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RURAL EQUITABLE ECONOMIC GROWTH ACTIVITY

Contract No. 519-C-00-94-00154-00

PRICE AND EXCHANGE RATE TRANSMISSION FOR BASIC GRAINS IN EL SALVADOR

Prepared by:

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EXECUTIVE SUMMARY

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The objective of this report is to empirically estimate the response of internal prices for basic grains in El Salvador to changes in the exchange rate and international prices. This information can be critical in anticipating the impacts of policy changes such as currency devaluations and trade liberalization.

Elasticities of price and exchange rate transmission are estimated for white maize, red beans, rice and sorghum using annual data for the 1975-98 period and two price transmission equation models: one for nominal values and another one for real exchange rates and real prices. The findings are:

1. The results for the nominal price transmission equations indicate that regional prices are almost perfectly transmitted to domestic prices for white maize ad red beans, in contrast with rice and sorghum whose prices appear to lack response to reference (U.S. gulf) prices.

2. Changes in the nominal exchange rate are almost perfectly transmitted to changes in domestic prices for all four grains, especially for white corn and sorghum.

3. The results for real price transmission equations indicate that although white maize and red beans are strongly influenced by their real foreign prices, the real price for rice is the most influenced by the real reference price.

4. Changes in the real change rates are strongly transmitted for all four grains, except rice, but much less so that changes in the nominal exchange rates.

5. The internal sorghum prices were found to be isolated from world market conditions, whether using a nominal or real price transmission equation. However, its prices are strongly influenced by the U.S. price for yellow maize.

SECTION I
INTRODUCTION

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Introduction

As El Salvador grain markets progressively continue their liberalization trend in the new millennium, an important issue is: what is the most likely response in domestic prices to a change in the world, regional, or international reference prices? This issue is highlighted by the paradoxical decrease in grain prices following the aftermath of Hurricane Mitch in October of 1998.

A second issue concerns the domestic supply, demand, and import/export response to changing world prices. This can be addressed by examining the changes in the domestic prices to changes in international prices through a price transmission equation, and in turn, the impact on the country's production, demand and imports for a given commodity. The last part (supply, demand, and import responses) has already been addressed by two previous reports (López, June 1998; López October 1998).

The objective of this study is to empirically estimate the response of internal or domestic prices for basic grains in El Salvador to exchange rates and international prices. Elasticities of price transmission are estimated for white corn, red beans, rice and sorghum using annual data for the 1975-98 period. Implications of the results are presented in the last section.

A complementary objective was to strengthen the capability of the personnel of the Ministry of Agriculture and Livestock in quantitatively analyzing international prices and commercial policy. This was achieved through a six-teaching modules of four hours each plus consulting directly with personnel of the OAPA, CENTA, and DGEA units. These activities are reported separately.

SECTION II
PRICE TRANSMISSION EQUATIONS

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PRICE TRANSMISSION EQUATIONS

Following Bolling (1988), the specification of a price transmission equation begins with an identify known as the price linkage equation, which links the domestic price of a commodity to the world price:

$$P = eP_f(1+t) \qquad (1)$$

P is the domestic (nominal) price, P_f is the reference price for the commodity in question, e is the nominal exchange rate expressed in units of domestic currency per unit of the relevant foreign currency, and t is the transfer cost which includes transportation and tariffs.

Letting transfer costs remain constant, the price linkage equation (1) can be written as:

$$(dP / P = (de / e) + (dP_f / P_f) \qquad (2)$$

This equation states that the percentage change in the internal price is equal to the percentage change in the exchange rate plus the percentage change in the world price. This, of course, holds true for the case where prices are transmitted perfectly.

To quantify the response of internal prices to changes in the exchange rate and world prices, the following equation can be estimated:

$$1nP = b_o + b_1\ 1ne + b_2\ 1nP_f + U \qquad (3)$$

U is the error tern accounting for all other changes in P not accounted for by e and P_f. The term 1n is the natural log operator. Thus, b_1 and b_2 are the elasticities of the internal price with respect to nominal exchange rate and reference price changes. In principle, without any type of government intervention, $b_1 = b_2 = 1$ for the case of perfect price transmission. The alternative case is b_1 , $b_2 < 1$ for partial or imperfect transmissions.

