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Xavier Bejarano, David R. Lee and Duty Greene

Department of Agricultural Economics
New York State College of Agriculture and Life Sciences
A Statutory College of the State University
Cornell University, Ithaca, New York, 14853-7801

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The authors are, respectively: Lecturer, Department of Agricultural Economics, Panamerican Agricultural School, El Zamorano, Honduras; Associate Professor of Agricultural Economics, Cornell University; and formerly, Macroeconomics Program Leader, Agricultural Policy Institute (IDEA), Quito, Ecuador. The authors wish to thank IDEA and the Mario Einaudi Center for International Studies at Cornell University for supporting the research reported herein.

ABSTRACT

This paper examines the effects of variations in the real exchange rate, export prices, and other factors on three traditional agricultural export markets in Ecuador (coffee, cocoa, bananas). Exchange rate and price transmission models and export supply models are estimated to analyze the structure of price determination and export responsiveness.

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Introduction

Exchange rate reform has been a key component of macroeconomic and sectoral structural adjustments in many developing countries in the 1980's. Ecuador has been no exception. The country experienced laggard economic growth and weak export performance throughout much of the 1980's, precipitated in part by chronic overvaluation in its domestic currency (the sucre). Ecuador has historically been heavily dependent on agricultural exports -- principally, bananas, coffee, cocoa, and more recently, shrimp -- for foreign currency generation, and so the performance of these sectors has traditionally played a key role in balance of payments performance and overall economic growth. Exchange rate reforms of the 1980's, though somewhat chaotic in nature, were thus of key importance in improving the prospects for improved performance in these economically important sectors.

Ecuador's experience with exchange rate reform in the 1980's provides a revealing case study of agricultural export responsiveness to variations in the real exchange rate and illustrates a number of important analytical and policy issues. First, the country's experience with real exchange rate depreciation is briefly documented below. Second, while real exchange rate behavior has been examined in a variety of **import** markets (Feenstra, Pompelli and Pick, Jabara and Schwartz, etc.), this paper focuses on the impacts of exchange rate reforms on the **domestic** markets for exports, where the gains from these reforms have typically been argued to exist. Price transmission models and market segmentation and integration measures, traditionally used in domestic market analysis, are employed to examine domestic price effects at FOB and farm levels for three traditional export markets (bananas, coffee and cocoa). Finally, the impacts of exchange rate changes on export response are analyzed using export supply response models.

Background to Ecuadorian Exchange Rate Reform

Although historically characterized by an inward-oriented development path based on import substitution, industrialization, and a heavy export dependence on primary commodities, Ecuador's economy changed markedly with rapidly growing oil exports in the 1970's (Scobie, Jardine and Greene).

With resulting sharp increases in foreign exchange earnings, the country's credit base and foreign borrowings expanded significantly, with an estimated 70 percent of oil-based proceeds spent on public sector salaries and subsidies to special interest groups (Whitaker, Colyer and Alzamora).

One of the implicit subsidies (to importers) was an exchange rate which was grossly overvalued. By May, 1982, free market rates for the sucre were more than 50 percent above official and intervention rates. In response to this overvaluation and anemic economic growth in the early to mid-1980's, Ecuadorian policymakers embarked on a series of exchange rate reforms from mid-1982 on. These reforms included an initial 33 percent devaluation of the sucre (in 1982), a crawling-peg series of "mini-devaluations" (1982-84), another major devaluation (1985), unification of the multiple exchange rate system and a shift to floating rates in 1986, a short-lived reintroduction of fixed rates in 1988, and a managed float (incorporating mini-devaluations) after August, 1988.

The effects of these reforms on the differential between Ecuador's real free market exchange rate and real exchange rate for exports -- the latter incorporating export proceeds' surrender values at "official" and "intervention" exchange rates (for details, see Bejarano, pp. 79-80) -- are shown in Figure 1 for the period 1978-89. In general, the real exchange rate is defined here, after Edwards, as:

$$(1) \qquad e = \frac{E * P^T}{P^{NT}}$$

where E is the nominal sucre/dollar exchange rate, P^T is the price of tradables (proxied by the Producer Price Index in the U.S., by far Ecuador's major trading partner), and P^{NT} is the price of non-tradables (proxied by the consumer price index in Ecuador). It is clear that the two measures diverged significantly through 1986 and again in 1988-89. While this differential implies an effective tax on Ecuadorian exports in most years, the size of that tax declined for most of the late 1980's as Ecuador adopted more market-oriented policies under the Febres Cordero and Borja administrations.

