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Re-examining the Importance of Exchange Rates to U.S. Farm Exports to Developing Countries

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The hypothesis that the value of the dollar matters to the level and prices of U.S. agricultural exports has received mixed empirical support, (for ex., 7, 9). One response to these findings has been to reevaluate the underlying methodologies employed, including the measurement of the effective dollar exchange rate (2, 5, 7). The purpose of this paper is add to this discussion the special perspective of developing countries, particularly the implications of their use of the U.S. dollar to denominate their primary product exports. The paper presents a simple model of how this characteristic causes changes in the value of the dollar to affect both the relative price of U.S. exports, and the income of developing countries through valuation changes in their dollar export earnings. Indices of real exchange rates which measure valuation changes, are calculated for 23 developing countries, and used to re-examine the significance of the value of the dollar for their commercial import demand for U.S. corn and wheat.

BACKGROUND

Developing countries have become an important and dependable export market for U.S. agriculture. In FY 1987, developing countries accounted for 40 percent of U.S. agricultural exports to the world. Sales to this market exhibited a relative stability during the 1980's when U.S. farm exports to the rest of the world fluctuated. Developing countries are a particularly important market for U.S. grains. Corn sales to developing countries rose from 20 percent to nearly 50 percent of total U.S. corn exports between 1981-87. Wheat sales to developing countries accounted for between 50 and 75 percent of U.S. world wheat exports during the same period. Wheat exports to developing countries fell in the mid-1980's, but not to the same degree as in other markets, thus helping to sustain U.S. wheat exports during

that period. U.S. wheat flour exports, while relatively small, are sent almost entirely to developing countries. In FY 1987, the 23 countries included in this study combined to represent 47 percent of U.S. corn exports, and 57 percent of U.S. wheat exports to the world.

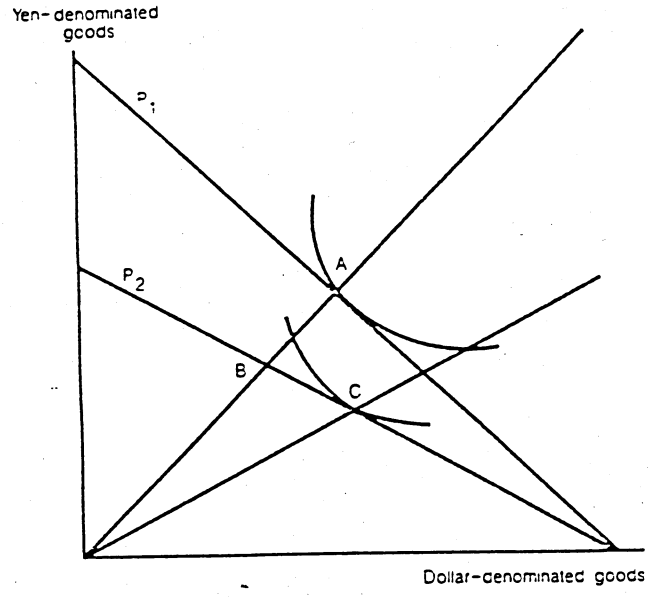
Developing countries depend on hard currencies to transact their world trade (6). In general, trade between developed and developing countries is invoiced in the currency of the developed country. Trade in primary products is typically denominated in a vehicle currency,[1] mainly the U.S. dollar and to some extent the British pound. When the currencies used to denominate their exports and imports are different, developing countries are exposed to income effects in the form of valuation changes in the import purchasing power of their exports earnings. For example, a country whose exports are denominated in dollars but which imports mainly from France, suffers a loss in import purchasing power when the dollar falls against the French franc.

Because of the central role of the dollar in denominating the exports of most developing countries, exports to developing countries may not necessarily increase as the value of the dollar falls. Dollar depreciation is expected to increase demand for U.S. goods as their local currency prices fall relative to the prices of other foreign suppliers. However, if a developing country's exports are denominated in dollars, then dollar depreciation causes its import purchasing power to fall. This can reduce import demand, and work against the stimulating impact of dollar depreciation on demand for U.S. goods.

