PN-AAD 305
ISN-30034
522-0209/62

Macroeconomic Supply/Demand Analysis of Beef, Pork & Dairy Products

(Project No. 522-0209)

Prepared for:

The Government of Honduras

Funded by:

USAID/Honduras

Under Contract PDC-1406-I-20-1142-00

Work Order No. 20

by:

Mr. H. van de Wetering

June 1983

EXPERIENCE, INCORPORATED
MINNEAPOLIS, MINNESOTA 55402

TABLE OF CONTENTS

	page
MAJOR FINDINGS, ASSUMPTIONS AND RECOMMENDATIONS	1
1. CONSUMER RESPONSE PARAMETERS	1
1.1 Income and expenditure on food	1
1.2 Prices paid for food by consumers in six major cities	7
1.3 Consumer response induced by changes in prices paid and real income	12
2. PRODUCER RESONSE PARAMETERS	17
2.1 Short-run supply response	19
2.2 Long-run supply response	20
3. MARKETING MARGINS	24
3.1 Domestic and international interrelationships between the price of beef measured at the farmgate, wholesale, export and retail level	24
3.2 Domestic and international relationships between the price of pork measured at the farmgate, wholesale and retail levels	28
3.3 Interrelationships between the price of milk measured at the farmgate, import and retail level	31
4. SUPPLY AND DEMAND BALANCES FOR BEEF, PORK, MILK AND MILK PRODUCTS	35
5. PROJECTED VALUES OF 9 EXOGENOUS VARIABLES	38
6. PROJECTED PRODUCTION, CONSUMPTION, EXPORTS, PRICES PAID AND RECEIVED FOR BEEF, 1985 AND 1990	44
6.1 Domestic production of beef	44
6.2 Domestic consumption of beef	45
6.3 Projected beef exports and the U.S. export quota	47
7. PROJECTED PRODUCTION, CONSUMPTION, IMPORTS, PRICES PAID AND RECEIVED FOR MILK, 1985 AND 1990	51
7.1 Domestic production of milk	51
7.2 Domestic consumption of milk	54
7.3 Milk imports	55
8. PROJECTED PRODUCTION, CONSUMPTION, PRICES PAID AND RECEIVED FOR PORK, 1985 AND 1990	57
APPENDIX A. SUPPORTING STATISTICAL TABLES	60

I. Major findings, assumptions, and recommendations

I.1 Major findings

I.1.1 The weighted average expenditure elasticities for food products are dominated by the expenditure elasticities of eight major cities

I.1.2 Rural area expenditure elasticities for food are substantially less than for urban areas

I.1.3 The expenditure elasticity for beef equals .72

I.1.4 The expenditure elasticity for milk equals .71

I.1.5 The expenditure elasticity for cheese equals .57

I.1.6 The expenditure elasticity for all food equals .62

I.1.7 For the period 1965-1982 the price of 12 basic foods decreased relative to the price of other foods

I.1.8 For the period 1965-1982 the price of 12 basic foods increased at the same rate as the consumer price index

I.1.9 For the period 1965-1982 the price of beef increased relative to that of 11 other basic commodities

I.1.10 For the period 1965-1982 the price of fluid milk decreased relative to that of 11 other basic commodities

I.1.11 For the period 1965-1982 the price of cheese (queso fresco) showed no increase relative to the price of 11 other basic commodities

I.1.12 Consumer demand for most of the 12 basic commodities is very price responsive

I.1.13 Price intervention brings about proportionately large shifts in the consumers' budget allocation

I.1.14 Price intervention in one basic commodity market has substantial spillover effects in related markets

I.1.15 Consumer demand for livestock products is price elastic

I.1.16 The direct price elasticity for fluid milk is -4.34

I.1.17 The direct price elasticity for cheese is -1.30

I.1.18 The direct price elasticity for beef is -1.18

I.1.19 The direct price elasticity for eggs is -1.95

I.1.20 Producers of livestock products respond to price incentives

I.1.21 The direct supply price response elasticity for pork equals .49

I.1.22 The direct supply price response elasticity for chickens (modern and traditional) equals 1.04

I.1.23 The direct supply price response elasticity for eggs equals .92

I.1.24 The short run supply price response elasticity for beef equals .60

I.1.25 The long run supply price response elasticity for beef equals .88

I.1.26 The short run supply response elasticity for milk equals .12

I.1.27 The long run supply response elasticity for milk also equals .12

I.1.28 Of the five livestock products analyzed milk production is least price responsive

I.1.29 The U.S. retail price for all beef products determines the Honduran f.o.b. export price of beef

I.1.30 The U.S. retail price for all beef products determines the Honduran retail price of beef

I.1.31 The Honduras retail price for beef determines the farm gate price of beef

I.1.32 The producer's share in the retail beef price dollar was constant for the period 1970-1980

I.1.33 The retail price of pork in Honduras is not related to the retail price of pork in the U.S.

I.1.34 The retail price of pork determines the farm gate price of pork

I.1.35 The producer's share in the retail pork price dollar decreased for the period 1970-1980

I.1.36 The import price of all dairy products in 1980 excluding donations, equalled .429 L./litre

I.1.37 The import price of all dairy products in 1980, including donations, equalled .300 L./litre

I.1.38 The EEC granted Honduras an implicit subsidy of .129 L./litre of imported dairy products in 1980

I.1.39 The farm gate price of milk in 1980 equalled .420 L./litre

I.1.40 Were it not for the EEC import subsidy Honduran domestic production would have been competitive with imported milk in 1980

I.1.41 The price of imported milk, with or without donations, fluctuates substantially between years.

I.1.42 The G.O.H. might consider a variable levy so as to maintain parity between the domestic farm gate price and the c.i.f. import price

I.1.43 The retail price of milk does not fully reflect variations in the cost of imported dairy products

I.1.44 The farm gate price of milk is determined by the retail price of fluid milk and cheese (queso fresco)

I.1.45 Variations in the retail price of cheese have a proportionately larger affect on the farm gate price of milk than do variations in the retail price of fluid milk.

I.1.46 The future development of the Honduran livestock industry will not be radically different from the period 1970-1980

I.1.47 Simple trend projections of the production of beef, milk, pork, chicken and eggs under estimate the probable increases in production as documented in this report

I.1.48 The U.S. export quota for beef will expand at a faster rate than Honduras capacity to utilize that quota

I.1.49 Honduras has access to export markets for beef other than the United States

I.1.50 Table I provides a detailed summary of the actual and projected production, consumption, exports, imports, retail price, farm gate price, export price, import price of beef, milk and pork for 1985 and 1990

I.1.51 All of above findings are substantiated by means of econometric analysis in the body of this report.

Table I: Actual and projected production, consumption, exports, imports, retail price, farm gate price, export price, import price of beef, milk and pork, 1985 and 1990.

Product	Actual[1/]	Projected	
	'79 - '81	1985	1990
Beef			
Production (M.T. carcass weight)	30,786	35,676	43,343
Consumption (M.T. carcass weight)	4,027	4,131	4,099
Exports (M.T. carcass weight)	26,759	31,545	39,244
Exports to U.S. (M.T. carcass weight)	25,251	29,767	37,046
Nominal retail price (L./lb.)	2.63	3.74	5.68
Nominal farm gate price (L./lb.)	1.77	2.63	3.93
Nominal export price (L./lb.)	2.82	3.88	5.79
Milk and milk products			
Production (million liters)	265.8	313.1	366.3
Consumption (million liters)	346.9	402.1	510.3
Imports (million liters)	81.1	89.0	134.0
Nominal import price[2/] (L./ltr.)	.300	.575	.797
Nominal retail price (L./ltr.)	.720	.984	1.423
Nominal farm gate price (L./ltr.)	.420	.588	.772
Pork			
Production (M.T. wholesale cuts)	8,136	11,115	14,157
Consumption (M.T. wholesale cuts)	8,136	11,115	14,157
Nominal retail price (L./lb.)	2.71	3.70	4.91
Nominal farm gate price (L./lb.)	1.00	1.39	1.84

1/ prices based on 1980 only

2/ includes donations

I.2 Major Assumptions

I.2.1 The current weighted price received for five livestock products by farmers will increase by 46.6 percent between 1980 and 1985 and by 111.2 percent between 1980 and 1990

I.2.2 The index of prices paid for all food by consumers in Honduras will increase by 42.9 percent between 1980 and 1985 and by 118.1 percent between 1980 and 1990

I.2.3 The index of prices paid for all food by consumers in the United States will increase by 50.0 percent between 1980 and 1985 and by 126.3 percent between 1980 and 1990

I.2.4 The price paid per lb. of all beef products by the U.S. consumer will increase by 37.6 percent between 1980 and 1985 and by 102.5 percent between 1980 and 1990

I.2.5 The price paid per litre of imported milk products, excluding donations, will increase by 49.1 percent between 1980 and 1985 and by 97.0 percent between 1980 and 1990

I.2.6 The G.O.H. will adjust the Lempira exchange rate so as to avoid both overvaluation and undervaluation of the Lempira vis a vis the U.S. dollar

I.2.7 Real expenditure on food by consumers will increase by 28.7 percent between 1980 and 1985 and by 72.1 percent between 1980 and 1990

I.2.8 Real gross value of livestock production will increase by 21.6 percent between 1980 and 1985 and by 47.8 percent between 1980 and 1990

I.2.9 The quantity of donated dairy products as a percentage of total dairy imports will decrease from 27 percent in 1980 to 15 percent in 1985 and to 10 percent in 1990

I.2.10 Honduras will remain self sufficient in pork production.

I.3 Recommendations for further work

I.3.1 That the G.O.H. be made aware of the potential distortions attendant upon price intervention in the markets for livestock products

I.3.2 The development of a policy rule which would implement the concept of a variable levy on imported milk products

I.3.3 The development of an analytical and quantitative framework yielding above two results

I.3.4 That the report be extended to cover the demand for and supply of private and public agricultural credit at the sector level

1. Consumer Response Parameters

1.1 Income and expenditure on food

In this section, we obtain a quantitative specification of the following generally accepted hypotheses.

1/ An increase in the price of a commodity i with other prices and money income remaining constant, will typically reduce the quantity demanded of that commodity by consumers.

2/ An increase in the weighted price of all other goods but commodity i with money income remaining constant, will typically increase the quantity demanded of commodity i by consumers.

3/ An increase in money income with all prices remaining constant will typically increase the quantity demanded of commodity i by consumers.

We consider the following thirteen basic commodities: unground corn, medium quality rice, vegetable shortening, pasteurized milk, medium-sized eggs, red beans, sirloin butt (tajo de pierna de res), medium-sized potatoes, red onions, white sugar, farm-fresh cheese (queso fresco), ripe bananas. These thirteen commodities constituted 51 percent of all expenditure on food in Honduras in 1978-1979. For each commodity, we tested the following hypothesis:

$$x_1 = a + bx_2 + x_3 + x_4,$$

where

x_1 = monthly expenditure on commodity i;

x_2 = total monthly expenditure on food and nonfood items;

x_3 = a shift variable with value 1 for observations related to major cities, and zero value otherwise;

x_4 = a shift variable with value 1 for observations related to other cities, and zero value otherwise.

In the above equation, the slope coefficient b measures the marginal propensity to spend on commodity x_1. Coefficient b multiplied by the inverse of the average propensity to spend on this commodity yields an estimate of the expenditure elasticity, suitably differentiated between cities, rural areas, and income groups within those categories.

The average propensities to spend are tabulated in Tables II-A-1 and II-C-1 of the "Patron del gasto y del consumo de alimentos en los hogares en Honduras," Document No. 31 published by SIECA in October, 1982. The information in these two tables was used to construct supporting Table 1: Monthly income, total monthly expenditure, total monthly expenditure on all food, monthly expenditure on 12 basic foods by major cities, other cities and rural areas according to five income groups. The number of observations in the highest income group in rural areas was very small, and was not considered for further analysis. This left a total of 14 observations which were used to statistically estimate the previously formulated linear Engel curves. The results are reported in Table 1.

R^2 measures the percentage of the variation in monthly expenditure on each of 13 basic commodities explained by the variation in total monthly expenditure and the shift variables associated with major and other cities. The sign of these shift variables is typically negative, indicating that for the same level of income, consumers in rural areas tend to spend more on most of the 13 basic commodities listed. This is also reflected by the fact that for most basic commodities the average propensities to spend are larger in rural areas than in major or other cities Consequently, for the same marginal propensities to spend.

Table 1. Expenditure elasticities for 12 basic foods, other food and all food by major cities, other cities, rural areas and national weighted average

Product	Ordinary least squares regression statistics					Average propensity[1] to spend			Expenditure elasticities[2]			
	R^2	Intercept	Shift variables: Major cities	Shift variables: Other cities	Marginal propensity to spend[4]	Major cities	Other cities	Rural areas	Major cities	Other cities	Rural areas	Weighted[3] average
Corn	.42	21.36	-6.43	-3.52	.003 (.002)	.029	.059	.139	.11	.05	.02	.09
Rice	.57	7.43	-3.03	-2.27	.008 (.002)	.016	.024	.051	.50	.33	.16	.43
Shortening	.54	8.12	-4.00	-2.50	.008 (.002	.016	.025	.050	.50	.32	.16	.43
Milk	.57	2.61	-1.88	.56	.006 (.002)	.007	.016	.011	.86	.38	.55	.71
Eggs	.85	4.07	.35	-1.01	.009 (.001)	.017	.020	.035	.52	.45	.26	.47
Beans	.53	11.11	-4.18	-2.80	.003 (.001)	.015	.030	.073	.20	.10	.04	.17
Beef	.93	.51	3.37	3.60	.030 (.003)	.038	.043	.031	.79	.70	.97	.72
Potatoes	.85	.70	-.30	-.14	.003 (.00...)	.004	.005	.005	.81	.60	.60	.72
Tomatoes	.93	.28	.27	.17	.003 (.00...)	.004	.004	.004	.75	.75	.75	.75
Onions	.86	.56	-.23	-.36	.002 (.00...)	.002	.002	.004	1.00	1.00	.50	.93
Sugar	.50	5.12	-2.42	-.86	.005 (.001)	.010	.019	.028	.52	.26	.18	.44
Cheese	.66	2.85	-.65	1.75	.008 (.002)	.012	.018	.015	.66	.49	.53	.57

Table 1. *Continued*

Product	Ordinary least squares regression statistics					Average propensity[1] to spend			Expenditure elasticities[2]			
	R^2	Intercept	Shift variables: Major cities	Shift variables: Other cities	Marginal propensity to spend[4]	Major cities	Other cities	Rural areas	Major cities	Other cities	Rural areas	Weighted[3] average
Banana	.75	.32	.11	-.14	.001 (.00...)	.001	.001	.002	.71	.71	.50	.70
Other food	.97	-4.43	27.22	20.58	.155 (.010)	.200	.208	.144	.78	.75	1.08	.72
All food	.91	60.60	8.20	12.98	.244 (.025)	.371	.476	.594	.66	.51	.41	.62

[1]Calculated from Table S-1.