Empirical Models of Exchange Rate Transmission and Market Integration

In addition to assessing the responsiveness of Ecuadorian agricultural exports to the real exchange rate changes described above, our major interest here is in understanding how specifically exchange rate reform has affected participants (export traders and producers) in agricultural export industries. Trade theory suggests that exporters should benefit from a real devaluation, at least in the short run, due to the higher domestic prices received for exportables. This effect is represented in Figure 2 by shifts in curve A to A' due to devaluation and in importer demand from ED to ED' due to the lower perceived price abroad. These shifts induce a higher local domestic price, P1, which should benefit exporters and producers. In the long-run, domestic factor prices adjust, mitigating the short-run gains from devaluation.

In practice, a number of factors make the timing and magnitude of actual responses to a real devaluation more difficult to predict in the case at hand. To begin, while coffee and cocoa are storable commodities and exporter inventories may thus adjust rapidly to increases in export demand stimulated by a real devaluation, bananas are perishable and export expansion can only be preceded by an increase in production at the farm level. Second, a host of subsidies and taxes have been applied in the past to all three commodities. Primary among the subsidies have been sui generis credit subsidies for the coffee and cocoa industries and ad valorem tax credit certificates (Certificados de Abono Tributario or CATs) applicable to all agricultural exports. At the same time, ad valorem export taxes were levied on coffee and cocoa exports through 1986 (with partial reimbursements to export cooperatives), and per-box taxes on banana exports have historically been levied to finance the government's banana disease prevention and export quality control programs. Empirical modeling of export responsiveness and price transmission effects from devaluation must be careful to incorporate these various empirical complications.

To examine specifically how real exchange rate changes have influenced Ecuador's agricultural export performance and domestic market effects for export products, several different empirical models are employed. The **farm level response to world prices and exchange rates** is measured through

estimation of equation (2):

$$(2) \qquad \ln \frac{P_i^F}{CPI^{EQ}} = \ln \frac{E * PPI^W}{CPI^{EQ}} + \ln \frac{P_i^W(1-t)}{PPI^W} + e$$

which can be reexpressed as:

$$(3) \qquad \ln p_i^F = b_0 + b_1 \ln e + b_2 \ln p_i^W + e$$

where p_i^F and p_i^W are real farm and real world prices -- nominal prices (P_i^F and P_i^W), the latter adjusted by net taxes (t), are weighted by changes in the Ecuadorian CPI and U.S. PPI, respectively -- and e is the real effective exchange rate. This approach is analogous to transmission equation specifications used in studies by Bolling, Carter, and Jabara and Schwartz, typically with respect to the import price changes.

Estimating the **farm level response to border price changes** can be considered analogous to estimating domestic and spatial price transmission (as in studies by Ravallion, Timmer and Heytens), with the border price here substituted for the "central market price". Through a series of transformations (see Bejarano, pp. 124-127, for details), the following estimating equation can be generated:

$$(4) \qquad (p_{i,t}^F - p_{i,t-1}^F) = \alpha_1 (p_{i,t-1}^F - r_{i,t-1}) + \alpha_2 (r_{i,t} - r_{i,t-1}) + \alpha_3 r_{i,t-1} + \alpha_4 e_t + e$$

where $r_{i,t}$ is the FOB exporter price. Changes in farm prices are thus estimated to be a function of the lagged differential between the farm and border price, changes in the border price, the lagged border price and the exchange rate.