MODEL

In Figure 1, we illustrate this ambiguous outcome using a simple, partial equilibrium model, with two goods. The model has no backward linkages between changes in relative prices, and foreign and domestic supply and

Figure 1
Dollar-surplus country



demand responses for exports, imports and import substitutes. Prices only change when exchange rates change. Such an approach is consistent with some reasonable assumptions about elasticities in a general equilibrium framework. Most of the countries in this analysis are small, and their domestic supply and demand responses do not affect world prices for their imports or exports. (Some exceptions exist; for example, the domestic supply response of Cote d'Ivoire and Brazil for cocoa can be expected to significantly affect world prices.) The approach also implies that foreign demand for developing countries' exports does not change much when foreign prices fluctuate because of exchange rate movements. Low price elasticity of demand for developing country exports would tend to support a stable world price in this model.

Figure 1 shows the case of the typical developing country, whose trade results in a surplus of dollars which are used to purchase imports in the dollar and other currencies. As drawn, figure 1 shows the simplest case of a country that exports goods denominated solely in dollars and imports and consumes goods denominated in yen and dollars. As the dollar depreciates, the relative domestic currency price of dollar goods declines against the price

of yen goods, in a shift of the price line from P1 to P2. Relative prices change regardless of the developing country's exchange rate arrangement. If the developing country pegs to the dollar, then the domestic currency price of its exports is unchanged while the relative price of its imports rises. If the country pegs to the yen, then the domestic currency price of its imports is unchanged but the relative price of its exports falls. If the developing country's currency is fixed to some weighted basket, then the relative prices of its exports and imports fall and rise respectively, in amounts determined by the weights.

As the relative price of exports falls, income falls. The effect of the decline in income is to reduce consumption of both yen and dollar goods along a ray, in a movement from points A to B. However, the decline in the relative price of dollar goods can be expected to induce some substitution toward consumption of those goods, in a movement from points B to C.

The assumption that the positive substitution effect toward dollar goods dominates the fall in demand for those goods as the dollar, and thus income, decline underlies the construction of figure 1, where it is shown that on net, purchases of dollar goods rise and yen goods fall as the developing country's import basket moves from points A to C. Dollar depreciation causes dollar exports to the developing country to increase, but they rise by less than they might have if the import purchasing power of their exports had not also fallen.

The magnitude of the substitution effect depends upon consumer preferences and the elasticity of substitution between dollar and yen denominated goods. In the short run, there tends to be a relatively low elasticity, due to long term contracts, traditional suppliers and a commodity composition of bilateral trade that limits substitution among suppliers. The

inability to substitute among suppliers and offset the effects of valuation changes in export earnings can result in the income effect of exchange rate changes being relatively important.

In international trade, there are two components of the income effect (4). One is the impact of a given change in income on the propensity to import, which reflects consumers' preference patterns. The second aspect is the degree to which real income is affected by a change in relative prices. In general, this depends on the extent of trade, since the effect on national income of a change in relative prices is proportional to the size of trade in the economy. For developing countries, the magnitude of this effect is also sensitive to the direction of trade. When trade patterns result in a large surplus of one currency which is used to purchase imports denominated in other currencies, changes in exchange rates expose developing countries to significant valuation changes in their export earnings, and can result in a large income effect. The dependence of the income effect on both the extent and direction of trade is a point that deserves emphasis with respect to developing countries.

In this study, we calculated indices of real exchange rates that measure the effects of valuation changes on import purchasing power. Following (1), the real exchange rate index is calculated as:

$$RER = \hat{E} (\bar{a}_{ij} - \beta_{ij}) (\log e_{ij} + \log P_i^{\circ}) \quad (1)$$

where: $\bar{a}_{ij}$ = export weight for ith partner of small country j

β_{ij} = import weight for ith partner of small country j

$\hat{E}\ \bar{a}_{ij} = \hat{E}\ \beta_{ij} = 1$

For each country, e_{ij} is the price in units of domestic currency per unit of foreign currency, indexed as (1.0 = 1972). P_i° is the wholesale price index in the partner country, also indexed as (1.0 = 1972).

When a country is a net exporter ($\tilde{a}_{ij} - \beta_{ij} > 0$) in a currency that is depreciating relative to other currencies, it suffers a valuation loss in its export earnings, causing the exchange rate index to declines. The country experiences a valuation gain when it is a net exporter in an appreciating currency, and the index consequently rises. There is no valuation gain or loss when a country maintains a trade balance in the currencies used in its trade. Since in this case, ($\tilde{a}_{ij} - \beta_{ij} = 0$), the exchange rate index does not change.

