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WORLD GRAIN TRADE: AN EVALUATION OF FACTORS AFFECTING NET IMPORT DEMAND FOR WHEAT AND COARSE GRAINS BY SELECTED COUNTRIES

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Vernon L. Sorenson served as chairman of the thesis committee. J. Roy Black contributed importantly to Ms. Wilde's thesis preparation. James T. Bonnen, A. Allan Schmid and Norman Obst contributed through their participation as members of Linda Chase Wilde's thesis committee.

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SUMMARY

World trade in grain changed significantly during the period 1960-80. Beyond the overall growth in trade volume, significant change occurred in trade patterns and in the degree of short term variability. A comprehensive understanding of factors that influence trading patterns requires in-depth study of individual countries, especially the policies that effect the linkage between their domestic economy and the international market. Effective policy formulation requires knowledge of how markets function and how buyers and sellers respond to economic and policy variables. This study seeks to contribute to the needed knowledge base by focusing on characteristics of net import demand for grain over the period 1960-80.

A framework is developed for examining the structure of net import demand for grains. Empirical estimation of the resulting model is carried out for various industrial and less developed countries to investigate the responsiveness of imports to changes in their domestic and international environments. The demand for both wheat and coarse grains are examined.

Net import demand elasticities are estimated which show the short-run response of imports to changes in price, income, production, stocks and specific financial variables. The estimating procedure implicitly takes into account domestic pricing policies which in importing countries may intervene between domestic economic relationships and actual net imports.

Economic and policy sensitivity analysis is undertaken using a selected sample of countries to examine three broad types of changes. First, the impact on the level of net imports is examined by changing the value of the intercept term. This simulates an increase or decrease in demand represented by a parallel shift in the demand curve. Second, the impact on net imports of a change in one or more of the exogenous variables, ceteris paribus, is simulated. A change in own price level represents a movement along the demand curve, while a change in the level of other variables represents a shift in the net import demand curve. Third, import demand changes resulting from a change in the slope coefficient of one or more of the exogeneous variables is simulated. These changes are identified as structural changes. The usefulness of simulating slope changes is that it provides a direct way of examining the impact of various changes in economic policy through their effect on elasticities of demand.

One key result of this research is the relatively low direct price elasticity estimates for net imports found in many grain importing nations. This is an indication of the effects of domestic pricing policies on grain imports. It is consistent with theoretical expectations which take the limiting effects of domestic agricultural policies

into account. However, the low price elasticity of import demand is counter to results obtained from analyses based solely on domestic demand and supply functions.

Empirical results of this study show that the majority of importers make little adjustment in the short run to the quantity of their imports of wheat and coarse grains in response to changes in import prices. For wheat, short-run price elasticity estimates were typically -0.1 to -0.3. The high and low elasticities were -0.99 (Saudi Arabia) and -0.0008 (Ecuador). For coarse grains, price elasticity estimates were a little higher but for the majority of countries studied, they were below -0.5. The range was -2.1 (Philippines) and -0.03 (Switzerland). These results indicate that domestic policies are often effective in isolating importing countries from changes in world prices, at least in the short run.

For most countries, income is important in explaining changes in net imports. Estimates of income elasticities are generally positive and, along with production, income was one of the most statistically significant variables tested.

Income elasticities are higher for coarse grains than for wheat. Elasticity estimates for coarse grains were generally over 1.0 and for about half the countries sampled, the estimates were greater than 2.0. For wheat, income elasticities were typically closer to 1.0. Within each commodity group, the highest income elasticities were found in low income countries. For wheat, lowest elasticities (less than 0.5) were found in middle-income countries; whereas for coarse grains, lowest estimates (around 1.5) were found in industrial countries.

As expected, the relationship between domestic production and net imports of both wheat and coarse grains was negative for most countries examined. In the less developed importing countries, the size of domestic production elasticity estimates for coarse grains were higher than those for wheat (typically greater than -1.0 and those for wheat closer to -0.5). This may be due to the price sensitive livestock demand from which coarse grain demand is derived. By contrast, demand for wheat as food is more inelastic. Production elasticity estimates for industrial countries were closer to -1.0 for both wheat and coarse grain.

The beginning stocks elasticity estimates were generally negative, although some positive estimates were obtained especially for lower income countries. The typical range for wheat stocks elasticities (-0.3 to -0.05) was slightly lower than that for coarse grains (-0.5 to -0.1). A positive stocks elasticity, found most often in lower income countries, has been interpreted as reflecting a demand for stocks held largely for

security reasons; whereas a negative stocks elasticity indicated use of stocks as a buffer against short-term market variations.

Results concerning a separate role for financial variables in determining net imports are mixed. Inclusion of foreign exchange reserves as an independent determinant of net imports in the short-run was justified on grounds that, for some countries, the degree of ownership of international currency could directly effect imports. A lack of such funds, in turn, would constrain a country's ability to import in any given year. This expectation was not borne out in all countries studied. For about half the sample a negative relationship between net imports and foreign exchange reserves was found for both wheat and coarse grains. Overall, foreign exchange availability elasticity estimates were small (often close to 0.2) and were less significant for wheat than for coarse grains.

Results also suggest that further information is needed to clarify the role of exchange rates with respect to their effect on net imports. Conceptually, the exchange rate is included separately in net import demand equations to represent changes in relative domestic prices between traded goods and nontraded goods. That is, as the exchange rate changes, relative prices of traded and nontraded goods in a country cannot be assumed to remain constant. Particular characteristics of a country are expected to have a bearing on how these changes in relative prices effect net imports of grains.

CHAPTER 1

SHIFTS AND VARIABILITY OF INTERNATIONAL GRAIN TRADE, 1960-1980

U.S. concern with international markets as a growing outlet to absorb surplus production capacity and the adaptation of U.S. domestic policy to that end began in the early 1960s. Following a decade of relatively slow growth in world grain trade during the 1960s, trade volume increased sharply during the 1970s (Table 1). Net exports of wheat by major exporting countries increased from 35.2 million metric tons (MMT) in 1960 to 85.7 MMT in 1980. Net coarse grain exports by major exporters increased from less than 19 MMT in 1960 to over 103 MMT in 1980. Exports of wheat by the United States increased from 17.9 MMT in 1960 to 19.8 MMT in 1970 and 41.4 MMT in 1980. U.S. coarse grain exports expanded from 10.8 MMT in 1960 to 18.2 MMT in 1970 to 69.2 MMT in 1980. While declines have since occurred, international markets remain crucial to U.S. grain producers.

This increased linkage of American agriculture to world markets creates instability that affects American agriculture and food industries. Production decisions by farmers and storage and merchandising decisions by food industries are complicated by increased uncertainty. Multilateral trade negotiations during the 1970s did not significantly alter the structure of international grain markets and efforts to deal directly with the problem of instability through multilateral stocking agreements were unsuccessful. In general because of policy and structural conditions in world markets the U.S. tends to be the residual supplier and absorbs much of the variability generated. Because of this variability and because of the central importance of international markets to U.S. agriculture, policies and programs to stabilize and assist the continuing orderly growth of these markets are required.

Effective policy formulation requires knowledge of how markets function and how buyers and sellers respond to economic and policy variables. This study seeks to contribute to the needed knowledge base by focusing on characteristics of net import demand for grain over the period 1960-80. Specifically, the main objective is to estimate the responsiveness of net import demand for wheat and coarse grains to economic variables and evaluate the results in terms of the impact of national policies. The impact of policy decisions is implicit in the estimating procedure.

Table 1

NET WHEAT AND COARSE GRAIN EXPORTS 1960,1970 AND 1980

Million Metric Tons

Item	1960	1970	1980
Wheat			
Net Exports by Major Exporters*	35.2	42.6	85.7
U.S. Exports	17.7	19.8	41.4
Coarse Grain			
Net Exports by Major Exporters**	19.0	44.0	103.2
U.S. Exports	10.8	18.2	69.2

Source: Ellis Perraut and Vernon Sorenson, Trends in World Grain Trade, Consumption and Production, 1960-1980. M.S.U. Ag. Econ. Staff Paper No. 83-51, August 30, 1983.

* Includes U.S., Canada, Australia, Argentina, France.

** Includes major wheat exporters plus Thailand and South Africa.

The remainder of this chapter presents a descriptive overview of the changing characteristics of world grain markets during the period 1960-80. This is followed by a review of related analyses completed in the past, the development of a structural model for import demand analysis, empirical estimates of net import demand for selected countries and an effort to evaluate the economic and policy implications of the results obtained.