[2]Expenditure elasticity = MPS/APS.

[3]Calculated from Table 1; W_i = (no. of households$_i$ x mthly. expend$_i$)/ $\sum_{i=1}^{3}$ (no. of households$_i$ x mthly. expend$_i$)

weight major cities = .75; weight other cities = .18, weight rural areas = .07.

[4]Figures in parentheses are standard errors; (.00...) indicates zero third digit upon rounding.

expenditure elasticities in rural areas will tend to be lower than in major and other cities.

For projection purposes, we need the national weighted average. A natural weighting scheme is the sampling frame, which underlies the SIECA-ECID household expenditure study. Supporting table S-1 lists respectively 2870, 1316, 1070 households for major cities, other cities and rural areas. The corresponding average total monthly expenditures per household are 642.8, 339.8 and 180.5 Lempiras. This implies that consumers in major cities account for 75 percent of expenditure on food, smaller cities account for 18 percent, with the residual 7 percent being accounted for by rural areas. It follows that the weighted expenditure elasticities are dominated by consumer behavior in the eight major cities, i.e., Santa Rosa, San Pedro Sula, Comayagua, Tegucigalpa, Choluteca, Juticalpa, La Ceiba, and Danli. For projection purposes, we do not consider the consequences on these elasticities of a possible income redistribution strategy. We, therefore, assume implicitly that in the next decade the distribution of expenditure on food will not change materially between major cities, other cities and rural areas.

None of the 12 basic commodities is an inferior good, i.e., a commodity with a negative income elasticity. On the other hand, none of the 12 basic commodities is a luxury, i.e., having an expenditure elasticity greater than unity. Of particular interest are the expenditure elasticities for milk (.71), eggs (.47), beef (.72) and cheese (.57). The SIECA-ECID study did not tabulate the expenditures on pork. The retail price of this commodity is higher than that for beef. On the other hand, it is primarily consumed in rural areas. Given these likely off-setting effects, we postulated a value of .70 for the expenditure elasticity of pork. Supporting

Table S-1 lists monthly incomes as well as monthly expenditures. It is possible to estimate the latter as determined by the former. Specifically,

$$x_2 = 51.0 + \underset{(.021)}{.646}\, x_5 + 21.5\, x_3 + 12.7\, x_4 \qquad R^2 = .99$$

where

x_2 = monthly household income;

x_5 = monthly household expenditure;

x_3, x_4 as before.

The above relation indicates a very high marginal propensity to save of .354. The relation can be used to derive global expenditure-income elasticities by multiplying the marginal propensity to spend by the inverse of the average propensity to spend, which from Table S-1, equalled .753, .819, .861 respectively for major cities, other cities and rural areas. Table 1 lists expenditure elasticities. In order to convert these elasticities to <u>income</u> elasticities, they should be multiplied by the appropriate expenditure-income elasticities derived above. In this study, we use expenditure elasticities for three reasons:

1/ The data on expenditures appear to be more reliable;

2/ The national income accounts of Honduras contain a series on agregate expenditure on food;

3/ The theory relating savings (the difference between income and expenditure) to prices of commodities is not adequately understood.

1.2 Prices paid for food by consumers in six major cities

The homogeneity postulate implies that, if all prices and income double, the quantities demanded of each commodity will remain unaffected. In practice, prices will increase at different rates which will increase the quantities demanded of those commodities whose relative pricess fall. The possibility of a cheap food policy pursued by the GOH during the Seventies implies that the prices of "controlled" commodities should fall relative to the prices of "uncontrolled" commodities. If basic grains are kept cheap, then the demand for livestock products will expand proportionately less. If milk is kept cheap to the consumer and unprofitable to the farmer, then beef production will expand proportionately more. If consumer and producer response are price elastic, then price intervention will have substantial reallocative effects. We must, therefore, in this report address three questions:

1/ What is the behavior of relative food prices?

2/ How price responsive is domestic consumption?

3/ How price responsive is domestic production?

The third question will be answered in section 2. In this section, we deal with the first and second questions.

The Departmento de Estudios Economicos of the Banco Central de Honduras has published the "Indice general de precios al consumidor" since 1965. Monthly data for a long list of specific articles were collected in Tegucigalpa, San Pedro Sula, La Ceiba and Choluteca throughout this period. The cities of Santa Rosa, Comayagua, Juticalpa, and Danli were included starting in 1978. That year also marked 2 revisions of the expenditure weights underlying the consumer price index. The revised weights are based on the household expenditure survey data used to derive the results in Table 1.

Supporting Table S-2 lists the nominal prices paid by consumers in Tegucigalpa for 12 basic foods, 1965-1982. Using the 1978 expenditure weights from Table S-1, we constructed a weighted price index for these 12 commodities. That price index can be compared with the fixed weight consumer price index published by the Banco Central de Honduras, as well as with the current weight consumer price index derivable from the National Income Accounts data published by the Banco Central de Honduras.

The trend in relative price for commodity i was determined from the following equation

$$\ln(x_i/x_{13}) = a+b.t$$

where

x_i = nominal price of commodity i;

x_{13} = weighted average price of 12 basic commodities

$\ln(x_i/x_{13})$ = natural logarithm of the relative price of commodity i;

t = time, with t=1=1965.

The slope coefficient b in the above equation represents the average percentage change in relative price. If a commodity increases in relative price, the coefficient b will be positive. Table 2 lists the regression statistics of the above equation for each of 12 commodities. A low R^2 indicates the absence of any systematic trend in relative price for the period 1965-1982. Such is the case for cheese (R^2 = .01), tomatoes (R^2 = 0), and potatoes (R^2 = .16). Only eggs (R^2 = .95), beef (R^2 = .73), shortening (R^2 = .63), beans (R^2 = .55) and sugar (R^2 = .54) show statistically significant trends.

The relative prices for corn, rice, beans, and beef increased. The relative prices of shortening, milk, eggs, potatoes, sugar and bananas decreased. The relative prices for tomatoes and cheese showed no change. For this project, the changes in relative prices of beef, milk and cheese are of

Table 2. Annual percentage changes in the relative prices of 12 basic foods, Tegucigalpa, 1965-1982

Relative price of 12 basic foods[1]	Definition of variables	Regression statistics[2]			Annual percentage change in relative price[4] $\Delta x_i/x_i - \Delta x_{13}/x_{13} \gtrless 0$
		R^2	Intercept	Slope	
Corn	x_1/x_{13}	.37	-1.11	.026 (.011)	.026
Rice	x_2/x_{13}	.21	.10	.018 (.011)	.018
Shortening	x_3/x_{13}	.66	1.13	-.021 (.005)	-.021
Milk	x_4/x_{13}	.23	.56	-.014 (.008)	-.014
Eggs	x_5/x_{13}	.95	1.75	-.040 (.003)	-.040
Beans	x_6/x_{13}	.55	-.29	.042 (.013)	.042
Beef	x_7/x_{13}	.73	1.31	.013 (.003)	.013
Potatoes	x_8/x_{13}	.16	.18	-.012 (.010)	-.012
Tomatoes	x_9/x_{13}	.00	.12	-.000 (.023)	-.000
Sugar	x_{10}/x_{13}	.54	-.08	-.026 (.008)	-.026
Cheese	x_{11}/x_{13}	.02	1.58	.001 (.003)	.001
Bananas	x_{12}/x_{13}	.29	-2.14	-.040 (.021)	-.040

[1] For a further commodity definition, see Table S-2.

[2] $\ln(x_i/x_{13})=a+bt$, $t=1=1965$ --- $t=18=1982$, for data on x_i, x_{13} see Table S-2.

[3] $x_{13} = \Sigma\, k_i x_i$, $i=1 \ldots 12$, where k_i are 1978 expenditure weights for Tegucigalpa; see Table S-2.

[4] $(\Delta x_i/x_i - \Delta x_{13}/x_{13})$ = slope of $\ln(x_i/x_{13}) = a + bt$.

particular interest. Over the past seventeen years, the relative price of beef increased by 1.3 percent annually. The price of fluid milk decreased by 1.4 percent annually, with the relative price of cheese remaining constant. Fluid milk consumption accounts for one-third of the total milk product consumption. Consequently, the retail price of milk products must have decreased at an annual rate of -.5 percent. Other things remaining constant, beef production must have increased in profitability relative to milk production. This in turn has important implications for the future choice of breeds and the capital-labor intensity of the technologies used in beef and milk production.

The 12 basic commodities listed in Table 2 account for half of the expenditure on food. Table 3 demonstrates that the price index of that food basket is but weakly correlated with the complete food basket included in the cost of living index. Nevertheless, a cheap food policy should show a decline in relative prices for the 12 basic commodities. This is, indeed, the case because of a .5 annual percent decrease in the relative price of these 12 basic commodities. On the other hand, the price index of all food increased relative to the general price index. Because of this, the price of the 12 basic commodities increased at approximately the same rate as the general consumer price index. For projection purposes, it will be convenient to use the general consumer price index as a proxy variable for the price index of 12 basic foods.

Table 3. Annual percentage changes in major relative price indices, 1965-1981

Price indices[1]	Relative price indices	Regression statistics[2]			Annual percentage change in relative price $\Delta x_i/x_i - \Delta x_j/x_j \gtrless 0$
		R^2	Intercept	Slope	
Price index of 12 basic foods (x_{13})	x_{13}/x_{14}	.26	-5.37	-.005 (.003)	-.005
Consumer Price Index All food (x_{14})	x_{14}/x_{15}	.85	-.15	.010 (.001)	.010
All food + non-food (x_{15})	x_{15}/x_{17}	.84	-.89	.024 (.003)	.024
Implicit price index Food (x_{16}) GDP (x_{17})	x_{14}/x_{16}	.39	-.54	-.008 (.003	-.008

[1]For a further definition and sources of data, see Table ---.

[2]$\ln(x_{13}/x_{14}) = a+bt$, $t = 1 = 1965 \ldots t = 17 = 1981$.

$\ln(x_{14}/x_{15}) = a+bt$, $t = 6 = 1970 \ldots t = 16 = 1980$.

$\ln(x_{15}/x_{17}) = a+bt$; $t = 6 = 1970 \ldots t = 16 = 1980$.

$\ln(x_{14}/x_{16}) = a+bt$; $t = 6 = 1970 \ldots t = 16 = 1980$.

1.3 Consumer response induced by changes in prices paid and real income

Section 1.2 showed statistically significant trends in relative prices for beef, milk, eggs and other selected products. These trends, based on the 1965-1982 period, are likely to persist. They will have an important bearing on the allocation of the consumer's budget if consumer response is price responsive. The purpose of this section is to establish those parameters. We start with the following hypothesis:

$$\ln X_1 = a + b \ln X_2 + c \ln X_3 + d \ln X_4$$

where

X_1 = quantity demanded of commodity X_1;
X_2 = retail price of commodity X_2;
X_3 = weighted retail price of all commodities but X_2;
X_4 = total expenditure per household.

The above equation b represents the Marshallian or compensated direct price elasticity. It will typically be negative. Coefficient c represents the Marshallian or compensated cross price elasticity. It will typically be positive. Coefficient d represents the expenditure elasticity. It will typically be positive. We need to obtain estimates of b, c, and d for the purpose of projecting the domestic consumption of beef, milk and pork.

The SIECA-ECID study does not contain information on X_1, X_2 or X_3. It does contain information on expenditure shares, i.e., $(X_1 \cdot X_2/X_4)$. Let k_1 represent the expenditure share of commodity X_1; then

$$\ln k_1 = \ln X_1 + \ln X_2 - \ln X_4.$$

Substituting above yields

$$\ln k_1 = a + (b+1)\ln X_2 + c \ln X_3 + (d-1)\ln X_4.$$

A similar equation for all commodities but X_1 would read

$$\ln(1-k_1) = a^* + b^*\ln X_2 + (c^*+1)\ln X_3 + (d^*-1)\ln X_4.$$

Upon subtracting, we obtain

$$\ln(k_1/1-k_1) = (a-a^*) + (b+b^*+1)\ln X_2 + (c+c^*+1)\ln X_3 + (d-d^*)\ln X_4.$$

Given homogeneity, the above equation can be transformed further into

$$\ln(k_i/1-k_i) = z + \alpha[1/1-k_1)\ln(P_i/P] + (e_i-e_0)\ln(M/P)$$

where

$$\alpha = e^u_{ii} + e^u_{00} + 1;$$

$$e^u_{ii} = (1-k_1)(\alpha-1)$$

$$\sigma = e_{ii} + e_{00};\ e_{ii} \leq 0;\ e_{00} \leq 0;$$

P = weighted exponential price index of all commodities.

The above equation states that α equals the sum plus one of the uncompensated direct price elasticities e^u_{ii} of commodity i and all other commodities e^u_{00}. The sum of these two direct price elasticities, both of them negative, equals the elasticity of substitution which should also be negative. Therefore, $\alpha \leq 1$. Also note that a statistical estimate of α yields an estimate of the direct price elasticity e^u_{ii}. Knowledge of this coefficient, and the income elasticity e_i can be used to calculate the uncompensated cross price elasticity e^i_{i0}.