The exchange rate indices are based on developing countries' trade with five partners, as reported by the partners: the U.S., U.K., France, Germany and Japan. Trade was assigned to five currencies: U.S. dollar, pound, deutschemark, yen and French franc. Assignments were based on observed patterns in the currency invoicing of international trade (3, 6, 11). Trade in most primary agricultural products (SITC 2, less SITC 22, 27, 28), coffee, rubber, cotton and petroleum trade was assigned to the dollar. Trade in cocoa, tea and non-ferrous metals was assigned to the pound sterling. All other trade was assigned to the currency of the bilateral trade partner. The total trade of developing countries conducted in these five currencies, either through trade denominated in vehicle currencies or in bilateral trade with these five partners, represented an average of 61 percent of their global exports and 63 percent of their global imports.

The dollar has the preeminent role in denominating the exports of developing countries. On average, 62 percent of the exports of developing countries in this study were denominated in dollars during 1984-86, but only 32 percent of imports were dollar-denominated. Because most developing countries earn dollars in excess of their expenditure of on dollar denominated imports, trends in their import purchasing power followed movements in the

real exchange value of the dollar. For most developing countries, import purchasing power has declined since 1972, except for an interval in the mid-1980's when the dollar strengthened. Import purchasing power peaked in 1984, and began to decline as the dollar started its depreciation in February 1985.

THE EFFECTS OF EXCHANGE RATE MOVEMENTS ON IMPORTS

Empirical estimation of the relationship between exchange rate-induced changes in import purchasing power, and demand for U.S. corn and wheat had two purposes: to test for the significance of this variable on import behavior; and to determine whether there was a predominantly positive or negative relationship between dollar depreciation and the import demand response of dollar surplus countries--that is, to determine whether the substitution or the income effect of dollar depreciation predominated. To do this, we econometrically estimated the demand of selected developing countries for U.S. corn and wheat during 1972-86.

The estimated equations are represented by:

$$X=a+b(S)+c(P)+d(Y)+e(RER)+f(P.L.480)+u \qquad (2)$$

where:

X=per capita commercial U.S. exports, metric tons
S=per capita domestic production, metric tons
P=real local price, domestic currency
Y=real per capita GDP, or real financial import capacity
RER=real exchange rate index of import purchasing power
P.L. 480=per capita U.S. aid shipments.

Commercial exports are total U.S. exports less P.L. 480 shipments. Data on U.S. exports, P.L. 480 shipments and domestic production are from USDA/Economic Research Service. Financial data are from (8). Eighteen countries were included in estimates of U.S. wheat exports, and 18 were included in estimates of corn exports. The two groups were not identical,

since not all countries import both commodities from the U.S. All equations were first estimated as log functions using OLS, with all relevant independent variables. (Production and P.L. 480 shipments were included only when relevant). One and two year lag structures were used, but in most cases were not significant. Depending on results, some insignificant variables were in a few cases omitted and some countries were dropped. Seemingly unrelated regression estimators (SUR) were then used to reestimate the equations jointly, using generalized least squares. SUR estimates are efficient relative to OLS when errors in the demand equations are uncorrelated over time, but correlated across cross-sectional units (10). This is often caused by common omitted variables. Because the number of countries exceeded the number of observations, the group of corn importers was run in two systems.

There was some experimentation with definition of price, income and domestic supply variables. For most countries, real income was measured as real import capacity, measured as current export earnings plus least year's foreign reserves in domestic currency, deflated by CPI. When these data were not available (Senegal and China), or appropriate (as for the NIC's), or significant (Brazil) real per capita GDP was used as a measure of income. The price variable was initially represented as a ratio of the U.S. price and the price of the developing countries' leading non-U.S. supplier, in an Armington-type model. Relative prices were generally insignificant and real domestic price was used, except in the case of Singapore wheat imports where the price ratio was used. Both lagged and current production were tried, and current domestic production was used in the SUR estimations.

The expected relationship between the exchange rate variable and U.S. exports depended upon the net trade pattern of each developing country. For those countries holding a surplus of dollar earnings over dollar expenditure,

the expected relationship was ambiguous. Because they hold a net dollar surplus in their trade, their import purchasing power declines (improves) when the dollar depreciates (appreciates). A fall in their import purchasing power is expected to have a negative effect on U.S. corn and wheat exports. But, dollar depreciation also reduces the relative price of U.S. corn and wheat exports, and this is expected to have a positive effect on U.S. exports. For dollar deficit countries, dollar depreciation was expected to unambiguously have a positive effect to U.S. exports since it both increases their import purchasing power and reduces the relative price of U.S. goods.