CHANGING PATTERNS OF WORLD GRAIN TRADE

Beyond the overall growth in trade volume significant change occurred in the structure of international trade during the period 1960-80.[1] For wheat the most

[1]Data in this section are from Ellis Perraut and Vernon Sorenson, Trends in World Grain Trade, Consumption and Production, 1960-1980, M.S.U. Ag. Econ. Staff Paper No. 83-51, August 30, 1983.

important change is that France increased its share of net exports from about 1 percent in 1960 to nearly 13.5 percent in 1980. Most of this growth occurred in the 1970s. In coarse grains the most significant shift was that the U.S. increased its share of the market from 57 to 67 with the result that market share declined for all other exporters except Argentina which increased from 13 to 14 percent.

Major shifts also occurred in import patterns during the 1960-80 period. In general, this reflects increasing entry by LDCs and CPEs into grain markets. Asia emerged as the region with the largest quantity of wheat imports with total growth of 20.5 MMT during the 20 year period. Growth occurred throughout the region but the largest quantity was about a 12 MMT increase in imports by China, most of which occurred during the 1970s. Japanese imports of wheat grew steadily at an average rate of nearly 4 percent per year.

European net imports of wheat reflected three distinct trends. West Europe change from net imports of about 11 MMT in 1960 to net exports of about 11 MMT in 1980. France was a strong contributor to this change with export growth of about 12.5 percent per year. The Soviet Union shifted from a net exporter of 4.4 MMT in 1960 to imports of 16 MMT in 1980. East European imports were about the same in 1980 as in 1960. Overall net wheat imports into Europe declined by about 20 percent during the period.

Wheat imports by Africa, Central and South America increased substantial during the period with average annual import growth rates of 7.7, 6.3 and 4.4 respectively. These regions combined increased net imports from 6.1 MMT in 1960 to 25.7 MMT in 1980.

Coarse grain import markets are substantially more concentrated than those for wheat. Europe is by far the largest market and grew from net imports of 12.5 MMT in 1960 to 41.8 MMT in 1980. Essentially all of this growth occurred in East Europe and Russia. Net imports into West Europe increased somewhat during the middle part of the period but declined again by 1980 to near their level in 1960.

Asia is the next largest coarse grain import area with steady growth from 3.6 MMT in 1960 to 32.4 MMT in 1980. Japan was the primary source of this growth though East Asian middle income countries[2] also expanded imports substantially. Coarse grain imports by Africa, Central and South America were nil through 1970 but increased to 14.6 MMT by 1980.

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[2] Korea, Taiwan, Singapore.

INSTABILITY IN INTERNATIONAL GRAIN MARKETS

Another dimension of change in international markets that is of concern from a policy perspective is the extent to which instability is generated that can impact U.S. producers and market firms and generate the need for a policy response.

A number of factors have led to the general perception that instability in international grain markets has increased. The changing structure of grain trade is of importance. Imports have shifted toward socialist countries and middle income LDCs. Some of these countries have relatively stable import needs while purchases by others are highly variable. Variability in import demand by individual countries is in turn affected by their production variability and stockholding policy. Thus, an important component for evaluating the impact of the U.S. linkage to international markets is to evaluate the shifting patterns of U.S. exports and the related buying patterns of the countries involved.

A second element is the mix of domestic policies and programs in industrial countries designed to protect their agriculture from the vagaries of the international market. Domestic programs get translated into foreign market operations in a number of ways. Canada and Australia both export through marketing boards that seek long term sales agreements with their traditional trading partners. The European Community, through its common agricultural policy, supports its internal prices and traditionally has exported through a system of restitutions and sales tenders. Their internal prices are at a level that require both import protection in areas where they have deficits and export subsidization in areas where surpluses occur. Japan licenses imports through trading companies so as to separate internal price from world prices.

State trading practices are significant in a wide range of countries. The Soviet Union, China, and other socialist countries import exclusively through government agencies. Most of the major grain importing LDCs also exert close government control over their trade usually through direct state trading or parastatal organizations.

A third factor that influences world markets is that the existence of close government control over grain trade by many governments has led to an increase in bilateral trade commitments among countries. These can take the form of established traditional buyer/seller relations or of government to government bilateral trade agreements. These kinds of changes reduce the size of "free market" component in international grain trade and reduce flexibility for the U.S. to enter world-wide markets.

A fourth factor that is presumed to affect stability in international markets is exchange rate phenomena and changes in international monetary arrangements. Since 1971 the world has moved from a closely controlled, stabilized exchange rate system to a

fluctuating system where the dollar is no longer protected in terms of its value in relation to other currencies. But because of various government interventions, full equilibrium adjustment is never reached. Among LDCs, a number of currencies are linked to the dollar. The effect that this has had on trade flows is uncertain. From the viewpoint of the U.S., it is argued that an overvalued exchange rate through much of the 1960s and early 1970s placed a significant tax on exports, and hence, inhibited trade flows. Since then, the value of the dollar has declined relative to other major currencies and again has increased in value during the early 1980s. These changes affect price relationships in world markets and potentially impact on trade.

MEASURES OF VARIABILITY

Does historical data support the belief that market instability has increased? If so, what represents a meaningful measure of instability? This will be influenced by the purpose for which variability is being measured. Variations in quantities traded and prices impact markets at the margin, hence comparing change in relative terms as through a coefficient of variation may not present an appropriate comparison. The value of the coefficient is influenced both by the amount of variation and the value of the mean of the variable.

Further, if a strong upward or downward trend of change exists, variability of time series data will appear exaggerated. To avoid this bias year to year, variation from trend both in absolute and relative terms is accepted as the most meaningful bases for evaluating whether instability has increased as is commonly perceived. The approach used, thus, is to fit a trend regression and measure absolute variability as the standard error of the estimate for each period and relative variability as the ratio of the standard error to the mean of the dependent variable. A comparison of these measures for world trade and U.S. gulf port price for wheat and coarse grains are shown in Table 2.

Further insight can be gained by viewing variability as it applies specifically to individual countries and regions. A set of such computations is included in Tables 3 through 6.

Several significant changes are reflected when comparing individual countries and regions in the periods 1960-70 and 1971-80. Among exporters greater variability in exports, both absolute and relative, occurred only for the United States. For other major exporters as a group both absolute and relative variability declined substantially; the decline for individual countries is less pronounced indicating the individual country variability occurred in a pattern that was offsetting during the 1970s.

Table 2

STANDARD ERRORS AND COEFFICIENTS OF VARIATION FOR WHEAT AND COARSE GRAINS, 1960-70 AND 1971-80*

	1960-70		1971-80	
	SE (absolute)	CV (relative)	SE (absolute)	CV (relative)
Wheat Exports				
World Total (MMT)	6.44	13.29	5.67	7.64
Price ($)	14.65	5.94	31.94	12.31
Coarse Grain Exports				
World Total (MMT)	3.29	9.26	5.05	5.88
Price ($)	12.30	5.86	20.84	10.24

* Standard errors (SE) measures the "absolute" magnitude of squared deviations from the fitted trend values adjusted to the degrees of freedom.

$$SE = \frac{(xi-x)^2}{n-2}$$

where xi is the actual value and x is the fitted trend value. The degree of freedom is two because we have an intercept term and a time trend variable.

Coefficient of variation (CV) based upon squared deviations from trend and standardized by dividing through by the mean value. This is a relative measure of the deviation.

$$CV = \frac{\frac{(xi-x)^2}{n}}{\bar{x}}$$

where $\bar{x}$ is the mean value of the dependent variable.

Table 3

WHEAT: NET IMPORTS AND EXPORTS, SELECTED REGION, 1960-70

Region	1000 Metric Tons (Mean)	Standard Error	Coefficient of Variation SE/Mean	World Share*
Exporters				
U.S.	19,184	2,776	14.4	44.5
Canada	11,283	2,989	26.5	26.1
Australia	6,751	1,266	18.8	15.6
Argentina	2,781	1,784	64.1	6.4
France	3,134	1,066	34.0	7.2
Major Exporters Less U.S.	23,949	4,338	18.1	55.5
Importers				
West Europe	5,725	2,459	43.0	13.3
East Europe	4,520	1,650	36.5	10.5
U.S.S.R.	-2,247	4,886	217.4	-5.2
Soviet Bloc	2,273	5,555	244.4	5.3
Total Europe	7,998	5,598	70.0	18.5
East Asia Middle Income[1]	1,373	331	24.1	3.2
Japan	3,646	308	8.4	8.4
China	4,479	1,183	26.4	10.4
South Asia Major Importers[2]	7,652	2,108	27.5	17.7
Total Asia	19,549	2,422	12.3	45.3
Africa Major Importers[3]	3,413	614	18.0	7.9
Total Africa	4,461	847	19.0	10.3
Mexico	-132	179	136.0	--
Total Central America	1,212	84	6.9	2.8
Total South America	4,099	532	12.9	9.5
LDC Oil Exporting	2,050	471	22.9	4.8

* World share computed as a percent of total net exports shown in the upper section of the table.