Observe that the estimated equation contains only two independent variables, i.e., the relative price ratio (P_i/P) and the real expenditure variable (M/P). This is important because we have only eight observations for each commodity to statistically estimate this equation. Table II-C-10 of the SIECA-ECID study lists the k_i for 12 basic commodities by 8 major cities, other urban areas and rural areas. The Banco Central de Honduras started

collecting retail price data for these 8 cities at the time the SIECA-ECID household expenditure survey was conducted. Two-thirds of the interviews were conducted in the last 8 months of 1978, the remainder in the first 4 months of 1979. Assuming a slight lag in consumer response, we took the 1978 average price paid by consumers in these 8 cities as the price variables in the above equation. The data for each of 12 basic commodities are listed in supporting Table S-3.

Table 4 lists the direct price elasticities and cross price elasticities at the retail level. The ordinary least squares regression statistics are surprisingly good for major commodities. The last two columns indicate that the consumer typically responds strongly to a change in relative price. The demand for fluid milk is very price elastic, with a coefficient of -4.34. The demand for cheese is also price elastic, with a coefficient of -1.30. The demand for beef is also price elastic, with a coefficient of -1.48. This indicates that a substantial increase in domestically marketed beef and milk can be absorbed at only a moderate reduction in prices received by farmers.

On the other hand, increases in the relative prices of milk and beef engineered as a matter of policy or because of developments in international markets will also affect the domestic consumption of beef and milk disproportionately. If the prices of beef and milk are taken to be exogenous to the Honduran economy, and if such prices show substantial variability, then we should expect a correspondingly larger variability in the volume of beef exports and milk imports.

Table 4. Direct price elasticities and cross price elasticities at the retail level for 12 basic commodities

Product	Ordinary least squares statistics[1]				Average propensity to spend	Expenditure elasticity	Uncompensated direct price elasticity	Compensated direct price elasticity	Compensated cross price elasticity
	R^2	Intercept z	Elasticity of substitution plus one α 2/	Expenditure elasticities differential $(e_i^M - e_o^M)$ 3/	k_i 4/	e_i^M	e_{ii}^u 5/	e_{ii}^M 6/	e_{io}^M 7/
Corn	.36	-28.87	-.72 (1.92) 8/	3.82 (2.27) 8/	.077	.11	-1.59	-1.60	+1.49
Rice	.59	4.75	-2.12 (.86)	-1.51 (.83)	.043	.50	-2.99	-3.01	+2.51
Shortening	.54	-9.43	.82 (.98)	.94 (1.16)	0.42	.50	-.17	-.19	-.31
Milk	.89	6.53	-3.40 (.56)	-2.21 (1.24)	.019	.86	-4.32	-4.34	+3.48
Eggs	.41	-17.46	-1.03 (.80)	2.29 (1.30)	.047	.52	-1.93	-1.95	+1.43
Beans	.59	-17.43	.66 (.79)	2.22 (.84)	.040	.20	-.38	-.39	+.19
Beef	.47	-10.27	-.56 (.74)	1.50 (.74)	.103	.79	-1.10	-1.18	+.39
Potatoes	.12	-2.84	.25 (.50)	-.29 (.54)	.010	.81	-.74	-.75	-.06
Tomatoes	.34	1.51	.44 (.42)	-.87 (.82)	.012	.75	-.55	-.56	-.19
Sugar	.68	2.46	-1.37 (.53)	-.80 (.61)	.026	.52	.36	-.35	-.17

Table 4. *Continued*

Product	Ordinary least squares statistics[1/] R^2	Intercept z	Elasticity of substitution plus one α [2/]	Expenditure elasticities differential $(e_i^M - e_o^M)$ [3/]	Average propensity to spend k_i [4/]	Expenditure elasticity e_i^M	Uncompensated direct price elasticity e_{ii}^u [5/]	Compensated direct price elasticity e_{ii}^M [6/]	Compensated cross price elasticity e_{io}^M [7/]
Cheese	.50	-25.50	-.32 (.62)[8/]	3.40 (1.53)[8/]	.033	56	-1.28	-1.30	+.64
Bananas	.09	-22.07	-1.26 (1.79)	1.85 (3.87)	.004	.71	-2.25	-2.25	+1.54

[1/] $\ln(k_i/1-k_i) = Z + \alpha[1/(1-k_i)\ln(P_i/P)] + (e_i^M - d_o^M)\ln(M/P)$.

[2/] $\alpha = (e_{ii}^u + e_{oo}^u + 1)$; elasticity of substitution $= \sigma = e_{ii} + e_{oo}$; $e_{ii} \leq 0$; $e_{oo} \leq 0$.

[3/] For representative values of e_i^M, e_o^M see Table 1, expenditures elasticities for major cities.

[4/] k_i from Patron del gasto y del consumo de alimentos en Honduras, Table II-C-10, Autorepresentados.

[5/] $e_{ii}^u = (1-k_i)(\alpha-1)$.

[6/] $e_{ii}^M = e_{ii}^u - k_i e_i^M$.

[7/] $e_{io}^M = -(e_{ii}^M + e_i^M)$

[8/] Figures in parentheses indicate standard errors.

2. PRODUCER RESPONSE PARAMETERS

In this section, we obtain a quantitative specification of the following generally accepted hypotheses:

1/ An increase in the price received by farmers for commodity i, other prices received and agregate factor availability remaining the same, should increase the production on commodity i;

2/ An increase in the price received by farmers for all products but commodity i, agregate factor availability remaining the same, should decrease the production of commodity i;

3/ An increase in the agregate of factors committed to production, with all commodity prices remaining the same, should increase the production of all commodities.

We consider the following five livestock products: beef, pork, chicken, eggs and milk. Table 5 lists the production and nominal prices received by farmers for beef, pork, chicken, eggs and milk for the period 1970-1981. Given these data, it is possible to calculate the gross value of production.

Supporting Table S-4 lists the corresponding shares for the above products. The shares of beef and pork and eggs have been stable during the past decade. The share of chicken increased, while the share of milk production decreased. The earnings shares in Table S-4 were used to calculate the current exponentially weighted average price received by farmers.

$$\ln P = \sum k_i \ln P_i;$$

P = weighted average price;

P_i = nominal prices of 5 livestock products;

k_i = current share in gross value of livestock production.

Table 4. Production and nominal prices received by farmers for beef, pork, chicken, eggs and milk, 1970-1981

	X_1	X_2	X_3	X_4	X_5	X_6	X_7	X_8	X_9	X_{10}	X_{11}	X_{12}	X_{13}	X_{14}	X_{15}	X_{16}	X_{17}	X_{18}
	Beef			Pork			Chicken			Eggs			Milk			All livestock		
	Q[1/]	P[2/]	PQ[7/]	Q[1/]	P[2/]	PQ[7/]	Q[1/]	P[2/]	PQ[7/]	Q[3/]	P[4/]	PQ[7/]	Q[5/]	P[6/]	PQ[7/]	M	P	$\sum P_i Q_i$[7/]
1970	1,060.6	40.83	43.30	101.1	64.00	6.47	80.1	76.30	7.11	266.9	27.00	20.02	189.2	21.80	41.25	3.63	32.31	117.15
1971	1,121.5	40.87	45.84	108.0	66.00	7.13	89.5	78.70	7.04	300.1	26.30	21.92	191.6	22.90	43.88	3.82	32.98	125.81
1972	1,185.0	41.49	49.17	115.2	67.00	7.72	99.9	76.40	7.63	318.0	27.40	24.20	203.5	23.00	46.81	4.05	33.44	135.53
1973	1,098.6	42.84	47.06	123.7	69.00	8.47	111.4	83.10	9.26	337.6	27.70	25.98	207.1	24.00	49.70	4.06	34.61	140.47
1974	1,190.0	54.19	64.49	129.7	77.00	9.99	124.3	99.90	12.42	359.6	29.90	29.87	218.9	26.00	56.91	4.24	41.00	173.63
1975	1,191.7	59.16	70.50	139.6	79.00	11.03	138.7	102.40	14.20	380.7	32.04	33.88	225.9	28.00	63.25	4.38	44.01	192.86
1976	1,201.3	63.70	76.52	149.3	81.00	12.09	154.7	102.40	15.84	402.8	33.84	37.86	231.5	31.00	71.77	4.56	46.94	214.08
1977	1,304.0	73.24	95.50	159.0	87.00	13.83	172.7	105.70	17.74	424.1	34.92	41.13	242.6	34.00	82.48	4.80	52.23	250.68
1978	1,322.6	79.59	105.27	17.00	89.00	15.13	192.8	109.00	21.02	446.9	37.08	46.03	25.02	37.00	92.57	4.99	56.13	280.02
1979	1,414.9	80.19	113.46	174.3	92.00	16.04	215.4	114.60	24.69	463.7	37.08	47.76	257.2	40.00	102.88	5.23	58.26	304.83
1980	1,377.0	83.98	115.64	175.8	100.00	17.58	240.6	120.20	28.92	469.9	44.28	57.80	268.7	42.00	122.85	5.38	61.86	332.79
1981	1,482.0	88.29	130.85	186.3	107.00	19.93	303.7	128.80	39.12	487.6	44.64	60.46	271.4	43.00	116.70	5.56	66.04	367.06

1/ Thousands of quintals (1 quintal = 100 lbs.)

2/ Average farmgate price per quintal.

3/ Average farmgate price per case of 360 eggs.

4/ In millions of units.

5/ Millions of litres.

6/ Per 100 litres of milk.

7/ Millions of Lempiras.

The weighted price received P is listed in both Tables 5 and Supporting Table S-4. Deflating the current gross value of livestock production by P, we obtain the real gross value of livestock production. This latter concept measures the agregate real value of resources committed to livestock production in any given year.

2.1 Short-run supply response

We considered the following hypothesis

$$\ln X_1 = a + b\ln X_2 + c\ln X_3 + d\ln X_4$$

where

X_1 = the quantity produced of a given livestock product,

X_2 = nominal price received by farmers for that product,

X_3 = nominal price received by farmers for the remaining four livestock products,

X_4 = current gross value of production of factors committed.

In the above equation, b represents the direct price elasticity, which is expected to be positive. The coefficient c represents the cross price elasticity. It is expected to be negative. Coefficient d measures the resulting expansion elasticity. It is expected to be positive. The above equation, following the procedure on page 12, can be transformed into the following equation

$$[1/(1-k_i)]\cdot\ln(P_i/P) = a^* + b^*\ln[k_i/(1-k_i] + c^*\ln(M/P)$$

where

$$b^* = 1/(e_{ii}+e_{oo}+1),\ e_{ii} \geq 0,\ e_{oo} \geq 0;$$

$$e_i = 1-[(1-k_i)c^*/b^*];$$

$$e_{ii} = (1-k_i)/(1-b^*)/b^*;$$

$$e_{io} = -e_{ii};\ \sigma = e_{ii} + e_{oo}.$$

The statistically estimable coefficient b* represents the inverse of the elasticity of substituting α plus one. The elasticity of substitution α equals the sum of the direct uncompensated price elasticities e_{ii} and e_{oo}. Because both these elasticities are positive, it follows that $0 \leq b^* \leq 1$. The direct price elasticites can be calculated given an estimate of b* and of the earning share k_i.

The above equation was estimated by means of ordinary least squares regressions for beef, pork, chicken, eggs and milk on the basis of the eleven annual observations listed in supporting Table S-4. The results, presented in Table 6, show uniformly high coefficients of determination. Price and real earnings effects are statistically highly significant. The real earnings elasticities for the traditional sectors, i.e., beef and milk equal .65 and .86, respectively. This indicates that, for constant relative commodity prices, additional resources committed to livestock production, will result in a less than proportional expansion for milk and beef. The converse is true for pork, chicken and eggs, all of which grew relatively fast in the last decade. The direct price elasticities for pork, chicken and eggs equal .49, 1.04 and .92, respectively. The production of these products may be judged to be quite price responsive. The price elasticities for beef (.18) and milk (0) are much lower.

2.2 Long-run supply response

The response equation used in Table 6 in principle measures only current response to a change in current relative price. For products with a short production cycle, such as eggs, chicken and pork, this appears reasonable; i.e., the current year elasticities of these products equal their full response or long-run elasticities. Milk and beef production have a longer

Table 6. Short-run supply response elasticities for beef, pork, chicken, eggs and milk, 1970-1981

Commodity	Regression statistics[1/]				Real earnings elasticity[2/]	Direct Price elasticity[3/]	Cross price elasticity[4/]
	R^2	Intercept a	Relative earnings share b	Real earnings effect c	e_i	e_{ii}	e_{oo}
Beef	.82	.243171 (.174145)	.778481 (.209460)	.420920 (.083506)	.65	.18	-.18
Pork	.92	3.334045 (.846068)	.656653 (.332858)	-.573903 (.099215)	.183	.49	-.49
Chicken	.92	3.899789 (.501761)	.463232 (.104275)	-1.242483 (.161560)	3.39	1.04	-1.04
Milk	.80	-.247077 (.084365	.999415 (.169993)	.207546 (.060797)	.86	0	0
Eggs	.81	2.295760 (.403472)	.976308 (.306400)	-.467640 (.120630)	1.82	.92	-.91

1/ $[1/(1-k_i)]\cdot\ln(P_i/P) = a^* = b^*\ln[k_i/(1-k_i)] + c^*\ln(M/P)$

b^* = increse of commodity elasticity of substitution plus one = $1/(e_{ii}+e_{oo}+1)$; $e_{ii}\geq 0$; $e_{oo}\geq 0$

$c^* = -b(e_i-e_o)$ where e_i, e_o are real earnings elasticities.