Following Ravallion, market "integration" or "segmentation" can be tested by testing the restriction that all $b_j = 0$ in the equation:

$$(5) \qquad P_t = \sum_{j=1}^{n} a_j P_{t-j} + \sum_{j=0}^{n} b_j R_{t-j} + cX_t + e_t$$

where X_t stands for a vector of other market factors influencing farm price determination. This is tested

using the F-test:

$$F = \frac{SSE_R - SSE_U}{SSE_R} * \frac{(T - k + I)}{J}$$

Market integration or segmentation essentially means the extent to which, in this case, FOB border prices determine price changes at the farm level. Additionally, one can test for "short-run" market integration by testing the restriction that $b_0 = 1$ and $a_j = 0$ in (5) and for "long-run" market integration by testing that:

$$\sum_{j=1}^{n} a_j + \sum_{j=0}^{n} b_j = 1$$

Confirmation of short-run market integration would suggest that border prices are passed on fully and immediately to farm prices. Long-run market integration would suggest that current period farm prices are fully explainable by lagged farm prices and lagged and current border prices.

We also estimate Timmer's index of market connection (IMC) for each of the three export markets. This is expressed as

$$(6) \qquad IMC = \frac{1 + \alpha}{\gamma - \alpha}$$

where $d = (a_1 - 1)$ and $\gamma = (a_1 + b_0 + b_1 - 1)$. Intuitively, the closer the index gets to 0, the greater the degree of market integration because the lagged border prices explain a greater proportion of variation in farm-level prices than do lagged farm prices.

Finally, the responsiveness of each of the exported commodities to changes in real exchange rates, prices, and other factors is estimated through export supply response equations. The general estimation equation is:

$$(7) \qquad \begin{aligned} \ln \text{val } X_t = {} & b_0 + b_1 \ln (p_t^W \pm t_x) + b_2 \ln (p_{t-1}^W \pm t_x) \\ & + b_3 \ln e_t + b_4 \ln W_t + b_5 S_1 + b_6 S_2 + b_7 S_3 \\ & + b_8 D_{1983} + b_9 \ln \text{val } X_{t-1} + e_t \end{aligned}$$

where the dependent variable is the real value of exports (1978-89); p_t^W is the world average price adjusted for export taxes and transfers (t_x); e_t is the real effective exchange rate; W_t is the annual minimum wage (a proxy for production costs); the S_t are seasonal dummy variables, included given a priori expectations of seasonality in the production of all three exports and in the demand for bananas; and D_{1983} is a dummy variable for 1983, a year of excessive flooding due to El Niño, which negatively affected the production and exports of bananas and cocoa, in particular.

Empirical Results

Tables 1-3 report transmission elasticities and coefficient estimates for the world price/farm price (Table 1) and border price/farm price (Tables 2 and 3) relationships estimated using quarterly data for 1978-89. In the former case, real exchange rate transmission elasticities to farm prices are all significant and have a narrow range -- 0.75 to 0.79 -- across the three commodities, implying that three-quarters or more of the effects of currency depreciation are passed on to producers in the form of higher prices. The world price transmission elasticities are also significant and high for coffee and cocoa (0.93 and 0.81, respectively) indicating that a high proportion of price fluctuations in world coffee and cocoa markets are passed on rapidly to Ecuadorian producers. For bananas, this price effect is insignificant, possibly due to two industry-specific factors: the high degree of forward contracting which imparts a lag between world and domestic prices; and the important role played by the National Banana Program in insulating producers from the high degree of seasonal price fluctuation characterizing the world banana market.

Table 2 reports coefficient estimates from estimation of equation (4), and Table 3 reports transformed elasticity estimates, following transformation of equation (4) by combining common independent variables and separating lagged farm price effects from lagged border price effects (see Bejarano, p. 155). Due to space limitations, we shall discuss the Table 3 estimates only. The results again show that both the levels of and changes in border prices for coffee and cocoa are passed on in greater proportion and more rapidly than for bananas (where a two-quarter lag is estimated). In addition to the

factors identified above, market structure differences may be at work; the coffee and cocoa processing industries are more concentrated than the banana industry, with the likely result that processor/exporters find it easier to pass on border price changes, compared to the banana industry which is less concentrated and in which producers have a great degree of political power which can influence price formation. The price effects in Tables 2 and 3 tend to dominate the exchange rate transmission effects, unlike Table 1. This is not surprising given that we are dealing here with domestic transmission of border to farm prices, whereas the chief exchange rate effect is likely to be felt between world and domestic prices.