1 Korea, Taiwan, Singapore.

2 Bangladesh, Pakistan, Phillipines, Malasia, Sri Lanka, India, Indonesia, Thailand.

3 Angola, Egypt, Marocco, Mazambique, Tunisia, Zaire, Zambia.

Table 4

WHEAT: NET IMPORTS AND EXPORTS, SELECTED REGIONS, 1971-80

Region	1000 Metric (Mean)	Standard Error	Coefficient of Variation SE/Mean	World Share*
Exporters				
U.S.	30,678	4,767	15.5	47.0
Canada	13,821	1,904	13.7	21.1
Australia	9,062	1,426	15.7	13.9
Argentina	3,108	1,274	41.0	4.7
France	8,572	1,546	18.0	13.1
Major Exporters Less U.S.	34,563	2,530	7.3	53.0
Importers				
West Europe	-2,093	2,390	114.2	-3.2
East Europe	3,329	828	24.8	5.0
U.S.S.R.	6,031	6,057	100.4	9.2
Soviet Bloc	9,360	6,426	68.6	14.3
Total Europe	7,267	5,752	79.1	11.1
East Asia Middle Income[1]	2,643	281	11.0	4.0
Japan	5,484	223	4.1	8.4
China	6,450	2,475	38.4	9.8
South Asia Major Importers[1]	7,256	2,467	34.0	11.1
Total Asia	27,323	2,091	7.6	41.8
Africa Major Importers[1]	6,952	313	4.5	10.6
Total Africa	10,166	532	5.2	15.5
Mexico	628	396	63.0	1.0
Total Central America	2,457	400	16.3	3.7
Total South America	6,558	614	9.3	10.0
LDC Oil Exporting	7,979	859	10.7	12.2

* World share computed as a percent of total net exports shown in the upper section of the table.

[1] Countries included same as in Table 3.

Table 5

COARSE GRAINS: NET IMPORTS AND EXPORTS SELECTED REGIONS, 1960-70

Region	1000 Metric Tons (Mean)	Standard Error	Coefficient of Variation SE/Mean	World Share*
Exporters				
U.S.	17,716	3,417	19.3	58.0
Canada	798	1,017	127.4	2.6
Australia	989	654	66.1	3.2
Argentina	5,137	1,064	20.7	16.8
Thailand	1,098	65	5.9	3.6
South Africa	1,783	1,153	64.7	5.8
France	3,035	765	25.2	9.9
Major Exporters Less U.S.	12,842	3,046	23.7	42.0
Importers				
West Europe	18,300	2,743	15.0	60.0
East Europe	1,317	862	65.4	4.3
U.S.S.R.	-1,520	545	35.8	-5.0
Soviet Bloc	-203	708	348.0	--
Total Europe	18,097	2,845	15.7	59.2
East Asia Middle Income[1]	462	251	54.4	1.0
Japan	6,005	388	6.5	19.6
China	244	296	121.3	.8
Total Asia	7,797	957	12.2	25.5
Total Africa	-197	425	215.0	-.6
Mexico	-356	657	184.7	-1.1
Total Central America	-70	635	901.4	-.2
Total South America	-295	430	145.0	-.9
LDC Oil Exporting	-280	632	259.9	-.9

* World share computed as a percent of total net exports shown in the upper section of the table.

[1] Countries included same as in Table 3.

Table 6

COARSE GRAINS: NET IMPORTS AND EXPORTS, SELECTED REGION, 1971-80

Region	1000 Metric Tons (Mean)	Standard Error	Coefficient of Variation SE/Mean	World Share*
Exporters				
U.S.	49,405	4,211	8.5	66.0
Canada	3,301	1,144	34.6	4.4
Australia	2,695	320	11.9	3.6
Argentina	8,345	2,738	32.8	11.1
Thailand	2,102	485	23.1	2.8
South Africa	2,928	1,262	43.1	3.9
France	6,166	2,192	35.5	8.2
Major Exporters Less U.S.	25,539	3,281	12.8	34.1
Importers				
West Europe	19,882	4,736	23.8	26.5
East Europe	6,177	1,177	19.0	8.2
U.S.S.R.	9,257	4,489	48.5	12.3
Soviet Bloc	15,434	4,220	27.2	20.5
Total Europe	35,317	4,020	11.4	47.1
East Asia Middle Income[1]	4,234	739	17.4	5.6
Japan	15,155	765	5.0	20.0
China	950	1,095	115.0	1.2
Total Asia	23,760	2,480	10.44	31.7
Total Africa	1,216	404	33.3	1.6
Mexico	2,758	1,367	49.6	3.7
Total Central America	3,588	1,348	37.6	4.8
Total South America	1,532	1,124	73.3	2.0
LDC Oil Exporting	5,131	1,602	31.2	6.8

* World share computed as a percent of total net exports shown in the upper section of the table.

[1] Countries included same as in Table 3.

For importing regions a number of significant shifts occurred. In the case of wheat absolute variability changed very little in West Europe but relative variability increased substantially. This reflects the much lower value of the mean during the 1970s. Relative variability in East Europe declined somewhat despite a decline in mean import quantities due to a lower absolute variability about trend. In Russia and the Soviet Bloc relative variability declined sharply due largely to a significant increase in the mean value of imports. Little change occurred in either absolute or relative variability for Europe in total.

For Asia in total there was little change in absolute variability between the two periods but relative variability declined substantially due to the larger total quantities imported. In both periods East Asia Middle Income Countries and Japan represented stable markets characterized by relatively strong growth trends. Both China and South Asia Major Importers showed moderately increased variability in the period 1971-80. Import variability in Africa and South America declined between the two periods, while a slight increase occurred in Central America.

The market for coarse grains displayed a somewhat different pattern of change. As with wheat, relative variability by other major exporters declined, but in this case absolute variability increased slightly. This same pattern occurred for the United States. In West Europe both relative and absolute variability increased from the 1960s to the 1970s. In East Europe absolute variability increased between the two periods while relative variability declined sharply. For the USSR and Soviet Bloc as a whole there is little meaning in comparing the two periods because of the very low net trade volumes in the 1960s. During the 1970s, however, the USSR displayed the largest absolute and relative variability of any major trading area, and as such presumably contributed significantly to world price instability, though this cannot be concluded definitely without further evaluation of the circumstances under which the purchased occurred.

In Asia, Japan dominated coarse grain imports though East Asia Middle Income Countries expanded imports significantly in the 1970s. As with wheat, Asia represented a growth area with relatively low variability around trend in both periods. Africa, Central America and South America all display considerable import variability but total volume was relatively small even in the 1970s.

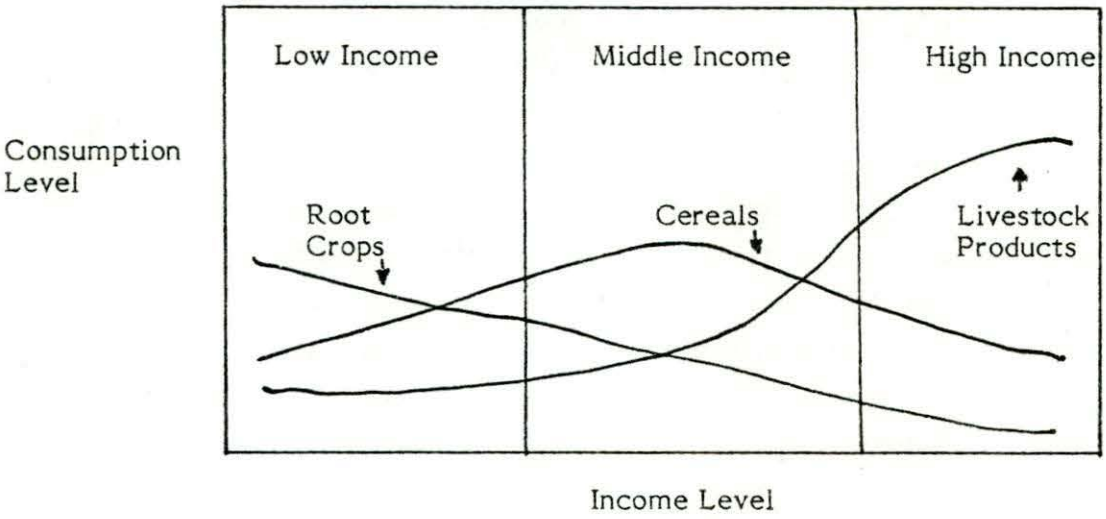
EVALUATION

The changes shown in the preceding sections are neither straight forward nor simple to evaluate. In a longer term framework, a significant background factor that might help explain import demand is the nature of the income-consumption pattern that

arises through different levels of development. This involves the movement through a root crop-cereal-livestock product consumption pattern. The nature of this relationship is illustrated in Figure 1.