2/ $e_o = e_i + c/b$ with additivity $k_i e_i + (1-k_i)e_o = 1$; therefore, $e_i = 1-(1-k_i)\cdot c/b$

k_i taken as 1981 earnings shares.

3/ $e_{ii} = (1-k_i)/(1-b)/b)$.

4/ $e_{io} = -e_{ii}$.

production cycle. There may, therefore, exist a delayed response to a change in current relative price. The delayed response may be distributed over several years. We, therefore, explored the following distributed lag model for beef and milk.

1. $Y^*_t = a(P_i/P)_{t-1}$

   Y^*_t the desired level of output for beef or milk in year t which corresponds to the relative price ratio which existed in year (t-1).

   a Proportionality constant.

2. $(Y_t - Y_{t-1}) = c(Y^*_t - Y_{t-1})$

   Y_t actual output in year t

   Y_{t-1} actual output in year t-1

   c The fraction of the difference between desired and starting production which can be closed in a given calendar year. If c=1, all of the output adjustment can be made within one calendar year.

Successive substitutions yield the following equation

$$Y_t = a.c.(P_i/P)_{t-1} + (1-c)Y_{t-1}.$$

All variables in the above equation are observable, and are listed in Table 5. We then estimated the above equation using ordinary least squares. The results in Table 7 are statistically significant. The one year delayed price elasticities equal .60 and .12 for beef and milk, respectively. The corresponding long-run elasticities equal .88 and .12. Beef production, therefore, is substantially price responsive. Milk production is not price responsive.

Table 7. Short-run and long-run supply response elasticities for beef and milk, 1970-1981

Commodity	Ordinary least squares regression statistics[1/]				Short-run[2/] price elasticity e^*_i	Long-run[3/] price elasticity e^{**}_i
	R^2	Intercept	Lagged price ratio b	Lagged output c		
Beef	.79	-313.7	563.9 (501.5)	.68 (.29)	.60	.88
Milk	.98	-20.4	40.3 (59.1)	1.00 (.05)	.12	.12

[1/] $Q_{i,t} = a + b(P_{i,t-1}/P_{t-1}) + c\ Q_{i,t-1}$, where $\ln P_t = \Sigma k_{it} \ln P_{et}$, $i = 1 \ldots 4$; $t=1 \ldots 12$; for data for Table 5.

[2/] Short-run supply price response elasticity = e^*_i = b·(mean of lagged price ratio/mean of output).

[3/] Long-run supply price response elasticity = $e^{**}_i \approx 1/1-c.e^*_i$.

3. MARKETING MARGINS

3.1 Domestic and international interrelationships between the price of beef measured at the farmgate, wholesale, export and retail level

Consumer response was expressed using prices paid by consumers. Producer response was expressed using prices received by farmers. In this section, we explain the relationship which exists between these prices for beef. Table 8, as indicated by its footnotes, reflects a careful comparison of all available information in this area. To achieve compatibility, all prices were expressed per 100 lbs. dressed carcass weight. Table 8 gives price data for the U.S. as well as Honduras. Because beef is an internationally traded commodity and because the U.S. is a major market for Honduran exports, one would expect beef prices in Honduras to be closely correlated with beef prices in the U.S., except for tariff and exchange rate distortions. For the period 1970-1981, these did not exist.

Table 9 shows the relation between the U.S. retail price for beef and prices paid for beef in Honduras. Virtually all of the variation in the price of beef at the retail and export level is explained by variations in the U.S. retail price for all beef products. The latter can be used to predict the former.

Data on prices received by farmers are less reliable than data on prices paid by consumers. Nevertheless, almost 80 percent of the variation in the farmgate price of beef is explained by variations in the price of the U.S. retail price of beef. A one percent increase in this price causes the price received by farmers for beef in Honduras to increase by one percent. Because of this, the real margin associated with transportation, processing and distributing appears to have been constant over the past decade.

Table 8. Comparative United States and Honduras cattle and beef statistics, 1970-1980

X_1	X_2	X_3	X_4	X_5	X_6	X_7	X_8	X_9	X_{10}	X_{11}	X_{12}	X_{13}	X_{14}	X_{15}
	Liveweight lbs/head		Carcass weight lbs/head		Price received by farmers per head			Prices per 100 lbs dressed carcass weight basis 11/						
						Honduras 6/		Live animal 7/		Wholesale 8/		Retail 9/		Export f.o.b. 10/
Year	U.S. 1/	Hond. 2/	U.S. 3/	Hond. 4/	U.S. 5/ $/head	L/head	$/head	U.S. $/100 lbs	Hond. L/100 lbs	U.S. $/100 lbs	Hond. L/100 lbs	U.S. $/100 lbs	Hond. L/100 lbs	Hond. L/100 lbs
1970	1035	645	616	306	179.0	263.35	131.68	29.64	85.96	48.44		69.30	92.00	102.87
1971	1028	655	612	311	184.0	267.70	133.83	32.35	86.04	53.70		73.68	108.00	110.04
1972	1038	655	623	311	208.0	271.76	135.88	35.71	87.35	56.79		80.72	115.00	115.94
1973	1043	676	628	321	252.0	289.60	144.80	44.89	90.19	69.72		96.65	127.00	144.10
1974	1039	661	622	314	293.0	358.20	179.10	42.47	114.08	69.13		99.33	151.00	167.68
1975	996	669	581	318	159.0	395.78	197.89	45.43	124.55	74.82		105.12	150.00	142.14
1976	1018	680	603	323	190.0	433.16	216.58	39.35	134.11	63.10		100.39	152.00	155.24
1977	1024	672	600	319	206.0	492.17	246.09	40.56	154.19	64.84	161.00	100.51	176.00	160.48
1978	1036	668	610	317	232.0	531.68	265.83	52.55	167.56	82.39	163.91	123.23	185.00	224.01
1979	1061	674	634	320	403.0	540.48	270.24	68.06	168.82	103.87	195.33	153.31	218.00	265.28
1980	1072	665	638	316	502.0	587.13	293.57	67.46	176.80	106.82	243.54	160.99	263.00	282.31
1981	1074		639		475.0			67.46		106.82		161.73	299.00	258.07

1/ Livestock and meat statistics, statistical bulletin No. 522, Economic Research Service, U.S.D.A., 1982. Tables 73, 108, on pages 63, 98.

2/ 4÷.475; i.e. dressed carcass yield of 47.5 percent on the basis of 266.868 cattle slaughtered by Empacadora ALUS for the period 1978-1982.

3/ Livestock and Mean Statistics, op. cit., Table 116, p. 110. U.S. dressed yield typically 59.0 percent.

4/ Table ---, column 9 divided by column 6.

footnotes *(continued ...)*

Table 3. Footnotes *(continued)*

5/ Livestock and meat statistics, op. cit., Table 3, p. 3.

6/ Honduras carcass weight/head x price per 100 lbs. carcass weight, live animal; 1 Lempira = .50 U.S. dollars.

7/ U.S. figures: Livestock and meat statistics, Table 174, p. 150.
Honduras figures: Departamento de Estudios Economicos, Banco Central de Honduras.

8/ U.S. figures: Livestock and meat statistics, op. cit., Table 174, p. 150.
Honduras figures: Departamento de informacion y estadistica, Ministerio de Recursos Naturales.

9/ U.S. figures: Livestock and meat statistics op. cit., Table 174, p. 150.
Honduras figures: See Table S-4, Tegucigalpa retail price series for sirloin butt (tajo de pierna de res).

10/ Comercio exterior, Direccion General de Economia y Comercio and Departamento de Estudios Economicos del Banco General. Original price data refer to boneless beef.

11/ Honduras conversion factors: 100 lbs./live weight = 47.5 lbs dressed carcass weight = 33.3 lbs boneless warm beef.

Table 9. The relation between the U.S. retail price for beef and prices paid for beef in Honduras at the farmgate, export and retail levels

Honduras prices paid in Lempiras per 100 lbs. dressed carcass weight 1/	O.L.S. regression statistics 2/		
	R^2	Intercept	U.S. retail price, $100 lbs $\ln(x_{13})$
farmgate price ($\ln X_{10}$)	.79	.315654	.969175 (.165599)
export f.o.b. price ($\ln X_{15}$)	.96	-.0649124	1.238399 (.084133)
Retail, Tegucigalpa ($\ln X_{14}$)	.94	-.167419	1.120488 (.095381)

1 For the data underlying this regression, see Table 8.

2 $\ln X_{10} = a + b \ln X_{13}$; therefore, $\Delta X_{10}/X_{10} = b \Delta X_{13}/X_{13}$; a one percent increase in X_{13} causes X_{10} to increase by b percent, i.e., approximately 1.00 percent.

$\ln X_{15} = a + b \ln X_{13}$; b = 1.23%.

$\ln X_{14} = a + b \ln X_{13}$; b = 1.12%.

3.2 Domestic and international relationships between the price of pork measured at the farmgate, wholesale and retail levels

Table 10 lists comparative United States and Honduras hog and pork statistics for the period 1970-1980. Prices are expressed per 100 lbs of wholesale cuts. In the early seventies, the retail price of pork in the U.S. was substantially above that in Honduras. This situation reversed itself in the late seventies. Pork exports or imports are negligible. Consequently, one should expect the price of pork in Honduras to move independently of the price of pork in the U.S. This is illustrated by the low R^2 of the following regression.

$$\ln(X_6/X_5) = 1.296680 + \underset{(.021626)}{.050264 \cdot t} \qquad R^2 = .35$$

X_6 = Honduras retail price of 100 lbs wholesale pork cuts

X_5 = U.S. retail price of 100 lbs wholesale pork cuts

t = time; 1970 = 1.

On the other hand, the retail price of pork in Honduras can be seen to determine the price received by farmers as indicated by $R^2 = .98$ of the following regression.

$$\ln(X_2/X_6) = .618450 - .022590.t \qquad R^2 = .98$$

X_2 = Honduras farm price paid per 100 lbs of wholesale pork cuts

X_6 = Honduras retail price per 100 lbs of wholesale pork cuts

t = time; 1970 = 1.

The time trend coefficient in the above equation is negative. This is indicative of a declining producer's margin for production, transportation, processing and distribution of pork. The declining margin in pork contrasts with the constant margin in beef.

Table 10. Comparative United States and Honduras hog and pork statistics, 1970-1980

Year	Liveweight lbs/head		Carcass weight lbs/head		Prices per 100 lbs of wholesale cuts					
					Live animal[5]		Wholesale[6]		Retail[7]	
	U.S.[1]	Honduras[2]	U.S.[3]	Honduras[4]	U.S. $/100 lbs	Honduras L/100 lbs	U.S. $/100 lbs	Honduras L/100 lbs	U.S. $/100 lbs	Honduras L/100 lbs
1970	240	89	186	70	21.95	64.00	59.85		72.97	108.00
1971	239	89	184	70	18.45	66.00	55.70		65.84	116.00
1972	239	89	185	70	26.67	67.00	67.30		77.95	120.00
1973	241	89	187	70	40.27	69.00	90.41		102.98	133.00
1974	244	89	190	70	35.12	77.00	80.64		101.67	157.00
1975	240	89	186	70	48.32	79.00	108.79		126.96	160.00
1976	238	89	187	70	43.11	81.00	99.29		126.40	172.00
1977	237	89	170	70	41.07	87.00	93.35		118.20	196.00
1978	240	89	171	70	48.50	89.00	101.59	142.00	135.36	213.00
1979	242	89	172	70	42.42	92.00	94.58	152.57	135.90	223.00
1980	242	89	174	70	40.08	100.00	92.46	171.64	131.56	271.00
1981	243	89	173	70	44.41	107.00	100.61	182.64	143.71	332.00

1/ Livestock and meat statistics, Statistical Bulletin No. 522, Economic Research Service, U.S.D.A., 1982, Table 73, 108 on pages 63, 98.

2/ FAO Food Balance Sheets, Honduras, 1964-1966 indicates 78.7% dressing yield.

3/ Livestock and meat statistics, op. cit., Table 116, p. 110.

4/ Direccion General de Estadisticas y Censos.

5/ U.S. data, Livestock and meat statistics, Op. cit., Table 173, p. 149.

(continued ...)

Table 10. Footnotes *(continued)*

6/ U.S. data, Livestock and meat statistics, Op. cit., Table 173, p. 149.
Honduras data, Departamento de Estudios Economicos, Banco Central de Honduras.

7/ U.S. data, Livestock and Meat Statistics, Op. cit., Table 173, p. 149.
Honduras data, Chuleta de Cerdo, Primary data, Precios al por Menor, Tegucigalpa, Departamento de Estudios Economicos, Banco Central de Honduras.

3.3 Interrelationships between the price of milk measured at the farmgate, import and retail level

In 1981, Honduras imported 27 percent of its domestic consumption of milk and milk products. Of these imports, 28 percent consisted of donated products. Supporting Table S-5 gives additional details on the volume, value and prices of imported dairy products for the period 1970-1981. Because milk is an important product, and because imports contribute a substantial share of domestic production, the cost of imported dairy products will be reflected in the retail prices of reconstituted and fresh milk as well as other milk products, such as cheese. The retail prices of these products in turn influence the prices received by farmers.

Table 11 lists the variables that determine the farmgate price of milk. It is apparent that, in 1981, donations lowered the weighted c.i.f. price of dairy imports from 37.5 cents per litre to 27.1 cents per litre. This 10 cent subsidy encourages domestic consumption of milk, but depresses domestic production of milk. Because donations can be seen as a trade policy variable, our projections will allow for this. We estimated the following regression based on the data in Table 11.

$$X_3 = .006 + \underset{(.021)}{.984}\, X_4 - \underset{(.013)}{.402}\, X_{11} \qquad R^2 = 1.00$$

X_3 = c.i.f. import price of milk products, including donations.
X_4 = c.i.f. import price of milk products, without donations.
X_{11} = volume share of donations in total volume of imported milk products.

As expected, donations lower the effective c.i.f. price of dairy imports. For the period as a whole, their influence is quite small. A similar hypothesis will be made for the period 1980-1990 in section 7, when projecting the demand and supply for milk.