Tables 4-6 shown summary statistics and coefficient estimates for the market segmentation and integration measures. In Table 4, given a critical F-value of 5.18 (1 percent level; 2, 42 d.f.), the banana market is shown to be "segmented" while the coffee and cocoa markets are estimated to be "un-segmented", in that border prices in general are confirmed to be significant determinants of farm prices for coffee and cocoa. The test for full "short-run" market integration (Table 5) is equivalent to shifting **all** the explanatory power to the border price. This hypothesis is rejected for bananas and coffee, but not for cocoa, confirming the particularly rapid transmission of border to farm prices for cocoa seen in Tables 2 and 3. "Long-run" market integration is based on the notion that lagged border price changes -- in addition to lagged farm prices and other market factors (e.g., exchange rates) -- significantly influence farm prices. The restriction of "long-run" market integration is assumed in the coefficient estimates in Table 6, which compared with the results in Table 2, show that, only for cocoa, do lagged border prices have a significant effect on farm prices.

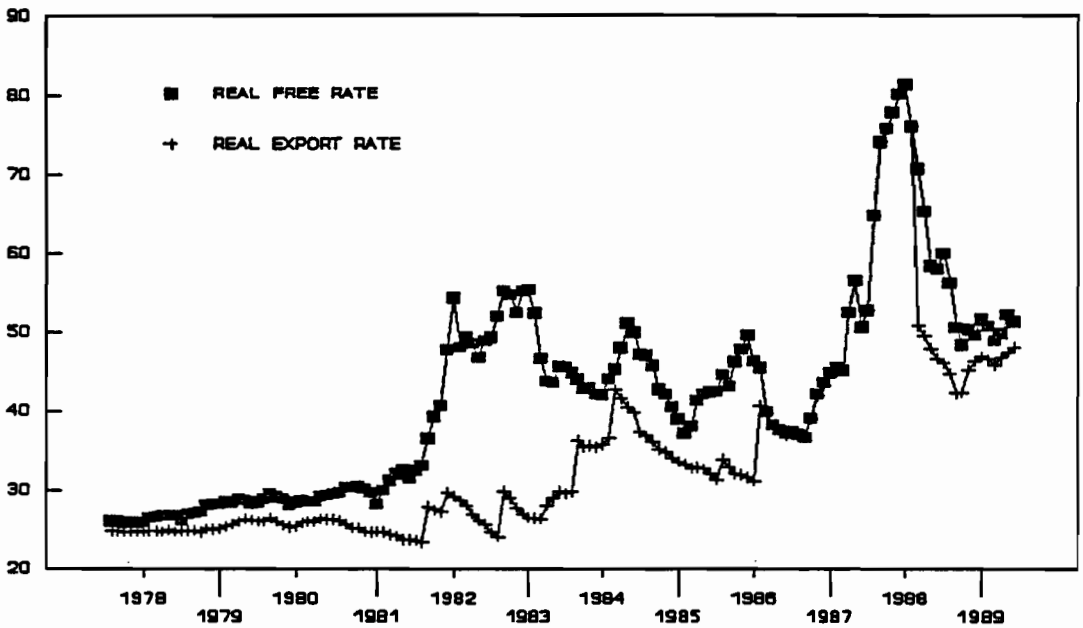
Calculation of Timmer's index of market connection, based on coefficient estimates from Table 2, yields indexes of 0.33 for cocoa, 1.27 for coffee, and 2.28 for bananas. These estimates reinforce those reported above, in that exporter markets for cocoa are shown to be particularly closely connected to farm markets, while price changes in banana exporter and farm markets are not closely linked (in fact are "segmented"), and coffee markets fall somewhere in between ("unsegmented" but not "integrated").