Alternatively, the price changes can be analyzed in real terms (values corrected for price inflation). Let d be the domestic price deflator and d_f the foreign price deflator. Define the real domestic price as $P^* = P / d$, the real exchange rate as $e^* = e\ (d_f / d)$ and the real world price as $P^*_f = P_f / d_f$.

Extending the definition of the price-linkage equation to account for the effects of inflation, one obtains:

$$P^* = e^*\ P^*_f\ (1+t) \qquad (4)$$

Again, letting the transfer cost remain constant:

$$(dP^* / P^*) = (de^* / e^*) + (dP^*_f / P^*_f) \qquad (5)$$

Expressing (5) in logarithms and including the stochastic component U:

$$1nP^* = c_0 + c_1\ 1ne^* + c_2\ 1nP^*_f + U \qquad (6)$$

Only in the case of no government intervention assuming the law of one price holds, $c_1 = c_2 = 1$. With the additional dimension introduced by inflation, the coefficients for the nominal and real variables in equations (3) and (6) should generally be unequal.

SECTION III
DATA SOURCES AND MANAGEMENT

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All the data used to measure domestic prices came from the DGEA unit of the Ministry of Agriculture and Livestock. For white maize and red beans, the producer prices are used. For rice and sorghum, the wholesale prices are used to measure domestic prices.

The international reference prices for each grain were obtained from several sources, depending on the foreign country that served as benchmark for the grain in question. For white maize and red beans, the producer prices for these grains in Honduras are used (one of the lowest cost producers in the region (Secretaría de Consejo Agropecuario Centroamericano, 1997: Consejo Nacional de Producción, 1999). Nicaragua, although an important supplier to El Salvador now, was excluded because of years of hyperinflation and hyper evaluation in the late 1970's and in the 1980's. Thus, the price, and exchange rate were very erratic. Although a significant amount of white corn is imported from Guatemala (especially from near-border areas), several attempts to weight the Guatemalan exchange rate and prices generally deteriorated the statistical performance of the price transmission equation for white corn. In addition, Guatemala has had higher internal prices than El Salvador. The reference prices (using Honduras as a benchmark) for white corn and red bean prices came form the FAO website for the 1975-1995 period and were then extrapolated from 1196-98 with Honduran price data reported in the Consejo Nacional de Producción Websit (http://www.mercanet.cnp.go.cr).

The U.S. gulf price for rice was used as a reference price, as reported in the *International Financial Statistics Yearbook* (1997) for 1975-96 period. The 1996 and 1997 prices came from the IMF's website. An important issue arose when deciding what price level to use as the internal price for rice. There was a huge discrepancy between the domestic producer price and the wholesale price for rice (average of 79 vs. 131 colones per ton in the 1975-98 period for rice in grain) which was atypical of the other grains. It is not clear why this was the case, but the wholesale price appear to be a more sensible choice, especially when comparing the domestic price with a reference price which is clearly also a wholesale export price. For sorghum, the U.S. gulf price was used as a reference price and the wholesale domestic price was used as the internal price.

Finally, the exchange rate and wholesale price indexes used to define real producer and real reference prices as well as real exchange rates came from the *International Financial Statistics Yearbook* (1997), supplemented with internet data from the Interamerican Development Bank for the last two years. As argued by Sadoulet and de Janvry (1995), the wholesale price index is the appropriate index for analysis, of this type.

Figures 1 through 4 indicate the movement of internal prices with respect to reference prices for basic grains in El Salvador between 1975 and 1998. Table 1 reports the means and standard deviations of the prices used in the study. Note that the reference prices are in the currency units of the country serving as a benchmark, as used in the equations.