Table 11. Honduras: variables that determine the farmgate price of milk

Year	Farmgate price L./ltr.	c.i.f. import price		Retail, Tegucigalpa		Quantity supplied				Consumer price index
		With donations L./ltr.	Without donations L./ltr	Fluid milk L./ltr	Cheese L./lb.	Domestic mill. ltr.	Imported: Donated mill. ltr.	Imported: Total mill. ltr.	Total supply mill. ltr.	
1970	.218	.193	.193	.40	1.20	189.0	0	29.5	218.5	61.9
1971	.229	.219	.219	.40	1.32	192.0	0	24.0	216.0	63.2
1972	.230	.322	.322	.40	1.30	203.0	0	20.5	223.5	65.2
1973	.240	.573	.573	.40	1.41	207.0	0	20.8	227.8	68.2
1974	.260	.350	.359	.56	1.72	219.0	.6	25.1	244.1	76.9
1975	.280	.502	.520	.60	1.82	226.0	.7	20.7	246.7	83.1
1976	.310	.320	.407	.60	1.65	231.0	7.2	33.5	264.5	87.3
1977	.340	.239	.431	.61	1.99	242.0	22.2	49.9	291.9	94.6
1978	.370	.236	.399	.62	2.09	250.0	21.5	52.8	302.8	100.0
1979	.400	.239	.359	.66	2.40	257.0	21.5	64.1	321.1	112.1
1980	.420	.300	.429	.72	2.89	269.0	23.6	78.4	347.4	132.4
1981	.430	.271	.375	.72	3.02	271.0	27.9	100.8	371.8	144.8

Source: Table S-5.

The retail price of milk is determined by the c.i.f. import price of milk products, including donations, and the consumer price index as a proxy variable for the costs of processing and distributing milk.

$$\ln X_5 = -4.029165 + \underset{(.090371)}{.037823} \ln X_3 + \underset{(.103272)}{.775345} \ln X_7 \qquad R^2 = .86$$

X_5 = retail price of fluid milk, Tegucigalpa
X_3 = c.i.f. import price of milk products, including donations
X_7 = consumer price index.

These two variables account for 86 percent of the variation in the retail price of milk. Nevertheless, an increase of one percent in the c.i.f. price of imported milk products increases the price of fluid milk by only .04 percent, a virtually negligible, although statistically significant, effect. An increase in the cost of living index by one percent increases the retail price of milk by .77 percent. Unaccounted for subsidies to milk processing plants are implicitly reflected in the above equation, indicating that fresh milk is probably the only truly subsidized food by the G.O.H.

Such plant based subsidies cannot be extended to cheese production, which is largely a secondary farm enterprise. The c.i.f. import price for milk products and the consumer price index for all food explain virtually all of the variation in the retail price of cheese, as can be seen from the following regression.

$$\ln X_6 = -4.119573 + \underset{(.045374)}{.044714} \ln X_3 + \underset{(.051851)}{1.067516} \ln X_7 \qquad R^2 = .98$$

X_6 = retail price of cheese, Tegucigalpa
X_3 = c.i.f. import price of milk products, including donations
X_7 = consumer price index for all food.

Milk produced on farms is primarily sold as fluid milk and as farm fresh cheese (queso fresco). The retail prices of these two products virtually determine the farm gate price for milk as illustrated by the following regression.

$$\ln X_2 = -1.430848 + \underset{(.241251)}{.234208} \ln X_5 + \underset{(.186556)}{.626669} \ln X_6 \qquad R^2 = .93$$

X_2 = farm gate price for milk

X_5 = retail price of fluid milk, Tegucigalpa

X_6 = retail price of cheese, Tegucigalpa.

A one percent increase in the price of fluid milk increases the farm gate price by .23 percent. A one percent increase in the price of cheese increases the farm gate price by .63 percent. Only the retail price of fluid milk is subsidized by the G.O.H. The effect on the farm gate price is substantially mitigated by an alternative use of farm milk, i.e., cheese.

4. SUPPLY AND DEMAND BALANCES FOR BEEF, PORK, MILK AND MILK PRODUCTS

Table 12 presents the production, exports, imports and domestic consumption of beef, pork, and milk. Beef exports accounted for 87 percent of production during the '79-81 period. The domestically consumed share is quite small and fluctuates greatly from year to year. All of pork is produced and consumed domestically. On the other hand, 25 percent of the domestic consumption of milk was imported during the period '79-'81. Such imports have increased steadily since the early seventies, as has domestic production.

The major objective of this report is to project the domestic production and consumption of beef, pork and milk for 1985 and 1990. One quick alternative is to study the historical trends underlying the production and consumption data in Table 12. We, therefore, formulated the following hypothesis.

$X_i = a + b \cdot t$

X_i = domestic production of beef, pork or milk

$t = 1 = 1970$; $t = 16 = 1985$; $t = 21 = 1990$.

The results are tabulated in Table 13. Milk production on that basis is expected to reach 305 million litres by 1985 and 344 million litres by 1990. Beef production is expected to reach 1578 thousand quintals liveweight by 1985. Given a dressing yield of .475, this equals 34.1 thousand metric tons carcass weight. By 1990, beef production is expected to reach 1753 thousand quintals liveweight or 37.9 thousand metric tons carcass weight. Pork production for 1985 and 1990 is projected at 220.1 and 260.1 thousand quintals, or 10.0 thousand and 11.8 thousand metric tons, respectively.

Extrapolation of past trends in production, while easily done, is of limited usefulness for this study because it does not deal with the variables that cause the historical trend to exist. Changes in such variables may cause an abrupt change in past patterns of evolution. To these we now turn.

Table 12. Production, exports, imports and domestic consumption of beef, pork, milk and milk products, 1970-1981

Year	Beef			Pork			Milk and milk products		
	Domestic[1/] production M.T. carcass wt.	Imports(+)[2/] Exports(-) M.T. carcass wt.	Domestic consumption M.T. carcass wt.	Domestic[1/] production M.T. carcass wt.	Imports(+) Exports(-) M.T. carcass wt.	Domestic consumption M.T. carcass wt.	Domestic[1/] production mill. ltr.	Imports(+)[3/] Exports(-) mill. ltr.	Domestic consumption mill. ltr.
1970	22920	-12407	10513	4600	0	4600	189.2	29.5	218.7
1971	24238	-15345	8893	4914	0	4914	191.6	24.0	215.6
1972	25608	-18137	7471	5242	0	5242	203.5	20.5	224.0
1973	23741	-19462	4279	5628	0	5628	207.1	20.8	227.9
1974	25716	-13120	12596	5901	0	5901	218.9	25.1	244.0
1975	25753	-16997	8756	6352	0	6352	225.9	20.7	246.6
1976	25960	-21075	4885	6793	0	6793	231.5	33.5	265.0
1977	28179	-17749	10430	7235	0	7235	242.6	49.9	292.5
1978	28581	-22713	5868	7735	0	7735	250.2	52.8	303.0
1979	30576	-29980	596	7931	0	7931	257.2	64.1	321.3
1980	29757	-26864	2893	7999	0	7999	268.7	78.4	347.1
1981	32026	-23432	8594	8477	0	8477	271.4	100.8	372.2
'79-'81 average	30786	-26759	4027	8136	0	8136	265.8	81.1	346.9

Source: 1/ Departamento de Estudios Economicos, Banco Central de Honduras.

2/ Oficina de Informacion y Estadisticas, Ministerio de Recursos Naturales

3/ Table S-5.

Table 13. Projected domestic production of 5 livestock products by linear extrapolation of 1970-1981 production

Production	Regression statistics[1/]			Projected domestic production	
	R^2	Intercept	Slope	1985	1990
Beef (1000 quintals)	.90	1018.1	35.0 (3.6)	1578.1	1753.1
Pork (1000 quintals)	.99	92.1	8.0 (.24)	220.1	260.1
Chicken (1000 quintals)	.93	42.2	18.2 (1.53)	333.4	424.4
Eggs (mill. units)	.99	257.8	20.1 (.58)	579.4	679.9
Milk (mill. litres)	.99	178.3	7.9 (.18)	304.7	344.2

1/ $X_i = a + b.t$ $t = 1 = 1970$; $t = 16 = 1985$; $t = 21 = 1990$.

2/ For beef 1000 lbs. liveweight = 475 lbs. carcass weight, 1 quintal = 100 lbs. Pork is expressed in carcass weight.

5. PROJECTED VALUES OF 9 EXOGENOUS VARIABLES

It is customary to divide economic variables into endogenous and exogenous variables. The analyst takes the exogenous variables as given or is prepared to make an assumption as to their probable value. He must then relate the exogenous to the endogenous variables. Given such relationships, the impact of changes in exogenous variables on endogenous variables can be studied. For the purpose of this report, we take as endogenous variables the production, consumption, imports, exports, prices paid and prices received of beef, pork and milk and milk products. This yields a total of 17 endogenous variables. We identify 9 exogenous variables, which via the consumer response, producer response and price formation equations developed in previous sections impact on the endogenous variables.

We proceed by listing the nine exogenous variables.

1/ Current weighted price received for five livestock products by farmers, Honduras.

2/ Index of prices paid for all food by consumers, Honduras.

3/ Index of prices paid for all food by consumers, United States.

4/ Price paid per 100 lbs of all beef products by consumers, United States.

5/ Price paid per equivalent litre of milk of imported milk products, Honduras.

6/ Number of Lempiras bought by one U.S. dollar.

7/ Real expenditure on food by consumers, Honduras.

8/ Real gross value of production of beef, pork, chicken, eggs and milk.

9/ Quantity of donated dairy products, as a percentage of total dairy imports, Honduras.

Supporting Table S-7 lists the values of these variables for the period 1970-1980. In order to analyze the trends in these variables, we fitted the following equation.

$$\ln X_i = a + bt$$

X_i = an exogenous variable

$t = 1 = 1970.$

The results are summarized in Table 14. Virtually all of the exogenous variables expanded at a steady rate of growth as indicated by the high R^2's of the regressions. Extrapolation of such trends is, therefore, justified. The projected values for 1985 and 1990, as well as the projected expansion coefficients relative to the 1980 base year, are given in the last four columns of Table 14.

The increases in the general price levels in the United States and Honduras reflect the monetary and fiscal policies in these countries. We project that the inflation rates between 1980 and 1990 will be similar to those of the seventies, i.e., approximately 8 percent annually. The number of Lempiras that can be bought by one U.S. dollar has equalled 2.0 for the last forty years. That rate was an equilibrium rate, i.e., the lempira was neither overvalued or undervalued. As of this date, the lempira is overvalued and a defacto devaluation has been achieved by export and import licensing.

In this report, our horizon relates to 1985 and 1990. Within that perspective, the only credible assumption is that of an equilibrium exchange rate for the lempira. This implies that the lempira will be adjusted so as to maintain the following equality.

Table 14. Projected values of nine exogenous variables, 1985 and 1990

	Regression statistics[1/]			Projected values		Projected multiple of 1980 base year	
	R^2	Intercept	Annual percentage change	1985	1990	1985/ 1980	1990/ 1985
Current weighted price received for five livestock products by farmers, Honduras	.97	3.338525	.073051 (.004086)	90.68	130.66	1.466	2.112
Index of prices paid for all food by consumers, Honduras	.98	3.876333	.084473 (.003929)	186.4	284.4	1.429	2.181
Index of prices paid for all food by consumers, United States	.99	4.628704	.082271 (.003220)	381.9	576.2	1.500	2.263
Price paid per 100 lbs for all beef by consumers, United States	.91	4.163533	.077305 (.008261)	221.5	326.0	1.376	2.025
Price paid per equivalent litre of milk of imported dairy products, Honduras	.32	2.573575	.055676 (.027333)	31.96	42.21	1.491	1.970
Number of Lempiras bought by one U.S. dollar	1.00	2.00000	0	2.00	2.00	1.000	1.000
Real expenditure on food by consumers, Honduras	.96	5.857535	.058152 (.004137)	887	1186	1.287	1.721
Real gross value of production of beef, pork, chicken, eggs and milk	.99	5.860343	.038927 (.001132)	654	795	1.216	1.478
Quantity of donated dairy products as a percentage of total dairy imports		not estimable		.15	.10	.542	.361

[1/] $\ln X = a + bt$, t=1=1970; 1985=t=16; 1990=t=21.

$$CPI_{Honduras} = CPI_{U.S.} \cdot R$$

where

CPI consumer price index

R exchange rate, i.e., the number of Lempiras bought by one U.S. dollar

With an overvalued exchange rate for the lempira, the CPI for Honduras will increase faster than the right hand side of the above equation. The consequence is an implicit tax on beef exports and an implicit subsidy on milk imports.

The burden of an implicit tax on beef exports will fall on the beef packing industry and the producers of beef. Domestic consumers of beef will benefit to the extent that packers and producers lose. The benefits of an implicit subsidy on milk imports are shared by milk processors and consumers. With excess capacity in the milk processing industry, consumers will capture viturally all of the implicit import subsidy. On the other hand, domestic producers will suffer a loss approximately equal to the money benefit captured by consumers. It follows from the above reasons alone that an overvalued exchange rate reduces farm income. On the other hand, consumers gain on both accounts. This gives any government in power a substantial incentive to maintain an overvalued exchange rate. Nevertheless, in a longer-run perspective, the exchange rate must adjust itself to the relative purchasing power of domestic currency (i.e., the lempira) and foreign currency (i.e., the U.S. dollar).

The price paid for beef by U.S. consumers increased at a slightly lesser rate than the U.S. consumer price index of food. We expect that trend to continue. Given this, the U.S. retail price for beef is projected at 2.21 $/lb. in 1985 and 3.26 $/lb. in 1990. They reflect the opinion of a

resurgence of inflation in the U.S. in the next few years, and throughout the rest of this decade.

The consumer price indices for food for the U.S. and Honduras increased at virtually the same rate during the seventies. This guaranteed a stable exchange rate. We project that this stability will continue throughout the eighties.

