac{w_i}{p_i} \quad ,$$

so

$$N_i = \left[\left(\frac{1}{\delta_i a_i} \right) \left(\frac{w_i}{p_i} \right) \right]^{\frac{1}{\delta_i - 1}} \quad ,$$

for which the elasticity of N_i with respect to (w_i/p_i) is $1/(\delta_i - 1)$.

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