Finally, export supply coefficient and elasticity estimates are reported in Tables 6 and 7, respectively. The results consistently show the significant positive effect of currency devaluation on export response; for example, a 10 percent real devaluation is shown to increase the real value of exports by 5.8 percent for coffee, 9.3 percent for bananas and 12.6 percent for cocoa (the most integrated market). Export prices (adjusted for taxes and subsidies) are estimated to have a particularly important effect in stimulating coffee exports and a particularly modest (and lagged) effect on banana exports, due largely to the segmented nature of that market, as shown earlier. Exports are shown to be sensitive to seasonal effects and adverse weather (in 1983) via the estimated dummy variable effects. Long-run export supply elasticities derived in Nerlovian fashion from the estimated coefficients in Table 6 and reported in Table 7 show that long-run (compared to short-run) supply effects are particularly important for bananas, due likely to industry-specific factors such as the production-export lag, extensive contracting, and perhaps reinforced by lags introduced price intervention by the National Banana Program.

Conclusions

The principal contribution of this paper is its focus on the effects of real exchange rate reform on an **exporting** country's domestic export markets and export responsiveness. First, the results show that the real exchange rate is an important determinant -- indeed a dominant determinant -- of export responsiveness across the set of commodities analyzed. Second, we have shown how measures of market integration and segmentation, traditionally used for domestic and spatial market analysis, can be employed to measure the domestic market effects of both macroeconomic changes (e.g., exchange rate reform) and global changes such as variations in world export prices. Third, the paper has demonstrated how the unique structural characteristics of individual export markets influence price and exchange rate pass-through at different levels. The extent to which export producers ultimately benefit from currency devaluation and higher real prices is shown to depend significantly on factors such as the crop produced, market structure characteristics, and underlying price, tax and subsidy policies.

Figure 1. Real exchange rates compared, 1978-89.



Source: Banco Central del Ecuador, various years.

Figure 2. Effects of real exchange rate depreciation in a short-run partial equilibrium model.

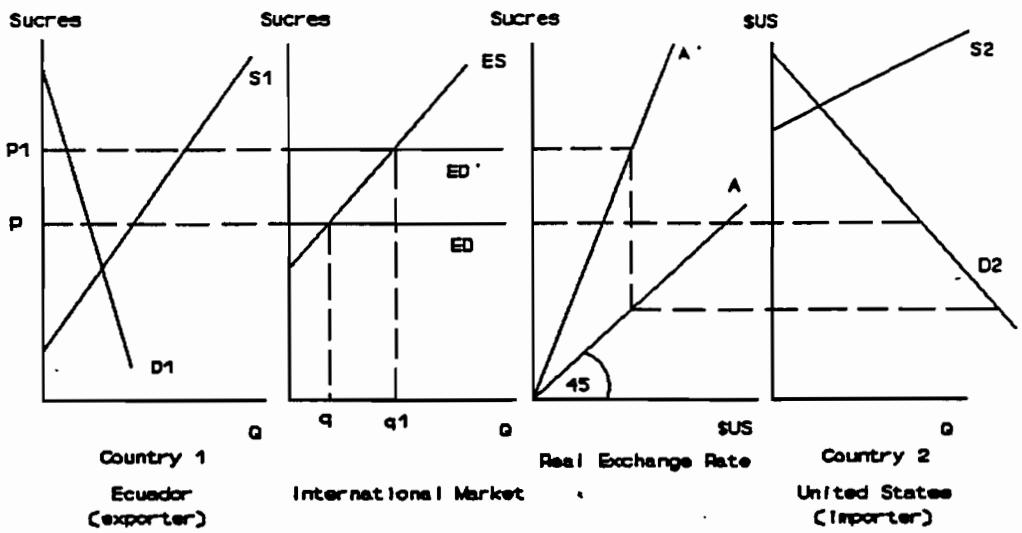


Table 1. Price and exchange rate transmission elasticities between world and domestic commodity markets.

p^F	ln e	ln p^W
COFFEE	0.75 (4.85)	0.93 (5.83)
COCOA	0.77 (8.79)	0.81 (12.73)
BANANAS	0.79 (12.04)	-0.09 (-0.657)

Table 2. Coefficient estimates for border-farm price market integration model.