Prices received by farmers for five livestock products increased throughout the seventies at 7.3 percent annually. The index of prices paid for consumers for all food increased at 8.4% annually during the same period. We project that this trend towards a decreasing farmers' share in the retail dollar will continue throughout the eighties.

The price for imported milk products fluctuated wildly throughout the seventies. Because of a general inflationary trend in the European Economic Community, there, nevertheless, exists a statistically significant upward trend. We, therefore, project a price of .32 Lempiras per litre equivalent of imported milk products in 1985, and a price of .42 Lempiras per litre in 1990. This implies that the price of imported milk is expected to increase at 5.6 percent annually. Given that the CPI for all food is expected to increase at 8.4 percent annually, milk imports will continue to be cheap.

Real expenditure on food grew at 5.8 percent annually during the seventies. It is also testimony to the solidity of the Honduras economy. We expect this rate of growth to continue throughout the eighties. The real gross value of production of beef, pork, chicken, eggs and milk grew at 3.9 percent. This is a substantial achievement. Nevertheless, the most dynamic sector was related to the transportation, processing and distribution of food which must have increased at approximately 8 percent annually.

The quantity of donated dairy products as a percentage of total dairy imports is an unpredictable policy variable. We, nevertheless, project the share of donations to decrease from 25 percent in the '79-'81 period to 15 percent in 1985 and 10 percent in 1990. Alternative projections which would assume the total elimination of donations would lead to a downward adjustment in projected domestic consumption and a minor upward adjustment in projected production.

6. PROJECTED PRODUCTION, CONSUMPTION, EXPORTS, PRICES PAID AND RECEIVED FOR BEEF, 1985 AND 1990

6.1 Domestic production of beef

In order to project the domestic production of beef, we utilize the following equation.

$$y_1 = ay_2 + by_3 + cy_4$$

where

y_1 = projected percentage increase in the domestic production of beef

y_2 = projected percentage increase in the nominal price received by farmers for beef

y_3 = projected percentage increase in the nominal price of all livestock products

y_4 = projected percentage increase in the real gross value of livestock production

a = direct price elasticity of supply

b = cross price elasticity of supply

c = resource expansion elasticity.

From Table 7, we derive a long-run direct price elasticity for beef equal to .9. Correspondingly, the cross price elasticity equals -.9. Table 6 yields a resource expansion elasticity equal to .65. In the above equation, the projected increase in the nominal price of livestock producers (y_3) can be obtained from Table 14. Between 1980 and 1985, the projected increase equals 46.6 percent. Between 1980 and 1990, it equals 111.2 percent.

The projected increases in the real gross value of livestock production (y_4) are given as 21.6 percent and 47.8 percent, respectively.

The farm gate price of beef (y_2) is determined by the price formation equation drawn from Table 9:

$$y_2 = .97\ y_5$$

where

y_2 = percent change in the farm gate price for beef

y_5 = percent change in the U.S. retail price for all beef products.

The projected values for y_5 are given in Table 14 as 50% and 126%, respectively. Therefore, between 1980 and 1985, the nominal farm gate price is expected to increase by (.97)(50) = 48.5 percent. Between 1980 and 1990, the projected increase in nominal price equals (.97)(126) = 122 percent. Substitution of the above information yields

$$y_1,\ 1985/1980 = (.9)(48.5) + (-.9)(46.4) + (.65)(21.6) = 15.75$$

$$y_1,\ 1990/1980 = (.9)(122.0) + (-.9)(111.2) + (.65)(47.8) = 40.79.$$

Beef production is projected to expand by 15.75 percent between 1980 and 1985 and by 40.79 percent between 1980 and 1990.

From Table 12, we have that for the period '79-'81 domestic production averaged 30786 metric tons carcass weight annually. Domestic production of beef is projected to reach 35676 metric tons in 1985 and 43343 metric tons in 1990.

6.2 Domestic consumption of beef

To project the domestic consumption of beef, we use the following equation:

$$y_1 = ay_2 + by_3 + cy_4$$

where

y_1 = projected percentage increase in the domestic consumption of beef;

y_2 = projected increase in the nominal retail price of beef;

y_3 = projected increase in the price index of all food;

y_4 = projected increase in real expenditure on food;

a=uncompensated direct price elasticity of demand for beef;

b=uncompensated cross price elasticity of demand for beef;

c = expenditure elasticity for beef.

From Table 4, we have -1.18 as the uncompensated direct price elasticity for beef. The corresponding uncompensated cross price elasticity equals 1.18. The expenditure elasticity equals .79. The projected increase in the nomimal price of beef (y_2) can be obtained from the appropriate price formation equation in Table 2.

$$y_2 = 1.12\ y_5$$

where

y_2 = percentage increase in the nominal retail price of beef in Honduras;

y_5 = percentage increase in the nominal retail price of beef in the United States.

Table 14 projects a 37.6 percent increase in y_5 between 1980 and 1985. We, therefore, project that the retail price for beef in Honduras will increase by (1.12)(37.6) = 42.1 percent between 1980 and 1985. The corresponding figure for 1990 equals 115.8 percent.

The projected increases for the price of all food in Honduras equal 42.9 percent and 118.1 percent, respectively. Real expenditure on food is projected to increase by 28.7 percent between 1980 and 1985 and by 72.1 percent between 1980 and 1990.

Substitution of the above information yields

$$y_1,\ 1985/1980 = (-1.18)(42.1) + (.69)(42.9) + (.79)(28.7) = 2.6$$

$$y_1,\ 1990/1980 = (-1.18)(115.8) + (.69)(118.1) + (.79)(72.1) = 1.8$$

Domestic consumption of beef is projected to increase by only 2.6 percent between 1980 and 1985; and by only 1.8 percent between 1980 and 1990.

Domestic consumption of beef is therefore projected to remain virtually at its '79-'81 levels.

Projected consumption for 1985 equals 4131 metric tons carcass weight. The corresponding figure for 1990 equals 4099 metric tons. Per capita beef consumption is projected to decline at the rate of population growth, i.e., 3.2 percent annually.

6.3 Projected beef exports and the U.S. export quota

Beef exports in first instance can be calculated as the difference between projected production and domestic consumption. We, therefore, have

	Projected production	—	Projected consumption	=	Projected exports
'79-'81	30786		4027		26759
1985	35676		4131		31545
1990	43343		4099		39244

*All figures in metric tons carcass weight.

All of the projected increase in beef production over the next decade will have to be exported. This leaves four questions:

1/ Are Honduras beef exports competitive given the assumptions underlying the projections?

2/ Does the Honduran beef processing industry have sufficient capacity to handle the increased export volume?

3/ Can Honduras rely on the U.S. as its exclusive market under U.S. meat import legislation?

4/ What additional exports markets are readily available to Honduras?

Honduras beef exports will be competitive as long as the f.o.b. export price maintains a proper relationship with the U.S. retail price for beef. From

Table 9, we have the following price formation equation:

$$\ln(X_1) = -.0649 + \underset{(.0841)}{1.2384} \ln(X_2) \qquad R^2 = .96$$

where

X_1 = f.o.b. export price of beef;

X_2 = retail price of U.S. beef.

A one percent increase in the retail price of beef in the U.S. increases the export f.o.b. price by 1.24 percent. Honduras exporters are price takers in the U.S. meat import market. To remain competitive, the packing industry must be able to pass through to the sellers of livestock and the workers in the packing industry any sharp downward fluctuation in export prices. It has been able to do so in the past.

However, with an overvalued exchange rate, which constitutes a tax on exports, this is less easily done. Since we project an equilibrium exchange rate for 1985 and 1990, the problem of an overvalued lempira does not arise. Even if it does arise, then with a black market for foreign exchange, live cattle can be exported to neighboring countries. Such exports will also occur if neighboring countries undervalue their domestic currency vis. a vis. the Lempira. Under such circumstances, Honduras would have access to an informal export market, in addition to the U.S. market.

Potential exports to the U.S. are governed, in the long-run, by U.S. meat import legislation. Table 15 summarizes the Honduran quota and actual exports to the U.S. The projected Honduras quota was obtained through the following regression:

$$\ln X_1 = 8.822028 + \underset{(.013482)}{.117706}\, t \qquad R^2 = .92$$

X_1 = Honduras quota in M.T.

t = 1 = 1970.

Table 15. Beef exports and the export quota, 1970-1980

Year	Honduras export quota M.T.	Actual exports to U.S. M.T.	Total exports M.T.
1970	7301	12262	12407
1971	7721	15087	15345
1972	17833	17803	18137
1973	*	19432	19462
1974	10440	12860	13120
1975	15660	16429	16997
1976	16110	19000	21075
1977	16909	16454	17749
1978	19818	21500	22713
1979	20863	28681	29980
1980	*	25572	26864

*In these years, there were no quotas.

Source: Oficina de Planificacion Agricola, CONSUPLANE

The above results indicate that Honduras' quota has grown at 11.8 percent annually. This is a conservative estimate, because it excludes the nonquota years 1973 and 1980. Setting t = 16 in above equation, we have a projected quota equal to 44593 M.T. in 1985. Setting t = 21, we obtain a projected quota equal to 101647 M.T. for 1990.

Historically, total beef exports increased at 7 percent per year. Using the data in Table 15, we obtained the following regression:

$$\ln X_3 = 9.396200 + \underset{(.019213)}{.070707}\ t \qquad R^2 = .66$$

X_3 = total beef exports

t = 1 = 1970.

Setting t= 16 in this equation, we obtain projected total beef exports equal to 37328 M.T. in 1985 and 53159 M.T. in 1990. The results reported at the beginning of this section indicate that both of these figures are too high, i.e., exports are projected to equal 31545 M.T. in 1985 and 39244 M.T. in 1990. In either case, projected exports increase at a lesser rate than the U.S. export quota. It implies that a substantial amount of additional beef exports can be placed in the U.S. market at the prevailing export price in those years.

7. PROJECTED PRODUCTION, CONSUMPTION, IMPORTS, PRICES PAID AND RECEIVED FOR MILK, 1985 AND 1990

7.1 Domestic production of milk

To project the domestic production of milk, we use the following five equations in ten variables:

7.1 $y_1 = a \cdot y_2 + b \cdot y_3 + c \cdot y_4$

7.2 $y_2 = d \cdot y_5 + e \cdot y_6$

7.3 $y_5 = f \cdot y_7 + g \cdot y_8$

7.4 $y_6 = h \cdot y_7 + i \cdot y_8$

7.5 $y_7 = j \cdot y_9 + k \cdot y_{10}$

where

y_1: percentage increase in domestic production of milk;

y_2: percentage increase in farm gate price of milk;

y_3: percentage increase in farm gate price of all livestock products;

y_4: percentage increase in real gross value of livestock production;

y_5: percentage increase in retail price of fluid milk;

y_6: percentage increase in retail price of cheese;

y_7: percentage increase in import price of dairy products, including donations;

y_8: percentage increase in consumer price index for all food in Honduras;

y_9: percentage increase in import price of dairy products, excluding donations;

y_{10}: volume of donated dairy imports as a share of total dairy imports.

In order to obtain the projected values for domestic production of milk (y_1), it will be convenient to start with the last equation, i.e., the price formation equation for the price of imported milk products.

From section 3.3, we have, in absolute values,

$$X_7 = .006 + .984\ X_9 - .402\ X_{10}.$$

The projected share of donations X_{10} equals .15 for 1985 and .10 for 1990. The projected c.i.f. import price of dairy products in 1985 equals its 1980 base price of .429 L./litre multiplied by the projected expansion factor 1.491 obtained from Table 14. This yields .640 L./litre. The corresponding figure for 1990 equals (.429)(1.970) = .845 L./litre. Substituting of this information above yields the projected values for X_7 equal to .575 L./litre for 1985 and .797 L./litre for 1990, respectively. The import subsidy on imported dairy products declines from .129 L./litre in 1980 to .065 L./litre in 1985 and .048 L./litre in 1990. The partial elimination of the dairy import subsidy causes a sharp increase in the effective import price of dairy products. The projected percentage increase in X_7 between 1980 and 1985 equals (.575 ÷ .300) - 1 = 91.6 percent. The corresponding figure for 1990 equals (.797 ÷ .300) - 1 = 165.7 percent.

We now turn to the calculation of the projected retail prices for fluid milk and cheese. From section 3.2, we transcribe the following price formation equations:

$$7.3 \quad y_5 = 0.37\ y_7 + .775\ y_8$$

$$7.4 \quad y_6 = .045\ y_7 + 1.068\ y_8.$$

In the above equations, the projected percentage increase in the cost of all food (y_8) can be obtained from Table 14 as 42.9 percent and 118.1 percent,

respectively for the periods 1980-1985 and 1980-1990. The corresponding figures for y_7 are 91.6 and 165.7 percent. Substitution of this information in 7.3 shows that the retail price of fluid milk (y_5) is projected to increase by 36.6 percent between 1980 and 1985, and by 97.7 percent between 1980 and 1990. The retail price of cheese (y_6) is projected to increase by 49.9 and 133.6 percent, respectively.

We are now in a position to calculate the projected increase in the farm gate price of milk (y_2) as in equation 7.2. From section 3.2, we transcribe the following price formation equation:

$$y_2 = .234\ y_5 + .627\ y_6.$$

For 1985, we calculated in the previous paragraph $y_5 = 36.6$ and $y_6 = 49.9$. The projected increase in the farm gate price between 1980 and 1985, therefore equals 39.9 percent. For 1990, we estimated $y_5 = 97.7$ and $y_6 = 133.6$. The projected increase in the farm gate price between 1980 and 1990 then equals 83.8 percent.