Tables 6 and 7 summarize our estimation results. In general, the findings tended to support the hypothesis that exchange rates matter to the volume of U.S. exports and furthermore that, when exchange rates were significant, the positive price effects of dollar depreciation on demand for U.S. corn and wheat, outweigh the negative effects of the valuation losses experienced by these countries as the dollar falls.

The coefficient of the exchange rate variable was significantly different from zero, at a 25 percent level of significance or less, for nine of the sixteen corn importing countries. Eight of these are dollar surplus countries, of whom five proved to have a negative relationship between improved terms of trade and imports for U.S. corn. For these countries, a fall in the value of the dollar that reduces import purchasing power, nevertheless causes an increase in imports from the U.S. Three dollar surplus countries, (Korea, Philippines and Singapore) decrease their corn imports from the U.S. as the dollar falls and they experience a valuation loss in export earnings. The single dollar deficit, corn importing country for whom the exchange rate variable was significant, Morocco, showed a negative relationship, so that U.S. imports fall as the dollar falls and their income rises, possibly reflecting the

Table 1--Determinants of developing countries' demand for U.S. corn

Country	Intercept	Domestic production	Real price	Real import capacity	Real GDP	Real import purchasing power	P.L. 480	R2 2/
(Expected sign)		(-)	(-)	(+)	(+)	(+,-)	(+,-)	
Algeria	3.4	-	-7.52	4.0	-	-1.0	-	.37
		-	(-2.14)*	(1.27)	-	(.12)	-	
Brazil	36.1	36.3	6.9	-4.1	-	-117.9	-	.55
		(3.45)** 1/	(1.31)	(-4.2)	-	(-2.3)**	-	
Burkina	66.5	-4.3	18.0	-15.6	-	-30.4	-	.48
		(-.6)	(2.0)*	(-2.34)**	-	(-2.7)**	-	
Cameroon	27.9	-	11.9	3.0	-	-37.3	-0.1	.42
		-	(1.3)	(.87)	-	(1.82)*	(-0.05)	
Egypt	11.5	-	-0.4	0.8	-	-4.1	-	.44
		-	(-1.1)	(2.2)**	-	(-1.52)	-	
Ghana	14.5	-5.7	-5.5	2.1	-	13.4	-	.54
		(-1.3)	(-1.2)	(.44)	-	(.46)	-	
Indonesia	80.2	-	-1.3	-6.3	-	-24.7	-	.17
		-	(-.2)	(-1.6)	-	(-1.36)		
Korea	-7.1	-	_.9	-	1.8	2.8	-	.68
		-	(-1.95)*	-	(3.0)**	(1.2)	-	
Mexico	-25.9	5.4	0.9	.7	-	-1.4	-	.39
		(2.72)	(.77)	(1.7)	-	(-.13)	-	
Morocco	236.4	-	-17.1	20.7	-	-118.8	-	.31
		-	(-1.68)	(2.0)*	-	(-1.6)	-	
Nigeria	2.6	-	-4.5	1.9	-	.93	-	.17
		-	(-1.5)	(.61)	-	(.1)	-	
Philippines	-51.2	-	2.1	3.0	-	20.1	-	.30
		-	(1.5)	(1.8)*	-	(1.8)*	-	
Senegal	-186.0	4.2	10.3	-	39.7	23.7	-	.37
		(.5)	(1.4)	-	(1.1)	(.2)	-	
Singapore	18.0	-	-5.5	-	-7.5	17.4	-	.35
		-	(-.9)	-	(-1.6)	(1.4)	-	
Taiwan	-5.4	-	.3	-	2.6	-.3	-	.84
			(.6)	-	(6.7)**	(-.2)	-	
Venezuela	21.9	-4.5	-5.8	1.8	-	4.8	-	.48
		(-1.6)	(2.0)*	(.7)	-	(.2)	-	

Note: *, ** denote significance at .10 and .05 levels, respectively.
1/ Numbers in parentheses are t-statistics.
2/ R2's are reported for OLS estimations of equations.