COMMODITY	Dependent variable	COEFFICIENTS				STATISTICS	
		$p_{t-1}-r_{t-1}$	r_t-r_{t-1}	r_{t-1}	e_t	R^2	DW
COFFEE	p_t-p_{t-1}	-0.45 (-3.11)	0.62 (2.72)	-0.02 (-0.16)	0.28 (1.49)	0.32	2.01
COCOA	p_t-p_{t-1}	-0.79 (-3.82)	0.83 (4.10)	-0.17 (-2.52)	0.51 (2.96)	0.34	1.82
BANANAS	p_t-p_{t-2}	$p_{t-2}-r_{t-2}$	r_t-r_{t-2}	r_{t-2}	e_t	R^2	DW
		-0.52 (-2.74)	0.37 (0.95)	-0.31 (-1.32)	0.43 (2.86)	0.19	1.04

Table 3. Coefficient estimates for transformed border-farm market integration model.

COMMODITY Dependent variable	COEFFICIENTS			
	p_{t-1}	r_t-r_{t-1}	r_{t-1}	e_t
COFFEE p_t	0.55	0.62	0.43	0.28
COCOA p_t	0.21	0.83	0.62	0.51
BANANAS p_t	p_{t-2}	r_t-r_{t-2}	r_{t-2}	e_t
	0.48	0.37	0.21	0.43

Table 4. Statistics for testing market segmentation.

Commodity	SSE_R	SSE_U	F_{calc}
COFFEE	3.50	2.75	5.78
COCOA	1.06	0.75	8.67
BANANAS	0.58	0.56	0.47

Table 5. Statistics for testing short-run market integration.

Commodity	SSE_R	SSE_U	F_{calc}
COFFEE	3.75	2.75	7.44
COCOA	0.78	0.75	0.84
BANANAS	0.67	0.56	3.75

Table 6. Coefficient estimates for long-run market integration model.

COMMODITY	Dependent variable	COEFFICIENTS			STATISTICS	
		$p_{t-1}-r_{t-1}$	r_t-r_{t-1}	e_t	R^2	DW
COFFEE	p_t-p_{t-1}	-0.45 (-3.20)	0.63 (2.88)	0.29 (1.58)	0.32	2.03
COCOA	p_t-p_{t-1}	-0.52 (-2.78)	0.76 (3.56)	0.39 (2.25)	0.24	1.98
BANANAS	p_t-p_{t-2}	$p_{t-2}-r_{t-2}$	r_t-r_{t-2}	e_t	R^2	DW
		-0.49 (-2.57)	0.46 (1.21)	0.40 (2.67)	0.15	1.03

Table 7. Coefficient estimates for coffee, cocoa and banana export supply models, Ecuador, 1978-89. (Dependent variable = real value of exports.

Independent variables	Dependent variable: $valx_t$		
	COFFEE	COCOA	BANANAS
Intercept	11.35 (4.76)	0.28 (0.08)	5.11 (4.32)
$[p^w \pm t_x]_t$	1.48 (6.50)	0.54 (1.73)	0.01 (0.02)
$[p^w \pm t_x]_{t-2}$			0.41 (1.65)
e_t	0.58 (3.02)	1.26 (2.88)	0.93 (5.93)
w_t	-0.59 (-1.65)	0.01 (0.01)	-0.25 (-1.44)
S_1	-0.18 (-1.38)	-0.01 (-0.01)	0.15 (1.77)
S_2	-0.25 (-1.87)	-0.13 (-0.53)	0.12 (1.42)
S_3	0.21 (1.49)	-0.48 (-2.04)	-0.04 (-0.53)
D_{1983}	-0.07 (-0.62)	-2.51 (-5.51)	-0.54 (-5.44)
$valx_{t-1}$	0.03 (0.28)	0.25 (2.38)	0.20 (1.60)
R^2	0.76	0.78	0.91
D_h	-2.24	-0.11	1.68

Table 8. Own short and long-run price and exchange rate elasticities for export crops, Ecuador, 1978-89.

COMMODITY	PRICE EFFECT		EXCHANGE RATE EFFECT	
	SR	LR	SR	LR
COFFEE	1.48	1.52	0.58	0.59
COCOA	0.54	0.72	1.26	1.68
BANANAS	0.01	0.51	0.93	1.16

Note: LR = long run
SR = short run

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