Once all variables were operations, the price transmission equations were estimated via Seemingly Unrelated Regressions. The last producer is particularly appropriate since the error terms in these equations are likely to be contemporarily correlated due to excluded factors that simultaneously

affect these commodity markets and because the set of explanatory (high-hand side) variables are different. The results are presented in the following section.

Figure 1. White Maize Prices

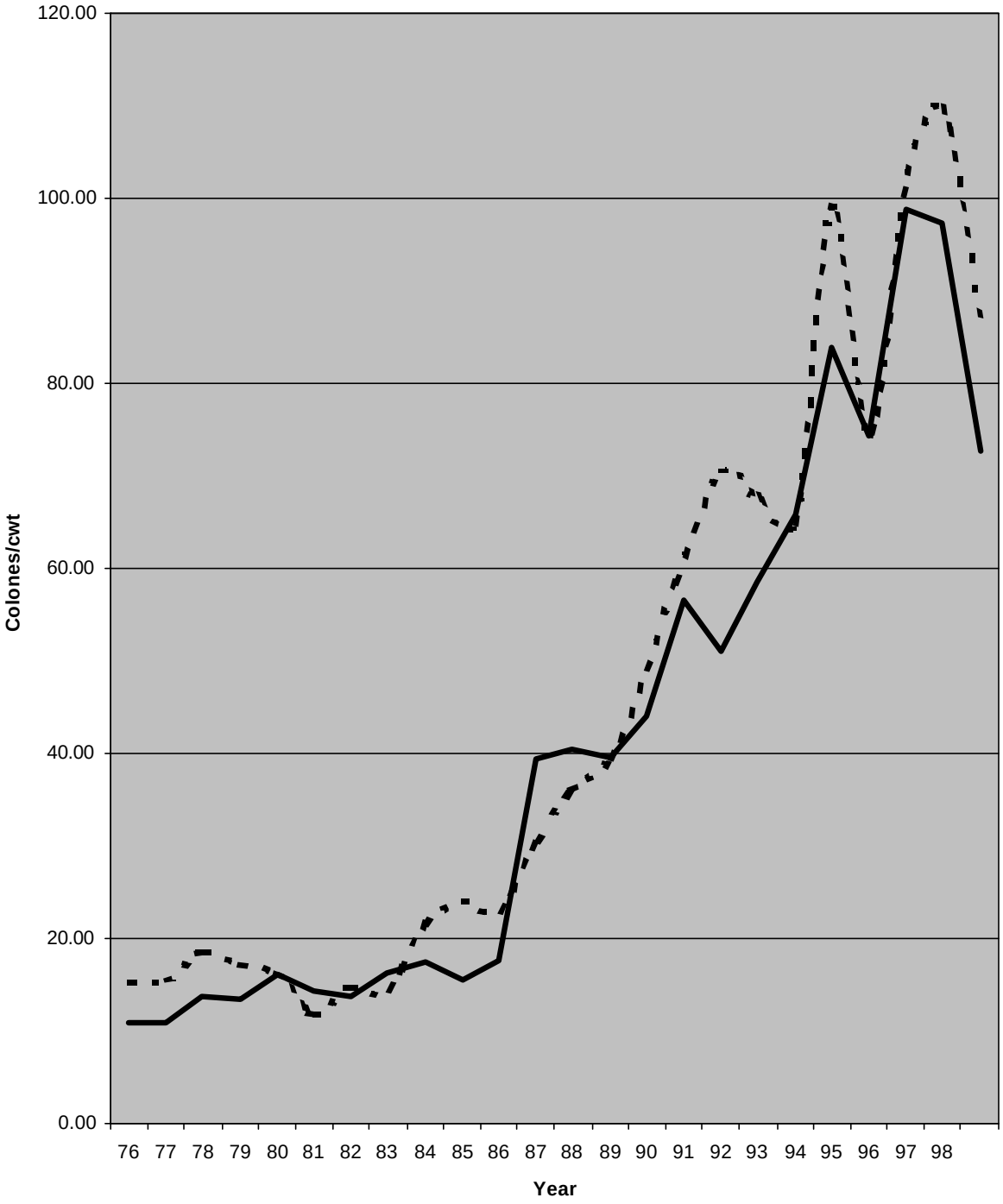

Figure 2. Red Bean Prices

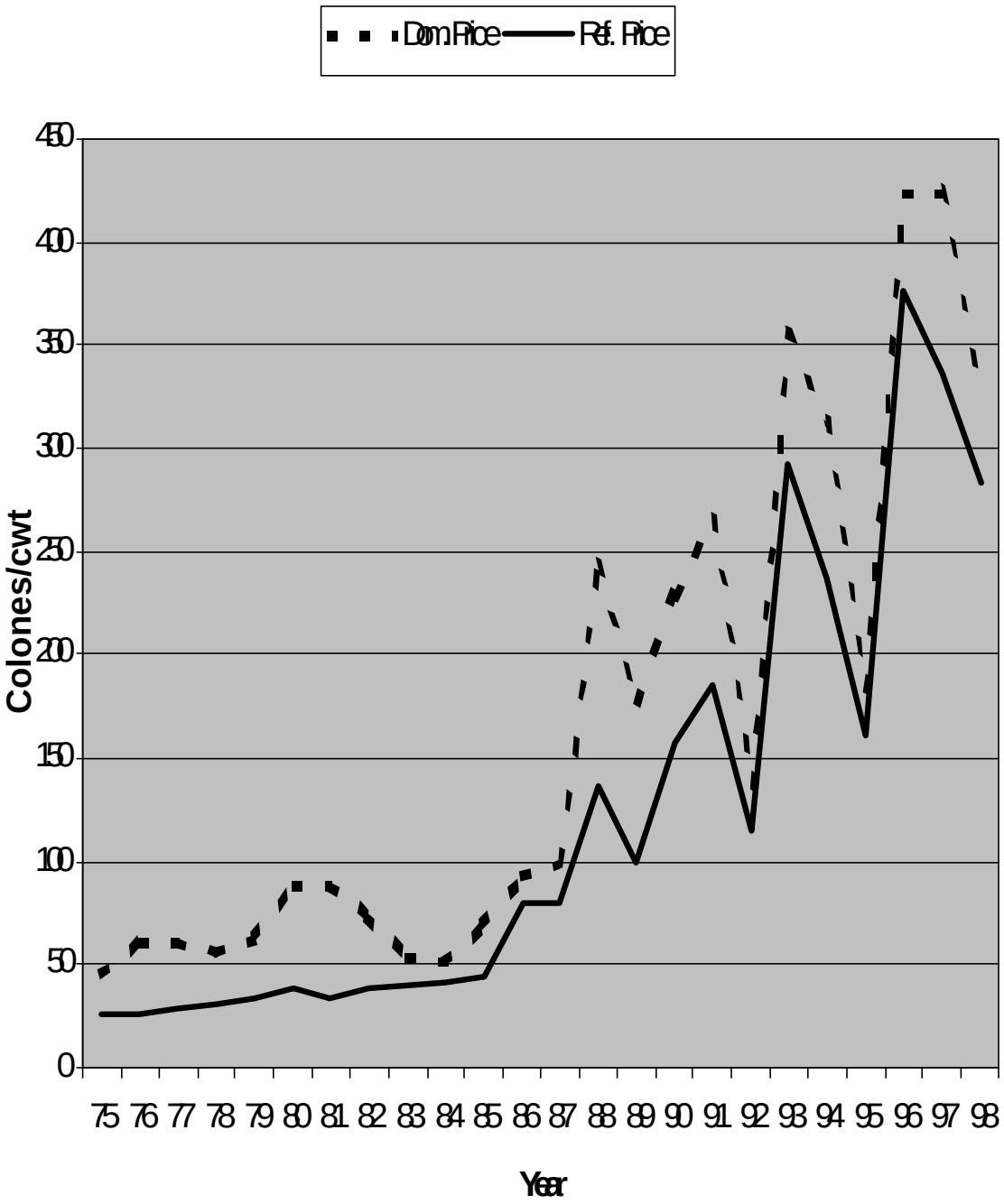