We now turn to the producer response equation 7.1. In that equation, coefficient a represents the direct supply elasticity of milk. From Table 7 we estimated $a = .12$. The cross price elasticity $b = -a = -.12$. The coefficient c represents the resource expansion elasticity. From Table 6, we have $c = .86$. The projected percentage changes in the price of all livestock products (y_3) and the real gross value of livestock production (y_4) can be obtained from Table 14. From the previous paragraph, we have the projected changes in the farm gate price of milk (y_2). Substitution of this information in equation 7.1 yields

$$y_{1,1985/1980} = (.12)(39.9) + (-.12)(46.6) + (.86)(21.6) = 17.8$$

$$y_{1,1990/1980} = (.12)(83.8) + (-.12)(111.2) + (.86)(47.8) = 37.8.$$

We, therefore, project domestic production of milk to increase by 17.8 percent between 1980 and 1985. The corresponding figure for the 1980-1990 period equals 37.8 percent.

From Table 12, we have that the '79-'81 average domestic production of milk equalled 264.8 million litres. The 1985 projected production equals (1.178)(265.8) = 313.6 million litres. The corresponding figure for 1990 equals (1.378)(265.8) = 366.3 million litres of milk

7.2 Domestic consumption of milk

To project the domestic consumption of milk, we use the following equation:

$$y_1 = a \cdot y_2 + b \cdot y_3 + c \cdot y_4$$

where

y_1 = percentage increase in domestic consumption;

y_2 = percentage increase in the nominal retail price of milk and milk products;

y_3 = percentage increase in the nominal price of all food;

y_4 = percentage increase in real expenditure on food.

In the above equation, coefficient a measures the uncompensated direct price elasticity for milk and cheese. From Table 4, we have -4.34 and -1.30 as the uncompensated direct price elasticities for milk and cheese. The respective expenditure weights are .019 and .033. This yields a weighted average direct price elasticity equal to

$$a = (.019)(-4.34) + (.033)(-1.30) \div (.019+.033) = -2.41.$$

The weighted uncompensated cross price elasticity b = -a = 2.41. From Table 4, the expenditure elasticites for milk and cheese equal .86 and .66. This yields a weighted average expenditure elasticity equal to

$$c = (.019)(.86) + (.033)(.66) \div (.019+.033) = .73.$$

In section 7.1, we projected for the period 1980-1985 the retail price of milk and cheese to increase by 36.6 and 49.9 percent, respectively. The weighted average increase is equal to $x_2 = (.019)(36.6) + (.033)(49.9) \div (.019+.038) = 45.0$ percent. The corresponding figure for x_2 for the 1980-1990 period equals 120.4 percent.

From Table 14, the projected percentage increases in the price of all food (x_3) and real expenditure on food (x_4) equal 42.9 and 28.7 percent for the period 1980-1985. For the 1980-1990 period, the corresponding figures are 118.1 and 72.1 percent, respectively. Substitution of this information in the demand response equation yields

$$y_{1,1985/1980} = (-2.41)(45.0) + (2.47)(42.9) + (.73)(28.7) = 15.9$$

$$y_{1,1990/1980} = (-2.41)(120.4) + (2.41)(118.1) + (.73)(72.1) = 47.1.$$

The consumption of milk and milk products is projected to increase by 15.9 percent between 1980 and 1985. The corresponding increase in consumption between 1980 and 1990 equals 47.1 percent. From Table 12, we observe that the '79-'81 average domestic consumption equalled 346.9 million litres of milk. Consequently, projected consumption for 1985 equals (1.159)(346.9) = 402.1 million litres of milk. Projected consumption for 1990 equals (1.471)(346.9) = 510.3 million litres of milk.

7.3 Milk imports

Projected imports of all milk products equals the difference between domestic consumption and production. Summarizing the results from sections 7.1 and 7.2, we have

Year	Consumption (mill. ltrs.)	—	Production (mill. ltrs.)	=	Imports (mill. ltrs.)
'79-'81	346.9		265.8		81.1
1985	402.1		313.1		89.0
1990	510.3		366.3		134.0

Imports are projected to increase by 8 mill. ltrs between 1980 and 1985. Between 1980 and 1990, the corresponding increase is 53.0 million litres of milk. Imports of all dairy products are, therefore, projected to grow at 5.2 percent annually between 1980 and 1990.

8. PROJECTED PRODUCTION, CONSUMPTION, PRICES PAID AND RECEIVED FOR PORK, 1985 AND 1990

To project domestic production and consumption of pork, we make use of the following four equations in eight variables:

8.1 $y_1 = a \cdot y_2 + b \cdot y_3 + c \cdot y_4$

8.2 $y_5 = d \cdot y_6 + e \cdot y_7 + f \cdot y_8$

8.3 $y_2 - y_6 = g$

8.4 $y_1 = y_6$

where

y_1 = projected percentage increase in pork production;

y_2 = projected percentage increase in nominal farm gate price for pork;

y_3 = projected percentage increase in the nominal price received by farmers for all livestock products;

y_4 = projected percentage increase in real gross value of livestock production;

y_5 = projected percentage increase in domestic consumption of pork;

y_6 = projected percentage increase in the retail price of pork;

y_7 = projected percentage increase in the price of all food, Honduras;

y_8 = projected percentage increase in real expenditure on food.

Equation 8.1 represents the projected production response. Equation 8.2 represents the projected consumption response. Equation 8.3 represents the connection between the retail price and farm gate price for pork. Equation 8.4 is a market equilibrium condition, specified on the assumption that Honduras will neither export nor import pork between 1980 and 1990. Given this,

the retail price (or the farm price) for pork is endogenously determined. It implies that we must solve for y_1 (or y_5) and y_2 (or y_6) simultaneously. Subtracting 8.2 from 8.1, using 8.3 and 8.4, yields an expression for the equilibrium farm gate price of pork.

$$8.5 \qquad y_2 = \frac{b}{d-a} \cdot y_3 + \frac{c}{d-a} \cdot y_4 - \frac{e}{d-a} \cdot y_7 - \frac{f}{d-a} \cdot y_8 + \frac{dg}{d-a} .$$

In the above expression, y_3, y_4, y_7 and y_8 are exogenous variables, whose projected values are listed in Table 14 as follows:

	1985/1980	1990/1980
y_3	46.6%	111.2%
y_4	21.6%	47.8%
y_7	42.9%	118.1%
y_8	28.7%	72.1%

It remains to specify coefficients a, b, c, d, e, f, and g in equation 8.5. Coefficient a is the direct supply response elasticity in pork production. From Table 6, we determine its value as .49. Coefficient b represents the cross price elasticity in pork production. From Table 6, we determine the value as -.49. Coefficient c represents the resource expansion elasticity in pork production. From Table 6, we determine its value as 1.83. Coefficient d represents the uncompensated direct price elasticity in pork consumption. From Table 4, we infer its value as -1.10. Coefficient e is the uncompensated cross price elasticity in pork consumption. Because d = -e, we have e = 1.10. Coefficient f represents the expenditure elasticity of pork. From Table 4, we infer its value as .50. Coefficient g measures the

annual rate of change of the pork producers' share in the retail pork dollar. From section 3.2, we determine its value as -.023. Substituting this information in equation 8.5, we obtain

$$y_{2,1985/1980} = 38.7$$

$$y_{2,1990/1980} = 83.6.$$

We, therefore, project the nominal price of pork to increase by 38.7 percent between 1980 and 1985. The corresponding figure for the 1980-1990 period is 83.6 percent.

Substituting this information in the supply response equation 8.1, we have

$$y_{1,1985/1980} = (.49)(38.7) + (-.49)(46.6) + (1.83)(21.6) = 35.7$$

$$y_{1,1990/1980} = (.49)(83.6) + (-.49)(111.2) + (1.83)(47.8) = 74.0.$$

Pork production (and pork consumption) are projected to increase by 35.7 percent between 1980 and 1985 and by 74.0 percent between 1980 and 1990. From Table 12, we observe that pork production during the period '79-'81 equalled 8136 M.T. carcass weight. The projected figures for 1985 and 1990 equal 11115 M.T. and 14157 M.T., respectively. For the period 1980-1990, pork production is, therefore, projected to grow at 5.7% annually.

APPENDIX A.

SUPPORTING STATISTICAL TABLES

Table S-1. Monthly expenditures on 12 basic commodities, major cities, other cities and rural areas

	No. of households	Monthly income	Monthly expenditures	Monthly expenditures per household in lempiras, 1978-1979														
				All food	Corn	Rice	Shortening	Milk	Eggs	Beans	Beef	Potatoes	Tomatoes	Onion	Sugar	Cheese	Bananas	Others
Major cities	2870																	
Average		853.6	642.8	238.5	18.36	10.26	10.02	4.53	11.21	9.54	24.57	2.39	2.86	1.43	6.20	7.87	.95	128.31
<100	31	79.5	67.7	44.5	10.72	2.40	2.49	1.07	2.89	5.21	1.87	.13	.22	.18	2.05	1.87	.53	12.86
100-300	572	215.9	196.5	121.5	16.28	7.29	7.41	2.79	6.68	8.26	8.87	1.09	1.22	.73	4.74	4.74	.61	50.79
300-500	725	387.4	346.4	188.0	19.36	10.15	9.96	3.76	9.21	9.78	18.42	1.69	2.07	1.32	6.02	7.14	.75	88.36
500-1000	878	701.9	598.7	259.[illegible]	20.74	11.41	11.67	5.19	12.19	10.63	27.49	2.59	3.11	1.56	6.22	8.82	1.04	136.65
>1000	664	2148.8	1436.2	375.8	16.53	11.27	10.52	6.39	15.78	9.40	41.34	3.76	4.51	2.63	7.14	9.77	1.50	235.25
Other cities	1316																	
Average		414.7	339.8	161.9	19.91	8.10	8.58	5.34	6.64	10.04	14.57	1.62	1.46	.81	6.31	6.07	.49	70.59
<100	113	73.2	61.1	41.7	13.68	1.83	2.17	1.58	1.46	5.55	.96	.13	.25	.13	1.88	1.58	.17	10.34
100-300	552	191.5	172.4	106.7	18.78	6.08	6.72	3.31	4.48	9.39	7.58	.96	.96	.53	5.22	4.69	.32	38.20
300-500	325	381.4	342.6	185.3	22.61	9.82	9.82	6.30	7.41	11.30	15.94	1.85	1.67	.93	7.60	8.71	.37	80.78
500-1000	247	679.5	571.0	249.1	21.67	10.97	11.71	8.47	10.21	10.96	26.40	2.74	2.49	1.49	8.22	12.70	1.00	120.[illegible]
>1000	79	1771.7	1172.8	350.8	20.35	15.08	16.49	9.82	13.33	11.92	38.59	3.51	4.21	2.10	9.47	14.03	1.05	190.84
Rural	1070																	
Average		180.5	155.5	92.3	21.69	7.94	7.85	1.66	5.45	11.35	4.80	.86	.65	.65	4.43	2.40	.28	22.34
<100	253	72.5	67.4	45.4	17.03	3.41	3.54	.32	2.32	8.44	.82	.27	.18	.14	2.04	.27	.09	6.54
100-300	683	163.8	148.3	94.1	22.77	8.66	8.19	1.51	6.02	11.96	4.61	.75	.66	.75	4.61	2.26	.28	21.08
300-500	106	371.1	327.4	169.7	25.62	13.07	13.75	3.56	8.49	14.09	13.24	2.04	1.70	1.19	7.47	6.28	.51	58.72
500-1000	22	677.0	490.8	185.3	23.53	12.60	15.38	11.12	9.08	13.34	14.08	2.59	1.85	2.04	11.30	10.93	1.30	56.15
>1000	6	1444.3	426.2	161.7	21.51	8.41	15.69	4.53	13.42	10.51	16.17	.16	0	.32	8.25	8.09	.97	53.68

Source: Patron del gasto y del consumo de alimentos en los Hogaren en Honduras, Proyecto "Estudio de los efectos de politicas de desarrollo agricola en el consumo de alimentos de la poblacion centroamericana," Secretaria Permanente del Tratado General de Integracion Economica Centro Americana, Documento 31, Octubre, 1982, Tegucigalpa, Tables II-9-1, II-c-1.

Table S-2. Retail prices paid for 12 basic foods and other consumer price indices, 1965-1982

Variable	Commodity	Lempiras / unit	1978 exp. wts.[2/]	1965	1966	1967	1968	1969	1970
X_1	Corn[1/] (unground)	lb.	.075	.11	.09	.09	.10	.08	.10
X_2	Rice[1/] (2nd class)	lb.	.033	.20	.22	.20	.21	.23	.24
X_3	Shortening (vegetable)	lb.	.032	.70	.70	.70	.70	.70	.70
X_4	Milk (past.)	liter	.007	.40	.40	.40	.40	.40	.40
X_5	Eggs (medium)	dozen	.046	1.05	1.07	1.07	1.05	1.05	1.11
X_6	Beans (red)	lb.	.034	.23	.21	.24	.23	.21	.29
X_7	Beef (sirloin butt)	lb.	.103	.88	.88	.91	.93	.97	.92
X_8	Potatoes (med. white)	lb.	.010	.18	.23	.23	.19	.25	.25
X_9	Tomatoes (fresh round)	lb.	.010	.29	.29	.18	.25	.39	.22
X_{10}	Sugar (white)	lb.	.023	.20	.20	.20	.20	.20	.20
X_{11}	Cheese (fresh, no skim)	lb.	.028	1.24	1.13	1.15	1.24	1.14	1.20
X_{12}	Bananas (ripe med.)	each	.005	.92	.92	.03	.03	.03	.03
X_{13}	Expenditure weighted price		.403	.23	.23	.23	.24	.24	.24
	Cons. Price Index (1978=100)								
X_{14}	All food[3/]		.412	49.7	50.7	51.9	52.7	53.2	55.9
X_{15}	All food + non-food [4/]		1.00	55.5	56.8	57.9	58.9	59.6	61.9
	Implicit price indices (1966=100)								
X_{16}	Food[5/]		variable						111.5
X_{17}	CDP [6/]		variable						111.5

[1/] Corn, rice, etc. Precios al por menor, Tegucigalpa, primary data, Departamento de Estudios Economicos, Banco Central de Honduras, 1965-1982.