Table 2--Determinants of developing countries' demand for U.S. wheat

Country	Intercept	Domestic production	Real price	Real import capacity	Real per capita GDP	Real import purchasing power	P.L. 480	R2 2/
(Expected sign)		(-)	(-)	(+)	(+)	(+,-)	(+,-)	
Brazil	3.2	.12	.4	-	.3	-.4	-	.20
		(.6) 1/	(1.6)	-	(2.7)**	(-.1)	-	pc
Egypt	-5.1	8.1	-	1.5	-	-13.6	2.5	.52
		(1.2)	-	(.3)	-	(-1.2)	(6.8)**	
Ghana	-123.7	-	-2.0	8.6	-	55.5	-.4	.63
		-	(-.8)	(3.7)	-	(3.8)**	(-3.6)	
Hong Kong	3.2	-	.5	-	.1	.8	-	.55
		-	(4.0)**	-	(.5)	(-1.5)		
India	119.3	-4.3	.9	1.5	-	-56.1	1.3	.87
		(-4.5)	(9.4)**	(.91)	-	(-3.0)**	(7.6)**	
Indonesia	-.4	-	-.4	.2	-	1.6	-.1	.31
		-	(-.8)	(.7)	-	(1.1)	(-2.5)**	
Mexico	46.3	-9.2	1.4	-.3	-	-6.2	-	.52
		(-3.8)**	(.8)	(-.4)	-	(-.3)	-	
Morocco	12.8	.1	-	1.4	-	-12.3	-6.0	.42
		(.52)	-	(3.33)**	-	(2.2)*	(-2.5)**	
Nigeria	4.2	-	-.8	.01	-	-.4	-	.88
		-	(-12.7)**	(.1)	-	(-1.6)		
Philippines	3.6	-	-.6	.5	-	-.3	.1	.42
		-	(3.3)**	(2.2)*	-	(-.3)	(1.2)	
Singapore	5.4	-	-2.3	-	-1.5	-4.2	-	.45
		-	(-2.9)**	-	(1.6)	(2.1)*		
Thailand	-11.3	-	-1.4	2.6	-	3.7	-	.56
		-	(-2.6)**	(5.1)**	-	(1.0)		

Note: *, ** denote significance at .10 and .05 levels, respectively,
1/ Numbers in parentheses are t-statistics.
2/ Rs's are reported for OLS estimations.

significant non-price competition in that market.

For three of the twelve wheat importing countries, the effect of the exchange rate variable was found to be not significantly different from zero (Brazil, Mexico and the Philippines). Of the remaining seven dollar surplus countries, four were found to have a negative relationship between the exchange rate variable demand for U.S. exports (Egypt, India, Nigeria and Singapore), indicating that dollar depreciation caused U.S. imports to rise despite valuation losses in export earnings. Three had a positive relationship (Hong Kong, Indonesia and Thailand) between the two variables. Of the two dollar deficit countries, for whom the relationship was expected to be positive, Ghana had a positive and Morocco had a negative relationship between changes in import purchasing power and import demand for U.S. wheat.

One would expect that those countries with high variability in U.S. market share (that is, high substitution among suppliers) would be more likely to a have price effect that dominates an income effect, since they would readily substitute toward the relatively cheaper U.S. export, despite declining import purchasing power. This in fact, tends to hold more in the case of wheat than of corn.

CONCLUSIONS

The findings on import demand correspond with characteristics of the developing country corn and wheat import market. There is a common perception that developing countries have strong and unwavering trade ties, usually with the former colonial powers. However, this does not hold for their trade in corn and wheat, which are relatively homogeneous products. Competition for this market is keen, and there is a relative ease of substitution among suppliers, as evidenced by the sizeable annual variability in

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the U.S. market share. Developing countries are apparently able and willing to respond to any differentiating features of their suppliers, including relative price differences caused by real exchange rate changes. Price responses differ by country, depending on their preferences. In addition, the income effect differs by country, not only because of preferences, but also because the income effects of exchange rate changes can affect each country differently. The role of the dollar in denominating developing countries' primary product exports, and the effect of changes in the dollar's value on their incomes, has important implications for the accurate analysis of the effect of dollar depreciation on demand for dollar-denominated imports.

1. A vehicle currency is a major world currency, not necessarily the currency of the parties to an international contract, that is used as a convenience to denominate the contract.