Figure 3. Rice Prices

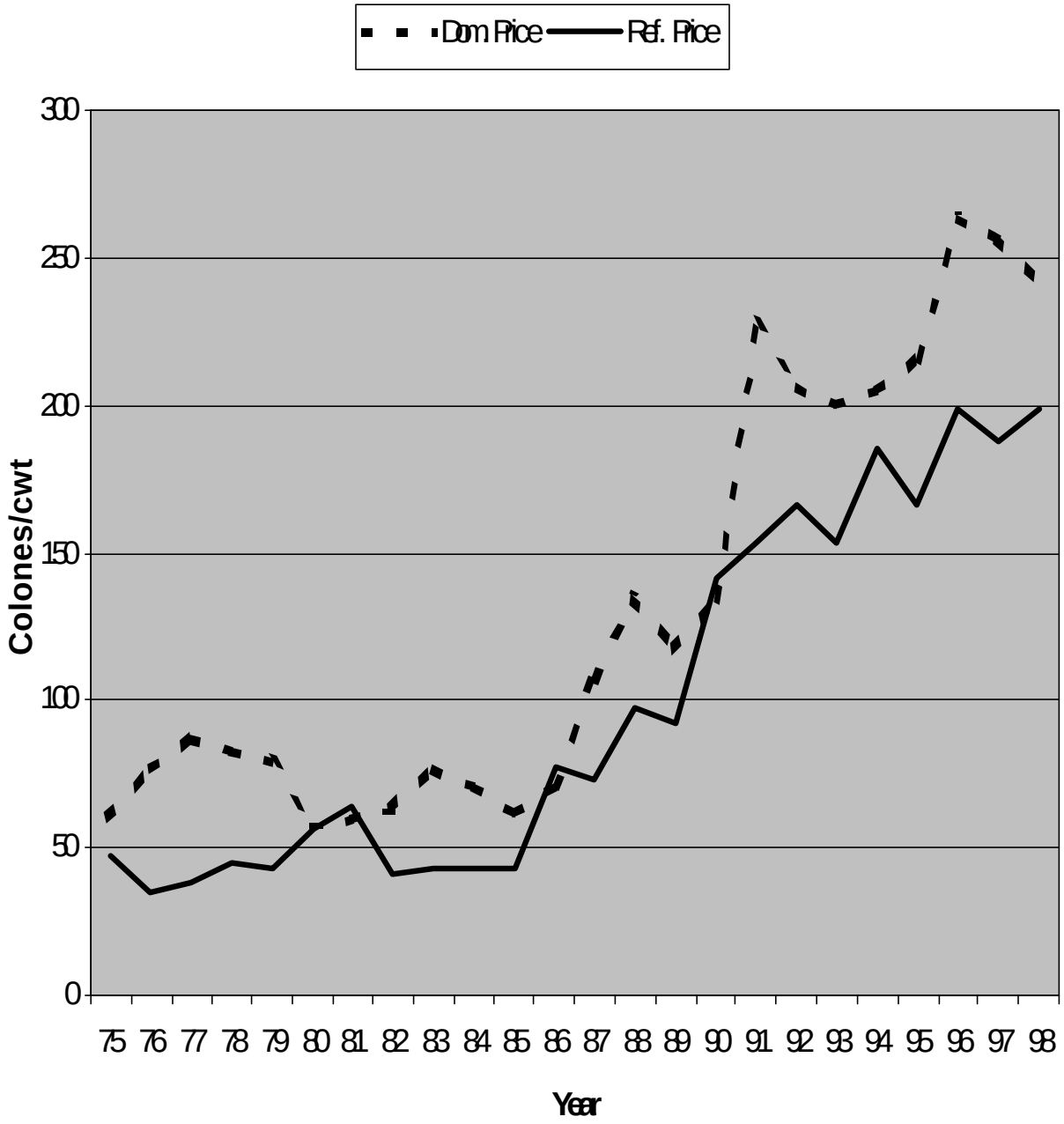

Figure 4. Sorghum Prices

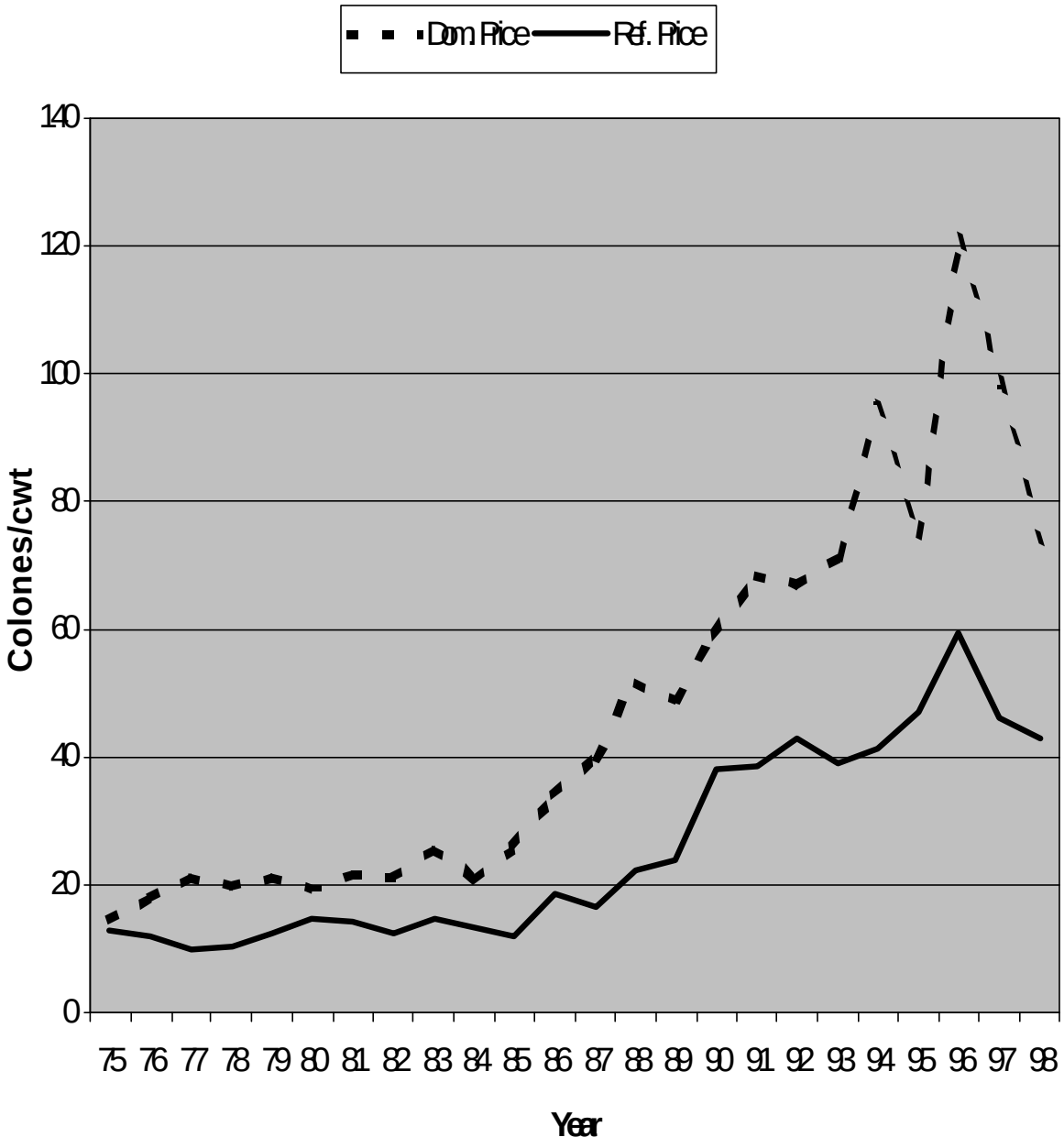

Table 1. Descriptive Statistics of the Variables Used in the Analysis.