Figure 1

LONG TERM INCOME-CONSUMPTION RELATIONSHIPS



Consumption of root crops (e.g., potatoes, casava) declines through all income levels. Initial displacement is through increased consumption of cereals. Cereal consumption peaks at some point in the middle income range and thereafter declines. Livestock product consumption grows through all income ranges, very slowly at low incomes, very rapidly in the middle income range, especially after cereal consumption begins to decline and then at gradually reduced rates as consumers move through successively higher income levels.

These consumption relations and related income levels are reflected in the import patterns shown in Tables 3 through 6. Imports of coarse grains to support livestock production are concentrated in high income countries while wheat imports have increasingly shifted to low income countries. In some cases, growth in wheat imports by LDCs has been increased by food subsidies that significantly reduce wheat prices relative to alternative home grown cereals or non-cereal products (Byerlee, 1983 and CIMMYT, 1983).

The other side of the equation in determining rates of growth in imports is growth in production. Rates of growth in production for both wheat and coarse grains have

generally been lower than rates of growth in consumption in LDCs and in Soviet Bloc countries. In West Europe wheat consumption has stabilized while production has grown fairly rapidly. For coarse grains both consumption and production increased substantially over the period with the result that net imports grew only moderately.

Short run variability in imports presumably is most affected by changes in production due to weather, disease or other phenomena. Only under unusual circumstances such as a major shift in government policy in a directed economy would internal consumption changes create sharp short term changes in traded quantities. Production variability also may have greatly different impacts among countries. In a country where domestic production represents a high proportion of consumption and imports are a marginal quantity, a small proportionate variation in production could create a major proportionate change in imports unless production changes are offset by adjustments in domestic inventories. This is in contrast to Japan where for both wheat and coarse grains imports provide the bulk of requirements and domestic production represents marginal quantities. This probably explains the relative small year to year variability in Japanese imports.

Central to any determination of factors that affect trading patterns is the role of government policy and the operating rules of state trading organizations. The implication of industrial country price policy on production, consumption and trading patterns has been extensively discussed and is most evident in the cases of Europe and the United States. Market growth and increased instability may be created where support prices stimulate production and where consumption is guided by prices isolated from world markets. On the other hand, inventories can accumulate and provide supplies that will stabilize prices in the face of fluctuating world production.

In CPEs and LDCs where government price support mechanisms similar to those in industrial economies do not exist government policies may affect the linkage between the domestic and international economy through storage and food price policy and the response to fluctuations in international prices. The presumption that most short term fluctuations in traded quantities is due to variation in production implies that governments stabilize consumer prices through variations in traded quantities but this may not follow in all cases.

A further element of concern in analyzing international markets is how trading behavior responds to changes in international prices and to international financial variables. International trading prices for grain are denominated in U.S. dollars. Changes in the relative value of the dollar influences the local currency price of imports differently among countries. In the EC, where prices are maintained above world market

levels, this impact is minimal. In countries with no protection from world markets the price impact will be direct. The effect these changes have on traded quantities will in turn depend on the extent to which food imports respond to price or are guided by other considerations.

A comprehensive understanding of factors that influence trading patterns requires extensive and in-depth study of individual countries, especially the policies that affect the linkage between their domestic economy and the international market. Short of this, an effort is made here to estimate how trading patterns change by empirically deriving net import demand functions that seek to reflect the effects of both traditional and financial variables. As indicated, the overall objective of this research is to generate empirically derived estimates that provide evidence concerning the nature of trading response in selected countries to changes in world price, national income, levels of domestic production and financial variables. We move now to a discussion of the conceptual framework implied by this kind of analysis, followed by a reporting of the empirical results obtained. Finally, an effort is made to interpret these results and discuss their implications for the U.S.

CHAPTER 2

CONCEPTUAL FOUNDATION FOR IMPORT DEMAND ANALYSIS

In developing the conceptual foundation for the estimation of net import demand, studies with three major directions are relevant. First, there are those studies which concentrate on the macro environment within which agriculture exists. Much of the recent literature in this area has focused on the relationship between agriculture and the exchange rate but other relationships are discussed. The role of agriculture in the balance of payments and the level of indebtedness, particularly in some LDCs, have also been considered. Second, there has been and continues to be considerable attention given to the structure of international markets and to the extent of imperfections in those markets. Treatment of government involvement in these markets has typically focused on state trading institutions or government management via market regulation. A third group of studies has been concerned with income and/or price elasticity estimates in international trade. Disagreement exists about the range considered appropriate for import price elasticities of demand. As might be expected, these three directions of the trade literature are not mutually exclusive. However, each provides useful background to the model used in this research.

MACROECONOMIC LINKAGES WITH AGRICULTURAL TRADE

The Exchange Rate

In 1974, Schuh (1974) contended that in many analyses attempting to explain the imperfectly competitive structure of world commodity markets, "a very important variable has been left out in the conception of the problem...the exchange rate" (p. 1). Previous to Schuh's attestation, the problem had been interpreted as hinging on domestic pricing policies, to which was added the effect of barriers to trade (for example, Schultz, 1945 and Johnson, 1973).

Schuh's ex post analysis of post World War II developments in agricultural trade identifies the value of the U.S. dollar as having a key role. For instance he identifies the overvaluation of the U.S. dollar, occurring around the time of the Korean War, as stimulating a policy response in the U.S. and leading to grains stock accumulation. Although he recognized the need to specify previously-identified forces on agricultural trade, such as how the development process affects the sectoral position of agriculture or the existence of barriers to trade, he pointed out that the exchange rate had thus far

been a neglected variable in agricultural economic literature.

More recently, however, attention has shifted from the structural impact of the exchange rate on agriculture to its relevance in explaining the variability of trade. This shift in orientation no doubt reflects in part the changing climate of international agricultural trade over the 1970s and in particular the move to flexible exchange rates between 1971 and 1973. Arguments have tended to focus on the relationship between the exchange rate and elasticities of demand and supply.

A pair of studies in 1976--one theoretical, the other empirical--examined the impact of exchange rates change on prices and quantities traded within a free trade environment. In his theoretical analysis, Kost (1976) contends that a change in an exporter's exchange rate alters the perceived supply and demand functions in the importing country, thus shifting import demand in the trade sector. Similarly, a change in an importer's exchange rate alters the excess supply function of the exporter. In this analysis, the impact of changes in the exchange rate depends solely on the magnitude of the exchange rate change and the elasticities of excess demand and supply. Assuming that these functions, derived from inelastic domestic functions, are themselves inelastic, Kost concludes that the impact of exchange rate changes on trade is small and "what effect there is will be primarily on price rather than quantity" (p. 104).

Villiantites-Fidas (1976) tests Kost's theoretical implications using both cross-section and time-series regression analyses. The cross-sectional study examined changes in U.S. trade in wheat, corn and soybeans during the two devaluation periods in 1971 and 1973. These exchange rate changes did not appear statistically significant in explaining either price or quantity changes for any of the commodities examined. The time-series study spanned trade among 20 countries over the 1960s, with similar results. Explanation for this nonsignificant relationship rested on the inelastic nature of excess supply and demand, although in the cross-sectional study, the price-insulating policies of the European Community were noted also.

Bredahl and Gallagher (1977) challenge Kost's assumption about the inelastic nature of excess supply and demand. Even if domestic relationships are inelastic, they argue, theory shows that the elasticity of excess relationships is the sum of domestic supply and demand elasticity and therefore may be greater than one. This study concludes that, although the size of the price effect may be confined to that of the exchange rate change, the quantity effect may be more if either of the excess relationships is elastic.

Subsequent studies on the impact of exchange rates on agriculture typically recognize that a perfectly competitive market does not obtain. This observation changed the focus of argument from the elasticity relationship between domestic and excess functions to how and by how much exchange rate changes are transmitted. To analyze

these questions, some level of demand and supply elasticities are typically assumed.

Johnson, Grennes and Thursby (1979) employ a differentiated goods model to examine U.S. wheat trade during the 1972-74 period, incorporating policy changes in major exporting countries. They note that devaluation by the United States was not the only economic variable whose fluctuation influenced trade during the period reviewed. Also during this period, the European Community and Japan lowered their tariff levels, Canada and Australia restricted exports by selling wheat domestically at lower-than-world prices, and costs of shipping U.S. wheat increased. Johnson, Grennes and Thursby develop a model which incorporates these policy changes and allows for goods to be differentiated with respect to place of origin. Their results show that dollar devaluation did contribute to an increase in wheat prices in 1972 and 1974 but they caution that while "the monetary effect should not be ignored...neither should it be exaggerated" (p. 624).