[2/] Table II-c-10, Patron del Gasto y del Consumo de alimentos en los hogares de Honduras, SIECA-ECID, 1982.

[3/],[4/] Indice general de precios el consumidor, Metodologia y series cronologicas, Banco Central de Honduras, 1982, p. 52.

[5/],[6/] Cuentas Nacionales de Honduras, 1970-1980, Departamento de Estudios Economicos, Banco Central de Honduras, 1982, p. 59, p. 60; p. 50, p. 51.

ble S-2. *Continued*

71	1972	1973	1974	1975	976	1977	1978	1979	1980	1981	1982
.09	.10	.12	.15	.18	.17	.22	.21	.21	.25	.23	.22
.37	.40	.35	.42	.52	.54	.57	.64	.68	.73	.78	.92
.71	.71	.69	.79	.88	.89	.84	1.01	1.11	1.22	1.30	1.32
.40	.40	.40	.56	.60	.60	.61	.62	.66	.72	.72	.80
.13	1.15	1.14	1.30	1.31	1.33	1.56	1.43	1.42	1.79	1.88	1.90
.24	.24	.36	.39	.40	.41	.48	.63	.62	.97	.92	.95
.08	1.15	1.27	1.51	1.50	1.52	1.76	1.85	2.18	2.63	2.99	3.14
.30	.26	.35	.37	.40	.41	.42	.36	.48	.56	.60	.58
.31	.50	.29	.26	.31	.39	.51	.51	.50	.56	.63	.57
.20	.20	.21	.23	.22	.29	.25	.28	.31	.33	.38	.55
.32	1.30	1.41	1.72	1.82	1.65	1.99	2.09	2.40	2.89	3.02	3.13
.02	.03	.02	.02	.02	.03	.03	.03	.03	.04	.04	.05
.26	.27	.29	.34	.35	.36	.40	.43	.46	.57	.61	.65
.7	60.4	63.6	74.5	81.4	84.6	94.2	100.0	111.4	130.4	139.9	
.2	65.2	68.2	76.9	86.1	87.3	94.6	100.0	112.1	132.4	144.8	
.2	120.5	125.7	145.8	156.0	162.6	171.9	174.5	186.2	202.6		
.5	118.4	126.2	140.9	154.0	167.0	189.6	202.7	217.8	240.7		

Table S-3. Expenditure shares and retail prices paid for 12 basic commodities in eight major cities, 1978

Major city	Corn		Rice		Shortening		Milk		Eggs		Beans		Beef	
	k_i 1/	P_i 2/	k_i 1/	P_i 2/	k_i 1/	P_i 2/	k_i 1/	P_i 2/	k_i 1/	P_i 2/	k_i 1/	P_i 2/	k_i 1/	P_i 2/
Santa Rosa	.117	.19	.040	.63	.048	1.00	.049	.36	.063	1.41	.056	.40	.076	1.36
San Pedro Sula	.066	.19	.052	.66	.047	1.00	.015	.56	.046	1.44	.035	.52	.115	1.71
Comayagua	.133	.19	.043	.58	.052	1.04	.048	.36	.049	1.47	.057	.46	.084	1.35
Tegucigalpa	.075	.21	.033	.64	.032	1.01	.007	.62	.046	1.43	.034	.62	.103	1.85
Choluteca	.097	.20	.035	.60	.051	1.03	.030	.39	.051	1.54	.042	.46	.081	1.73
Juticalpa	.073	.18	.049	.57	.056	1.08	.042	.27	.042	1.81	.052	.43	.122	1.43
La Ceiba	.023	.19	.073	.56	.037	1.07	.020	.42	.037	1.45	.034	.47	.094	1.42
Dahli	.104	.15	.037	.60	.062	1.04	.032	.39	.050	1.59	.062	.52	.095	1.66

1/ Table II-c-10, Patron del gasto y del consumo de alimentos en los hogares en Honduras.

2/ Precios al por menor en centros urbanos, primary data, Departamento de Estudios Economicos, Banco Central de Honduras, 1978.

3/ Calculated on basis of information in this table.

4/ Table II-9-14, Patron del gasto y del consumo de alimentos en los hogares en Honduras.

Continued ...

Table S-3. *Continued*

Major city	Potatoes		Tomatoes		Sugar		Cheese		Bananas		Exp. wtd. price	Tot. exp. on food	Total monthly expenditures
	k_i 1/	P_i 2/	k_i 1/	P_i 2/	k_i 1/	P_i 2/	k_i 1/	P_i 2/	k_i 1/	P_i 2/	P 3/	M 4/	G 4/
Santa Rosa	.011	.34	.009	.40	.037	.28	.051	1.59	.002	.03	.727	175.9	578.8
San Pedro Sula	.010	.37	.016	.47	.020	.28	.025	1.67	.002	.03	.882	234.6	586.5
Comayagua	.010	.32	.009	.33	.038	.30	.041	1.77	.006	.03	.701	170.9	522.0
Tegucigalpa	.010	.36	.010	.51	.023	.28	.028	2.09	.005	.03	.891	278.7	610.6
Choluteca	.008	.37	.013	.59	.028	.28	.025	2.03	.009	.03	.795	227.3	639.8
Juticalpa	.009	.38	.009	.33	.030	.30	.060	1.24	.003	.03	.746	232.8	628.7
La Ceiba	.008	.37	.011	.57	.030	.28	.025	1.17	.005	.02	.867	222.9	574.0
Dahli	.011	.42	.011	.52	.035	.28	.064	1.57	.002	.03	.776	210.6	593.4

Table S-4. Gross value of livestock production, 1970-1980

Variable	k_1	P_1	k_2	P_2	k_3	P_3	k_4	P_4
Product	beef		Pork		Chicken		Eggs	
Year	Earnings share %	Nominal price L./ .	Earnings share %	Nominal price L./ .	Earnings share %	Nominal price L./ /	Earnings share %	Nominal price L./360
1970	.3696	40.83	.0552	64.00	.0522	76.30	.1709	27.00
1971	.3644	40.87	.0567	66.00	.0560	78.70	.1742	26.30
1972	.3628	41.49	.0570	67.00	.0563	76.40	.1786	27.40
1973	.3350	42.84	.0603	69.00	.0659	83.10	.1850	27.70
1974	.3713	54.19	.0575	77.00	.0715	99.90	.1720	29.90
1975	.3656	59.16	.0572	79.00	.0736	102.40	.1757	32.04
1976	.3574	63.70	.0564	81.00	.0740	102.40	.1768	33.84
1977	.3810	73.24	.0552	87.00	.0708	105.70	.1641	34.92
1978	.3759	79.59	.0540	89.00	.0751	109.00	.1644	37.08
1979	.3722	80.19	.0526	92.00	.0810	114.60	.1567	37.08
1980	.3475	83.98	.0528	100.00	.0869	120.20	.1737	44.28
1981	.3565	88.29	.0543	107.00	.1066	128.80	.1649	44.64

Source: k_1, k_2, k_3, k_4, k_5 from Table 5, $k_1 = P_1Q_1/\Sigma P_iQ_i$, $i = 1 \ldots 5$.

P_1, P_2, P_3, P_4, P_4 from Table 5.

P = weighted nominal price; $\ln P = \Sigma k_i \ln P_i$; $i = 1 \ldots 5$.

[illegible]

Table S-4. *Continued*

k_5	P_5	Σk_i	P	$\Sigma P_i Q_i$	$\Sigma PQ_i/P$
Milk		All livestock		Gross value of livestock production	
Earnings share %	Nominal price L/100 ltr	Earnings share %	Wt. nominal price	Current Prices mill. L.	Real Mill. L.
.3521	21.80	1.0000	32.31	117.15	362
.3488	22.90		32.98	125.81	381
.3454	23.00		33.44	135.53	405
.3538	24.00		34.61	140.47	406
.3277	26.00		41.00	173.68	424
.3280	28.00		44.01	192.86	438
.3352	31.00		46.94	214.08	456
.3290	34.00		52.23	250.68	480
.3306	37.00		56.13	280.02	499
.3375	40.00		58.26	304.83	523
.3391	42.00		61.86	332.79	538
.3179	43.00	1.0000	66.04	367.06	556

Table S-5. Honduras, volume, value and prices of imported dairy products, 1970-1981

Year[1/]	Powdered milk[2/]							Condensed and evaporated milk[4/]				Butter[5/]			
	Donations[3/]			Commercial											
	Q	Q*	PQ	Q	Q*	P	PQ	Q	Q*	P	PQ	Q	Q*	P	PQ
1970				3470	24.9	.708	2458	402	.9	.373	150	119	2.6	.798	95
1971				2798	20.0	.738	2066	847	1.8	.503	426	78	1.7	.871	68
1972				2487	17.8	1.018	2533	1100	2.3	.690	759	4	.1	.800	4
1973				2500	17.9	1.000	2500	1200	2.6	.750	900	0	0	--	0
1974	90	.6	0	3224	23.1	1.197	3859	486	1.0	1.090	446	4	.1	1.000	4
1975	100	.7	0	2082	14.9	1.478	3078	1425	3.0	1.267	1806	73	1.6	2.411	176
1976	1000	7.2	0	3333	23.9	1.458	5861	160	.3	1.094	176	73	1.6	2.466	180
1977	3100	22.2	0	2931	21.0	1.290	3780	1268	2.7	1.398	1773	140	3.0	1.564	219
1978	3000	21.5	0	4006	28.7	1.418	5680	301	.6	.857	258	65	1.4	1.538	100
1979	3000	21.5	0	4585	32.8	1.387	6362	600	1.3	.775	465	360	7.8	1.478	532
1980	3300	23.6	0	5678	40.7	1.639	9305	1164	2.5	.921	1072	499	10.8	1.970	983
1981	3900	27.9	0	5500	39.4	1.709	9400	1200	2.6	.917	1100	1400	30.4	2.143	3000
1985															
1990															

Q: in metric tons, PQ in 1000 U.S. $; P in 1000 $/MT.

Q*: milk equivalent in terms of fat solids; 1,000,000 litres.

1/ Source: Food and Agriculture Organization: Trade Yearbook, Annual Volumes, 1971-1981.

2/ Conversion factor for obtaining whole milk equivalent in terms of fat solids = 7.162.

3/ Source: Direccion de Planificacion Agricola, CONSUPLANE-CEE.

4/ Conversion factor = 2.135.

5/ Conversion factor = 21.702

6/ Conversion factor = 8.243.

7/ $P^* = \Sigma PQ \div \Sigma Q^*$, P* in U.S. cents/litre of milk.

Table S-5. *Continued*

Year	Cheese[6/]				All dairy products in terms of milk equivalent					
					with donations			without donations		
	Q	Q*	P	PQ	ΣQ*	P* U.S. ¢/ltr)	ΣPQ	ΣQ*	P* U.S. ¢/ltr	ΣPQ
1970	138	1.1	1.028	142	29.5	9.64	2845	29.5	9.64	2845
1971	63	.5	1.127	71	24.0	10.96	2631	24.0	10.96	2631
1972	31	.3	1.806	56	20.5	16.35	3352	20.5	16.35	3352
1973	31	.3	1.806	56	20.8	28.63	5956	20.8	28.63	5956
1974	41	.3	2.146	88	25.1	17.52	4397	24.5	17.95	4397
1975	58	.5	2.345	136	20.7	25.10	5196	20.0	25.98	5196
1976	58	.5	2.414	140	33.5	15.99	5357	26.3	20.37	5357
1977	116	1.0	1.681	195	49.9	11.96	5967	27.7	21.54	5967
1978	68	.6	3.015	205	52.8	11.82	6243	31.3	19.95	6243
1979	86	.7	3.407	293	64.1	11.94	7652	92.6	17.96	7652
1980	94	.8	4.085	384	78.4	14.98	11744	54.8	21.43	11744
1981	60	.5	3.000	180	100.8	13.57	13680	72.9	18.77	13680
1985										
1990										

Table S-6. Actual values of nine exogenous variables, 1970-1980

Year	Index of prices received by farmers, Honduras	Index of prices paid for food, Honduras	Index of prices paid for food, U.S.	Prices paid by consumer for beef, U.S.	Index of prices paid for dairy imports, Honduras	No. of Lemps. bought by 1 U.S. $	Real expend. on food Mill. 1966 Ls.	Index of real gross value of livestock prodct.	Donated dairy imports ÷ total dairy imports
t	X_1 1/	X_2 2/	X_3 3/	X_4 4/	X_5 5/	X_6 6/	X_7 7/	X_8 8/	X_9 9/
1970	32.31	55.9	114.9	69.30	9.64	2.0	293	362	0
1971	32.98	57.7	118.4	76.68	10.96	2.0	395	381	0
1972	33.44	60.4	123.5	80.72	16.35	2.0	414	405	0
1973	39.61	63.6	141.4	96.65	28.63	2.0	952	406	0
1974	41.00	74.5	161.7	99.33	17.95	2.0	452	424	2.4
1975	49.01	81.4	175.4	105.12	25.98	2.0	468	438	3.3
1976	46.94	84.6	180.8	100.39	20.37	2.0	497	456	21.5
1977	52.23	94.2	192.2	100.51	21.54	2.0	537	480	44.5
1978	56.13	100.0	211.4	123.23	19.95	2.0	604	499	40.7
1979	58.26	111.4	234.5	153.31	17.96	2.0	654	523	33.5
1980	61.86	130.4	254.6	160.99	21.43	2.0	689	538	30.1
1981	66.04	139.9		161.73	18.77	2.0		556	27.7

Source: 1/ Table 5.

2/ Table S-2.

3/ United States Department of Agriculture, Expenditures on food Statistical Bulletin, 1982.

4/ Table 8.

5/ Table 11.

6/ International Monetary Fund, Financial Statistics.

7/ Departamento de Estudios Economicos, Banco Central de Honduras, Cuentas Nacionales 1970-1980, 1982, pp. 6.

8/ Table 5.

9/ Table 11.