Variable (*Unit)*	*Mean*	*Std. Dev.*	*Min./Max.*
Internal Prices:			
White Maize (Col/cwt)	45.23	32.11	11.80/109.63
Red Beans(Col/cwt)	165.72	125.19	45.27/423.80
Rice, Gold (Col/cwt)	131.60	73.21	57.25/263.74
Sorghum (Col/cwt)	47.30	30.43	14.55/121.08
Reference Prices:			
White Maize (Lempiras/cwt)	37.00	41.05	8.71/144.24
Red Beans (Lempiras/cwt)	116.22	152.60	20.37/503.10
Rice, Gold (U.S.$/cwt)	18.65	2.83	13.96/25.64
Sorghum (U.S.$/cwt)	4.89	0.73	3.30/6.81
Exc. Rates and Deflators:			
Exchange Rate (Col./Lemp)	1.43	0.56	0.66/2.50
Exchange Rate (Col./U.S.$)	5.22	2.86	2.50/9.17
WPI El Salvador (1998=1)	0.58	0.32	0.14/1.11
WPI Honduras (1998=1)	0.28	0.26	0.07/1.00
WPI United States (1998=1)	0.76	0.16	0.43/1.00
Ref. Prices in Colones/cwt:			
White Maize	40.92	29.09	10.89/98.76
Red Beans	121.77	109.24	25.46/376.68
Rice	99.71	60.93	34.91/198.73
Sorghum	25.63	15.33	10.12/59.62

Note: Data are from 1975 to 1998.

SECTION IV
EMPIRICAL RESULTS AND DISCUSSION

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The estimated parameters for the price transmission equations given in (3) and (6) are presented in Tables 2 and 3, respectively. The coefficients associated with the exchange rates and reference prices (in nominal or real terms) indicate the estimated elasticities of transmission from changes in those variables to internal prices. Note that these elasticities can range between zero (for complete isolation) to one for perfect price transmission.

Table 2 presents the results for the nominal price transmission. Overall, these results show that the primary basic grains (white maize and red beans) are quite sensitive to both the exchange rate and reference price movements. On the other hand, rice and sorghum are sensitive only to exchange rate movements.

It is interesting to note that for white maize, the reference price is transmitted almost perfectly. This indicates that the internal prices for maize in El Salvador are quite sensitive to regional white maize prices (in this case Honduras). Nominal exchange rates (with respect to Honduras) are also transmitted almost perfectly into internal prices. Thus, a devaluation, for instance (which would increase the nominal exchange rate) would increase the internal price for maize. It is also not surprising that during the post-Mitch period, the price of white maize has dropped considerably since the region (Honduras and Nicaragua) has experienced low prices for basic grains, including maize.

The nominal price transmission for red beans (Table 2) ranks second after white maize, although still quite strong. Nearly 80 percent of the variation of the red bean price in Honduras is transmitted to the internal price in El Salvador. Likewise, nearly 83 percent of the variation in the nominal exchange rate is transmitted to the internal price for red beans in El Salvador.

The internal prices for rice and sorghum were found to be quite responsible to changes in the nominal exchange rate changes but *not* to their reference prices. For sorghum, this is understandable since that commodity has shown little trade activity in the sample period, and thus has been isolated from world market conditions. However, for rice, the result is quite surprising. The real internal rice price appears to be quite sensitive to the real reference price as shown in Table 3.

The results for the real internal price equation in Table 3, reconfirm that the real prices of white maize and red beans in El Salvador are quite sensitive to the regional prices for these commodities. In addition, the real price of rice shows the highest degree of sensitivity to the real reference price. Nearly 72 percent of the real reference price is transmitted to the real internal price. As in the nominal case, the internal prices for sorghum continue to be isolated from world market conditions.