Bredahl, Meyers and Collins (1979) hold that domestic agricultural policies which insulate domestic prices from world price changes lower the price transmission elasticity (the response of one country's price to a change in another's price). Measures of this effect on export demand elasticities are provided. Bredahl, Meyers and Collins note that the price transmission elasticity will normally be between zero and one--equal to one with free trade conditions prevailing and zero with complete isolation.

In a later article, Collins, Meyers and Bredahl (1980) include the differential impacts of inflation in an analysis of exchange rate effects under both fixed and flexible exchange rate assumptions. They conclude that "as the pervasiveness of nominal-price insulation policies increases, the impact of exchange rate changes on U.S. export demand and real commodity prices increases significantly" (p. 664).

Chambers and Just (1979) break from tradition in their treatment of the role of exchange rates in the agricultural sector. Their concern revolves around a perception that "the most common specification (of the exchange rate) in empirical work is overly restrictive" (p. 255) in that it forces all adjustments to exchange rate changes onto the price variable. Thus the price response is typically assumed to lie between zero and one. Chambers and Just say that this imposes an implicitly false assumption that cross-price elasticities are equal to zero. They contend that an exchange rate change can cause changes in all other prices and suggest the inclusion of the exchange rate in agricultural trade models to account for this effect.

Given non-zero cross-price elasticities, a change in the exchange rate can shift both demand and supply of a commodity, and these shifts can result in price or quantity changes which are larger than the original exchange rate fluctuation. This contrasts with Collins, Meyers and Bredahl's conclusion that exchange rates equilibrate changes in relative inflation rates. Under flexible exchange rates, Collins, et al., say inflation will change nominal commodity prices, leaving demand and supply unchanged; while under fixed exchange rates, inflation will change supply and demand but not nominal prices. Chambers and Just conclude that trade elasticity estimates which limit exchange rate impacts on prices to the zero-one range may be biased downward.

Using what is essentially a macroeconomic model, Chambers and Just (1981) measure the impacts of exchange rate changes on both domestic and foreign sectors of the U.S. agriculture. Both the short and long runs are examined for wheat, corn and soybeans. Results showed that domestic disappearance and inventories declined with a devaluation while exports and prices increased. Short run elasticities with respect to exchange rate changes were found to be higher than long run elasticities. Soybeans were more price-responsive, while wheat and corn were more quantity responsive.

Reed (1980) comments that the solution offered by Chambers and Just of employing the exchange rate as a separate variable to capture cross-price effects is theoretically inappropriate. Since "the exchange rate, in and of itself, is only relevant to excess demand functions as a domestic deflator" (p. 253), Reed suggests that actual prices of relevant substitutes and complements be used. However, this begs the question of whether such prices are available for incorporation into trade analyses.

Gardner (1981) points to an inconsistent use of theory in incorporating the exchange rate in agricultural trade models. When looked at in the Marshallian sense, exchange rate influences enter via the standard exogenous determinants of demand and supply. Essentially this is Reed's view. However, when using Keynesian analysis, nonstandard variables such as the exchange rate and recessions/inflation can be included separately.

In Gardner's econometric analysis, dependent variables such as farm prices received, real net farm income and real farm land prices are regressed on macro variables which include recession, inflation, productivity, nonfarm wages, and the exchange rate. Where exchange rate is included, it typically is the most significant explanatory variable for the data period 1956-78. Gardner suggests that before this period, recessions had a major influence on the agricultural economy.

McCalla (1982) examines linkages between instability and international monetary variables. Macro variables have a variety of effects - the exchange rate affects price, interest rates affect supply, recession affects demand through income, and there is also a

portfolio effect. McCalla finds that "demand impacts (from inflation and recession) through income may be as large or larger than price impacts that come about through exchange rate changes" (p. 866).

Starleaf (1982) tests the hypothesis that exchange rate changes affect farm prices. Farm product prices are regressed on changes in the exchange rate (as measured by a trade-weighted market basket of foreign currencies) and changes in domestic farm and nonfarm output. As expected, results show a significant negative relationship between exchange rate changes and farm product prices.

A study by Longmire and Morey (1982) addresses dollar appreciation rather than depreciation, since the dollar had in fact appreciated by the early 1980s. A succinct summary of the still-open questions about the exchange rate effect on trade is provided (p. 3-4): (1) whether the impact of exchange rate changes on price should be confined to the range 0-1, (2) whether and by how much the price transmission elasticity is less than one, and (3) what effect cross-price effects have.

Adopting domestic price elasticity estimates from previous studies, Longmire and Morey use the inflation-adjusted exchange rate as the key variable.[3] Thus it is accepted that inflation is dependent on factors other than the exchange rate, such as real shifts in supply and demand, unanticipated policy shifts and short-term capital movements, and rigidities in labor and goods markets. The approach used by Longmire and Morey makes explicit assumptions with respect to inflation but modifies these to allow for (1) cross-price effects between commodities, (2) alternative assumptions with respect to expectations, and (3) different stockholding behavior.

Estimates of the exchange rate effect are calculated under assumptions of both perfect nominal price transmission and less-than-perfect transmission, though Longmire and Morey agree with previous authors that the latter is more realistic given the degree of domestic protection. They find that both price-insulation domestic policies and stockholding programs reduce the impact of exchange rate changes on U.S. agriculture. However, they concur with Chambers and Just that the direction and magnitude of change in exports and prices resulting from an exchange rate shift cannot be predicted a-priori.

Several general equilibrium models have been proposed to examine various aspects of the macroeconomic environment, in particular the exchange rate. Shei (1978) found that in a general equilibrium framework, the estimated impact of exchange rate changes

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[3] In this they follow the procedure used by Collins, Meyers and Bredahl (1980).

are somewhat less than that found in partial equilibrium approaches (pp. 110-111). Orden (1983) presents a general equilibrium model which he expects will show a modification of exchange rate impacts (p. 4) but does not test it empirically. Finally, Chambers (1984) develops a theoretical model which "provides rigorous justification for Schuh's assertion" (p. 18) that exchange rate changes cause disequilibrium in agriculture.

Thus, the arguments surrounding the role of exchange rates in agriculture have come full circle to again focus, through the use of general equilibrium models, on structural impacts. One outcome of this review is clear: there is still no agreement on what impact exchange rate changes have on agriculture. Another is that such effects are hard to measure, depending critically on underlying assumptions. In particular, one assumption that appears critical to measurement of the exchange rate effect is the adherence to domestic demand and supply elasticities as determining trade elasticities. The validity of this assumption is examined in a later section.

Balance of Payments Issues

With the shocks imposed during the 1970s on the international financial system by the Organization of Petroleum Exporting Countries and associated recessions in both the industrialized and the developing world, the role of debt in trade has received some attention. Focus has been given to the debt positions of LDCs and how this debt will affect their ability to import. The relationship between agricultural trade and balance of payments also has received some attention.

The sharp growth in oil imports in the mid-1970s, coupled with world recession, contributed to the deterioration of the U.S. trade balance as well as that of many other industrialized countries (Bergsten, 1980, p. 115). However, at least part of this overall deterioration was mitigated by a positive balance of agricultural trade (World Food Institute, 1983, p. 37). It was not always the case that agriculture contributed to the U.S. trade balance. For example, in the early 1960s the net contribution of agriculture to the U.S. balance of payments was negative (Christensen and Goolsby, 1973, p. 133).

The debt problems of some LDCs are very serious. In a study covering trends in the external debt of developing countries from the mid-1950s to mid-1970s, Smith (1979) documents the increased debt and associated debt servicing requirements of non-oil LDCs. From 1960 to 1973, total debt increased 5.4 times to almost 120 billion dollars. Smith expresses "tentative optimism" in that inflation and traditional rescheduling of debts have provided some relief. However, he suggests that employment of other mechanisms may be necessary to ward off serious contingencies.

Huddleston (1984) also seems to share some optimism about the ability of LDCs to pay for agricultural imports. She compares the total cost of cereal imports to export earnings between the periods 1961-63 and 1976-78. It appears that this ratio has declined in most LDCs. Exceptions are countries in Latin America and North Africa/Middle East. When food aid is taken into consideration, the value of total cereal imports to export earnings increased in Latin America over the time period studied.