Additional results were obtained to find out how the price of No. 2 yellow maize (the variety produced in the United States) influenced the price of *white* corn, type used for human consumption in El Salvador. An ordinary least squares regression was performed, with the log of the price of white corn as the dependent variable, and the log of the nominal exchange rate (with Honduras), the log of the price of white maize in Honduras, and the log of the price of yellow maize in the U.S. Gulf. These results indicated an insignificant influence of the price of yellow maize on the price of white maize. When the

same procedure was applied to sorghum, the internal price of sorghum in El Salvador was shown to be significantly influenced by the price of yellow maize in the United States. One explanation is that sorghum and yellow maize are substitutes in the production of feed for animal consumption, such as in the domestic poultry industry.

Table 2. Estimates of Exchange Rate and Reference Price Transmission Elasticities for Basic Grains in El Salvador, Nominal Values, 1975-98.

		----------*Nominal Values*----------	
Commodity	*Intercept*	*Exchange Rate*	*Reference Price*
White Maize	0.321*	0.951***	0.938***
	(1.829)	(8.256)	(19.536)
Red Beans	1.3191***	0.833***	0.796***
	(6.460)	(5.563)	(18.717)
Rice, Gold	3.322***	0.876***	0.034
	(4.316)	(12.171)	(0.126)
Sorghum	1.4757***	1.083***	0.35571
	(4.021)	(19.368)	(1.610)

Notes: The values in parentheses are the t-statistics of the corresponding parameters. One, two, and three asterisks indicate significance at the 90, 95, and 99% levels, respectively. All variables were expressed as the logs of the nominal values. The parameters of all the equations were estimated jointly via Seemingly Unrelated Regressions. The estimates correspond to the ones given in equation (3).

Table 3. Estimates of Exchange Rate and Reference Price Transmission Elasticities for Basic Grains in El Salvador, Real Values, 1975-98.

		----------*Nominal Values*----------	
Commodity	*Intercept*	*Exchange Rate*	*Reference Price*
White Maize	2.158*	0.648***	0.527**
	(1.955)	(3.124)	(2.128)
Red Beans	2.464**	0.434**	0.585***
	(3.217)	(2.017)	(4.342)
Rice, Gold	2.947***	0.108	0.715***
	(3.236)	(0.504)	(3.410)
Sorghum	3.607***	0.292*	0.112
	(8.225)	(1.918)	(1.003)

Notes: The values in parentheses are the t-statistics of the corresponding parameters. One, two, and three asterisks indicate significance at the 90, 95, and 99% levels, respectively. All variables were expressed as the logs of the real values. The parameters of all the equations were estimated jointly via Seemingly Unrelated Regressions. The estimates correspond to the ones given in equation (6).

SECTION V
CONCLUDING REMARKS

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The primary basic grains, white maize and red beans, exhibit nearly perfect price and exchange rate transmission when the producer price and exchange rate are expressed in nominal terms. This indicates that for these two grains, farm prices in El Salvador have changed in accordance with regional prices and exchange rates. For rice, internal prices have changed with the reference price (U.S. Gulf) only when prices and exchange rates are expressed in real terms. For sorghum, price transmission is practically non-existence. However, there is evidence that the price of yellow maize does influence the price of sorghum, in spite of little trade activity in sorghum itself.

While the 1975-98 period was used for analysis, there is no reason to expect that the estimated elasticities remained constant during the whole period of analysis. Price bands were common in the early 1990's. There was some additional price regulation during the 1980's by the Instituto Regulador de Abastecimientos. In addition, El Salvador has continued to slowly reduce some of the trade barriers which would increase price transmission. Finally, there is currently pressure to extend the IVA tax (value-added tax) to basic grains. This will negatively affect both domestic producers and consumers in favor of taxpayers and would constitute another factor hampering a stronger price transmission.

SECTION VI
REFERENCES

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REFERENCES

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