A USDA study (1984) links the current weakening of the U.S. position in trade first to "the incapacity of major LDC importers to buy" (p. 14). Other factors are the appreciation of the dollar and U.S. farm programs. This study discusses both financial system linkages between countries and also how these relate to current and future U.S. policy. It is remarked that "in today's environment, the majority of LDCs are facing a large debt overhang, a significant reduction in new credit availability, stringent economic austerity" (p. 5). Part of the response to this situation, being encouraged if not imposed by the International Monetary Fund, is a reduction of imports by these countries while exports are fostered.

MARKET IMPERFECTIONS

Literature on imperfect markets in agricultural trade is almost as extensive as that on exchange rate effects and often overlap.[4] As noted above, Schultz (1945) pointed out that a deterrent to U.S. trade was the essentially protective domestic pricing policies in effect at that time. Recent studies which attempt to measure the effects of government interference on agricultural trade is typified in two ways: (1) from the point of view of deviations from a desired norm of 'perfect' markets and (2) from the point of view of different national goals and constraints. No consideration is given here to either the effects of various international commodity agreements, or to that describing direct government control[5] of markets.

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[4]See, for example, studies measuring the price transmission mechanism.

[5]A comprehensive review of state trading can be found in Kostecki, ed. (1982). The effect of a grain cartel is given by Schmitz, McCalla, Mitchell and Carter (1981). See also the market share studies of McCalla (1966) and Alaouse, Watson and Sturgess (1978).

Imperfections as Deviation from a Desired Norm

In 1977, Shei and Thompson studied the effect of trade restrictions on world wheat price stability over the 1972-73 period. They draw attention to the price stabilizing effects of free agricultural trade. A quadratric programming model is used to examine trade flows and prices. Price elasticities are generated by combining a given domestic elasticity and the ratio of total quantities demanded to quantities imported. Data are applied to three scenarios, each with a different level of trade restrictions. Their results demonstrate greater world price variability as domestic price restrictions apply. Naturally the magnitude of shock effect is very sensitive to price elasticity assumptions.

A study by Firch (1977) examines the sources of U.S. farm market receipts over the period 1920-1975. It is concluded that U.S. domestic price policies "effectively buffered the variance of market receipts from the instability of foreign demand and largely explain the relatively low variance of market receipt in these periods (1946-55 and 1956-65)."

In Firch's study, the business cycle appears to be most highly associated with variability over most of the period, with exchange rate changes being highly associated with market receipt variability in the period 1966-75. Looking at receipts for specific commodities (cotton, wheat, corn and soybeans), Firch finds that "inventory changes buffered variance that would otherwise have arisen from changes in production" (p. 167) since 1945. However, he is not arguing for a government stock program, feeling that "any commodity reserve program that is intended to stabilize farm income will likely neutralize a substantial amount of free-market stabilizing capacity before it achieves any net stabilization of income (p. 168).

Bale and Lutz offer further argument against the presence of trade restrictions. Their first theoretical paper (1979) examines how different types of government market intervention generate different levels of instability as compared with the free trade case. For example, quotas are more destabilizing to world price than are tariffs.

Their second paper (1980) measures welfare effects of market intervention in nine countries (including both industrialized and developing) for several agricultural commodities in 1976. A partial equilibrium comparative statics model is used, and assumptions are made with respect to direct price elasticities. Cross-price elasticities are assumed to be zero. Their results show that producers in developed countries benefit from government price intervention while those in developing countries are taxed. The impact on consumers in these two areas is the reverse. Governments in all but one country (France) gain revenue. These results are apparently "stable with respect to elasticity assumptions" (p. 19).

Conflicting National Priorities

Josling (1980) provides a thorough study of the effects of domestic policies on world wheat trade. Consumer and produces subsidies/taxes are measured for five developed countries plus the European Community, and their impact on developing countries is discussed. A major conclusion of this study is that price and stock policies in developed countries often work together to increase supply variability on international markets. Although this outcome is not likely the intention of such policies, it exacerbates grain availability problems experienced in developing countries.

In two papers, Abbott (1979a and b) presents a model which makes the government decision-making process either explicitly or implicitly endogenous. Abbott states that "the assumption that free market behavior is sufficient to find the response of a country's net import demand to changes in international prices may no longer be valid" (1979a, p. 23). In these studies, Abbott estimates net import demand.

Abbott's model incorporates three variables affected by policy: the producer price, the consumer price and stocks. Using data which cover the period 1951 to 1973, his econometric results indicate that "domestic prices and net imports are unrelated to border prices in many countries" (1979a, p. 29). Moreover, exporters appear to adjust stocks in response to market conditions. The former finding makes the net import demand function less elastic; the latter makes the net export supply function more elastic.

In a study appearing about the same time as that of Abbott, Zwart and Meilke (1979) modelled government price policy and buffer stock policy as instruments affecting price stability. They simulate market outcomes over the period 1967/77 to 1990 for major wheat exporters and importers. They find that domestic price policies blunt the relationship between domestic prices and world price, increasing price instability. Stock policies typically add stability, though at some holding cost. The stability generated through stockholding is subject to current specification of the storage rule.

A study by Paarlberg and Thompson (1980) points to the partial equilibrium nature of previous national policy research as it affects trade. They show that unless cross-price effects between commodities are taken into account, estimated effects of policies may be biased. Empirical application of their theory reveals how critical are assumptions with respect to own- and cross-price elasticities. Analysis of an initial situation where cross-price elasticities are assumed to be low relative to own-price elasticity shows little difference from a single-commodity approach. However, where the assumed relative size of these elasticities is switched, the price response to policies is much more significant.

Schwartz and Blandford (1981) place less emphasis on the destabilizing effect of domestic policies on trade than on production variability particularly of those policies of developed countries. They note that increased trade with developing and centrally planned countries has altered market structure. Regions with higher production variability have entered international markets and certain regions with more stable output have left.

ELASTICITIES

The concept of elasticity is fundamental to much economic analysis. Early international trade studies examining price and income responses largely focused on trade in non-agricultural sectors of the economy.[6] Those elasticity estimates provided for traded agricultural commodities typically have been tied to neoclassical trade theory. Following this theory, empirical estimates of domestic demand and supply elasticities are used to generate estimates of the responsiveness of excess relationships. More recently, other factors such as the exchange rate and domestic protection policies have been cited as affecting trade elasticities. The outcome has been a reinterpretation of the relationship between trade and its determinants, with more focus given to direct estimation of demand.

Early Elasticity Estimates

Tweeten (1967) provides some of the earliest estimates of trade elasticities in agriculture, along with elasticity estimates for domestic U.S. demand. The price transmission mechanism is assumed by Tweeten to equal one in the long run. The calculation yields an estimated excess demand elasticity of -15.85, which Tweeten then scales down by considering factors such as foreign supply elasticity, aid and tariff barriers to arrive at a U.S. export demand elasticity of -6.42.

Tweeten points out that his elasticity estimate pertains to U.S. exports alone. World demand elasticity for grains would be smaller by the proportion of U.S. exports to world production.

Houthakker and Magee (1969) estimate elasticities of U.S. exports by commodity class. They estimate a double logarithmic equation which regresses agricultural and nonagricultural exports on first differences of income and price. World income elasticity

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[6] See reviews by Cheng (1960), Prais (1962) and Stern, Francis and Schumacher (1976).

for total agricultural exports is estimated at 1.02 and price at -.96. When sector data are broken into commodity classes, the income elasticity for crude foods is .97; no price elasticity is given for this commodity class. In all cases, the significance of income is greater than that of price.

Johnson (1977) takes issue with Tweeten's procedure for arriving at import demand elasticities for U.S. products, though not with the estimate itself. He interprets Tweeten as not taking into account the share of U.S. exports in total exports. Johnson suggests that rather than looking for an aggregate elasticity over commodities within each country and then summing, as he says Tweeten does, it is preferable to estimate elasticities for individual commodities and then weigh these by level of market participation to arrive at an aggregate demand elasticity. In a reply, Tweeten (1977) correctly points out that his procedure also uses weights, though at an earlier stage, thus obviating Johnson's criticism.

In an informative but little-quoted study by Coffin (1970), net import demand for wheat is estimated directly for the period 1959-66. Both industrial and less developed countries are examined. The method to obtain price and income elasticity estimates involves, first, estimating a model in which all parameters of the exogeneous variables are assumed to be constant. Then the model is reestimated, employing different combinations of dummy variables to account for variation between countries (measured by changes in the intercept term and in the slopes of price and income parameters). Net import demand elasticity estimates obtained by Coffin for individual countries will be discussed later. However, overall results place the price elasticity for wheat import demand between -0.21 and -0.87 (p. 89).

Results of a study by Rojko, Urban and Naive (1971) have often formed the basis of import elasticities estimates employed in subsequent research (e.g., Shei and Thompson, 1977; Bale and Lutz, 1981) Rojko et al. estimated domestic demand and supply elasticities for major countries for wheat, coarse grains and rice using multiple regression techniques. The change in preferences for different grains throughout the development process is pointed out. Although their focus is on domestic elasticities, a world elasticity of demand is inferred from the price flexibility of major grain exporters of close to unity for wheat and somewhat higher for coarse grains.

Recent Import Demand Elasticity Estimates

Returning to Abbott (1979), his analysis presumes there are forces in the international market, apart from domestic market conditions, which affect the response of import demand to changes in world price. Abbott estimates consumption elasticities

(the change in trade given a change in import price, calculated at a mean consumption level) which for developing countries are typically lower than the domestic demand price elasticities for both wheat and feed grains. For exporters, his calculated elasticities are typically higher than those which are suggested by looking only at domestic supply and demand responses.

Zwart and Meilke (1979) use assumptions similar to those of Abbott but rather than staying with the net import demand function, they simulate derived domestic demand elasticities. Their estimates of derived demand price elasticities are significantly lower than those reached by Rojko, et al.

Bredahl, Meyers and Collins (1979) accept Tweeten's formula for estimating excess demand elasticity[7] but do not assume unity for price transmission. Using given domestic elasticity estimates and implied values for the price transmission elasticity (where zero represents complete price insulation and one represents free trade), they modify Tweeten's excess demand elasticity estimates. Estimates of export demand elasticities for U.S. grain are provided for major regions of the world. Their estimates are typically greater than one for both wheat and corn. Their estimates for wheat range between -.4 (Japan) and -6.78 (USSR) and those for corn between -.39 (Japan) and -9.02 (Eastern European).

Jabara (1982) uses Abbott's procedure for estimating a reduced form net import demand equation for wheat. Pooled time-series and cross-sectional data for a group of LDCs over the period 1976-79 are used. Two subgroups are compared: countries producing wheat and those that do not. Her import demand elasticity estimates are lower than those of Bredahl, Meyers and Collins. Price elasticity is higher and more significant in nonwheat producing countries (-.18) than in those producing their own wheat (-0.07).

In all these studies, the importance of elasticities in international trade is recognized. Yet major methodological and empirical differences exist. Richardson (1976) pointed to two views of the international trade environment. One takes a "monetarist" approach, which carries with it the assumption that a domestic good is a perfect substitute for a foreign good. Another fundamentally different approach assumes imperfect substitutability between foreign and domestic commodities. The first implies that foreign and domestic prices must equate, at least in the long run; the second implies

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[7] The theoretical definition of excess demand or supply elasticities is the sum of domestic demand and supply elasticities.

that real factors may exist which prevent these prices from equating. Such factors affect not only assumptions with respect to the price transmission elasticity, but also expectations about demand and supply elasticities. The two approaches can lead to different questions about relationships in international trade and to different ways of modelling these relations. Different ways of treating exchange rate or elasticities issues in international trade seem to reflect one or the other of these approaches. No conclusive test has been provided to choose between them.

In this study it is assumed that real forces exist which keep domestic and foreign goods from being perfect substitutes. These forces include different roles for the agricultural sector in different countries, and different goals nations have for the growth and development of their economies. These are implicit in the model described in the next chapter.

CHAPTER 3

A STRUCTURAL MODEL FOR INTERNATIONAL TRADE

Traditional theory of international trade omits the impact of government intervention. Market participants are assumed to act independently in a perfectly competitive market. Moreover, attention is usually focused on traditional economic variables to the exclusion of some of the influences on demand which more recently have gained importance. In this paper, direct estimation of import demand is used as a way to incorporate implicitly into a market framework some of the influences brought about by the interaction of government and the market, within the macroeconomic environment.

THE CONCEPTUAL FRAMEWORK

From a theoretical standpoint, the economic arguments for trade lie in the theory of comparative advantage. Under the assumptions of perfect competition, flexible prices and full employment, trade enables efficient use of each country's resources and maximizes each country's preference structure.

Under these assumptions domestic demand and supply functions give rise to excess demand and supply functions. Domestic prices in countries trading with each other tend toward equalization through trade. Equilibrium occurs through the interaction of individual countries' excess supply and demand functions, at which point related exports, imports and prices in each country are determined. Figure 2 depicts this interaction.[8]

In reality this does not occur. Prices in different countries are observed to diverge from those anticipated by the theory. This observation has led to use of either an imperfect-substitutes model or an imperfect markets model in trade analyses (Richardson, 1976). In the former, the domestic good and the foreign good are treated as separate entities, allowing for differentiated prices in each market. Analogously, using the imperfect markets framework, imperfections such as tariffs, quotas and other forms of protection, explain the persistence of price differences.

The problem in applying the theory of comparative advantage to real world situations, thus, is related to the unattainable nature of its assumptions (Robinson, 1964, p. 64). Hence, a substantial gap exists between the theory of international trade, on the one hand, and empirical analysis on the other. It is in recognition of this gap that

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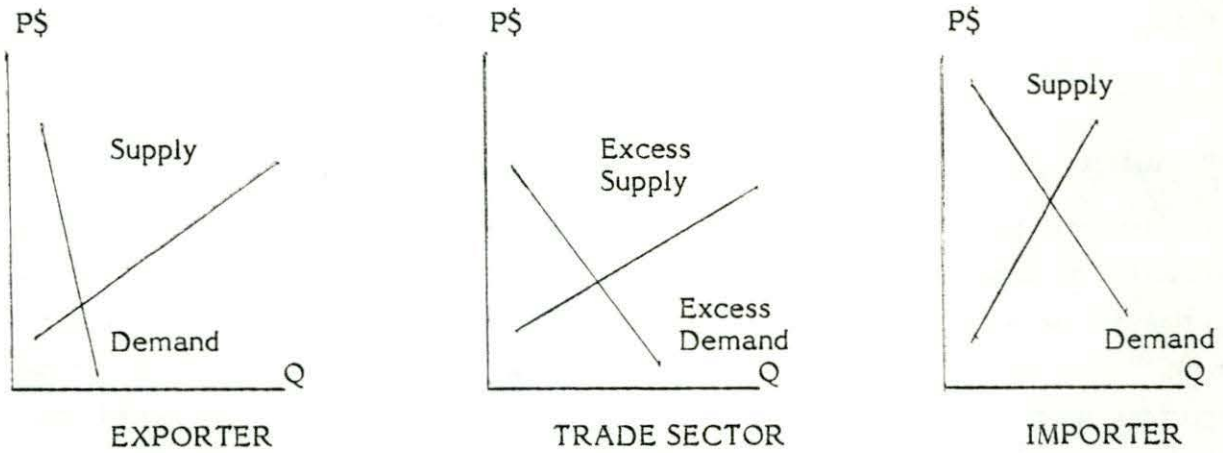
[8]For a similar presentation see Kost (1967, p. 100).

Figure 2

TRADE UNDER PERFECT COMPETITION



attention is given to how trading countries actually respond to their economic environment rather than on how they would respond given assumptions with respect to domestic demand and supply relationships. In terms of Figure 2, the subject of investigation here is the net import demand function (excess demand) in the trade sector for wheat and coarse grains.

To examine structural characteristics of trading patterns, the net import demand relation is estimated directly. Public intervention by governments acting on behalf of their domestic interests often means that the effect of world prices and production on trade is less than that suggested by domestic demand and supply relations. It is assumed that government policy can alter trade patterns by influencing parameters of domestic demand and supply. Further, what is traded may be strongly influenced by changes in the monetary environment in which trade takes place. For instance, factors such as exchange rates and debt relationships usually are not specified in the standard demand/supply model.

Interdependence has increased between what geographically and politically form independent countries. Aspects of growing interdependence are witnessed, for example, by increasing volumes of trade internationally, which spread weather-induced supply uncertainty further afield. There are closer monetary ties between countries, adding a dimension to the need for greater internationally coordinated efforts. Along with increased interdependence has come a growing awareness within individual countries of the impact of trade-induced instability on the well-being of their own domestic economies. Public choice decisions intended to minimize the negative effects of such

instability domestically can magnify instability for others, leading to a further round of policy responses. Choices having such an effect include not only the setting of goals with respect to a desired level of protection and degree of self-sufficiency, but also includes the degree of regulation of domestic prices and/or stocks. Seen in this light, actions taken within countries will often create conflict at the international level.

THE MODEL

The conceptual model is intended to highlight the importance of the changing structure and environment of international grain trade. The proposed behavioral relationships seek to reflect this focus. There are aspects of grain trade that will be ignored for reasons of simplicity, even though there is evidence that they may be important in some types of analysis. For instance, differences among qualities of grain are not considered.[9] For present purposes, wheat and coarse grains are each viewed as homogeneous products. Also, transportation costs are not explicitly considered in this analysis.

The model is intended to identify characteristics of net import demand which may be important within various economic, political and societal environments. It builds on the neoclassical supply/demand equilibrium model and, following a model developed by Abbott (1976), incorporates an explicit price relationship between the world price and domestic prices, which allows for adjustment in policy (Chambers and Just, 1979). Other variables are added to consumption and production relationships which take into account the growing interdependency among trading nations. These include effects of exchange rates and rates of inflation, aid and foreign exchange availability. A domestic stockholding relationship is specified which takes into account both individual and government participation.

Price Relationships

Domestic prices for traded goods may bear some resemblance to international prices, or they may be independent of world prices. The relationship of domestic prices and world prices is assumed to depend upon price linkages such as the exchange rate and/or relative inflation rates, but also upon the degree of government-induced intervention in the domestic economy. The role of government policy is crucial to theoretical expectations with respect to price elasticities of net import demand.

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[9]For this kind of analysis see Johnson, Grennes and Thursby (1977; 1979).

Starting with the neoclassical market model and assuming perfect competition and zero transportation costs, domestic price (PD) would be expected to equal world price (PW), ignoring for the moment the exchange rate. Allowing for the imposition of a tariff and/or nonzero transportation costs, domestic price would be expected to be some constant proportion of the world price:

$$PD_{xit} = (1+T)PW_{xt} \qquad (1)$$

where T represents either the tariff or transportation costs or both, and x and i represent, respectively, the specific commodity and the specific country over time t. Without considering the presence of domestic price-insulating policies, changes in domestic prices would be expected to reflect changes in the world price.

Contrary to the above expectation about domestic prices for traded goods, the hypothesis here is that domestic pricing policies may intervene in the relationship between domestic and world prices. Indeed, domestic prices may be completely isolated from world prices. However, it is considered unlikely that in the long run complete isolation between domestic prices and the world price could continue. A more plausible hypothesis is that there may be partial adjustment of domestic pricing policies. Given that such an adjustment takes place due to policies which at least in part insulate domestic prices from changes in the world price, an initial price relationship might be:

$$PD_{xit} = a_0 PD_{xi(t-1)} + dPW_{xt} \qquad (2)$$

where:

PD_{xit} = expected domestic price of commodity x in country i

$PD_{xi(t-1)}$ = actual domestic price of commodity x in country i

PW_{xt} = world price of commodity x

This relationship expresses domestic prices as a function of both the domestic economic environment and the world environment.

Summing over j time periods, domestic price response to world price can be expressed as a function of changes which took place in an earlier period and the current response:

$$PD_{xit} = \sum_{j=0}^{\infty} d\, a^j PW_{(t-j)} \qquad (3)$$

where d shows the immediate adjustment of domestic prices to world price changes and a shows the importance of previous period world price on current domestic prices. If j=0, the lagged response becomes a constant and all that is reflected is the immediate price adjustment of domestic price to changes in world price. The coefficient d, then, is the

short-run response of domestic prices to changes in world price. Where domestic pricing policies do not exist and where domestic prices vary proportionally to the world price, d=1. Where domestic policies completely dominate, d=0. So far the price specification is as formulated by Abbott.

There are other factors, either external or internal to an economy, which can affect the relationship between domestic and world prices. Foreign exchange availability, aid and stocks are relevant in this context.

Where foreign exchange availability is limited, governments may be unwilling or unable to maintain domestic prices at or below the world price. Spending of foreign exchange will depend not only on income earned through export receipts, representing repayment capacity, but also on the existing level of debt in the country under consideration. Further, aid may affect the price relationship by supporting or thwarting the intent of domestic pricing policies, making the latter easier or more difficult to maintain.[10] Such factors as aid and foreign exchange availability are likely to have more of an effect in developing economies than in more industrialized countries. The impact of these factors may change from year to year, or may represent a relatively permanent situation, depending on the country.

National stockholding behavior may also have an effect on the relationship between domestic and world prices. The extent to which a country holds stocks (at the moment ignoring any difference in behavior stemming from private versus public holding of stocks), will be affected by the level of domestic production and also the availability of storage capacity. Thus, stockholding behavior is likely to be more significant for major producers and exporters of grain.

Taking the above factors into consideration, the price relationship suggested here for a given commodity is:

$$PD_{xit} = f(PW)_{xt} + g(FX_{it}, ST_{xit}, AID_{it}) \qquad (4)$$

where:

PD_{xit} and PW_{xt} are as described above;

FX_{it} = a measure of foreign exchange availability;

ST_{xit} = beginning stocks; and

AID_{it} = foreign aid.

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[10]See discussion on aid at end of this chapter.

Similar arguments can be made to derive separate relationships for consumer prices and producer prices vis-a-vis the world price. For purposes here it is assumed that domestic producer and consumer prices respond similarly with respect to changes in the world price as well as in other variables. This treatment differs from that of Abbott, who specified an enclave production sector where domestic production goes directly into on-farm domestic consumption without first moving through the market. Thus Abbott separated the domestic production price from the domestic consumption price. Such enclaves may exist in all countries, including major exporters. It is felt here, however, that the value of using the same specification for all countries, as well as inadequacies in information relating to enclave production, justify the use of a single country price.

Consumption

As a practical matter, as statistical data almost inevitably relate to groups of consumers, it is usual to aggregate demands across individual consumers to derive market demand functions. This in effect assumes that the demands refer to a "representative consumer" such that aggregate demand relations may be obtained directly from the representative consumer demands. Therefore, in conventional fashion, aggregate demand is specified as a function of national income, population, the (endogenous) domestic price, and the aggregate price level of all other goods.

$$D_{xit} = d(I_{it}, POP_{it}, PD_{xit}, Py_{it}) \qquad (5)$$

where:

D_{xit} = aggregate domestic consumption;

I_{it} = gross domestic product, or equivalent;

POP_{it} = population;

Py_{it} = price of other commodities relevant to consumers; and

PD_{xit} as defined above.

In some instances, other factors such as food aid or the exchange rate may be factors in aggregate demand. The former is suggested by Abbott; the latter by Chambers and Just. To the extent that these factors change effective demand, they should enter as separate variables in the domestic consumption function. These variables are discussed separately at the end of this section.

The basic determinants of demand for coarse grains follows a pattern similar to that for food grains. A major difference is that the demand for coarse grains is largely derived from the demand for meat products. The amount of coarse grain demanded is related to the number and type of animals fed in a region.

Supply

Total aggregate supply of the commodity in question, without trade, is the sum of production and stocks.

$$S_{xit} = PRO_{xit} + ST_{xit} \qquad (6)$$

Specifically, stock levels at the beginning of every time period (one year) plus production during that year make up domestic aggregate supply.

Production

Planned grain production is a function of the expected price of the commodity under consideration, prices of inputs, acreage and other fixed inputs devoted to grain production, and the level of technology. Actual production is the result of these factors, plus exogenous conditions such as weather.

The Nerlovian adaptive expectations specification of profit maximization assumes that production responds to lagged rather than current prices and that only partial adjustment takes place between planned production and expected prices. This specification implies that last year's price is a reasonable proxy for the expected price operative when planting decisions are made. It seems appropriate for grains where there is likely to be a large degree of continuity in production from year to year.

Fertilizer availability and use may be cited as an example of an input to production which is a function both of technology and government policy. Even in industrial countries, fertilizer use can be subject to regulation. In many developing countries, fertilizer procurement and distribution, as well as for other inputs, is a matter of direct government involvement in markets (World Bank Report, 1981).

A specification of a national aggregate production function for a specific commodity parallels the individual production relationship, where exogenous variables related to the national economy.

$$PRO_{xit} = g(Pd_{xit}, Pn_{it}, ACR_{xit}, T_{it}, W_{it}) \qquad (7)$$

where:

PRO_{xit} = planned quantity produced;

Pd_{xit} = domestic price for the commodity under study;

Pn_{xit} = domestic price of inputs;

ACR_{it} = acres planted;

T_{it} = time trend/technology; and

W_{it} = weather.

Stocks

Grains are produced seasonally but consumed throughout the year. It is necessary, therefore, for some grain stocks to be held, whether by producers, consumers, private interest, or government.

Several motives for holding stocks can be identified (Eaton, 1980, p. 6). Grains are to a degree storable but their seasonal production is susceptible to factors beyond the control of even the best planning. Buffer stocks may be held to satisfy a demand for food security, as well as for speculative purposes. Pipeline stocks (or those needed for day-to-day activities throughout the year) provide intra-year stabilization, while buffer stocks (those stocks held as carryover between years) provide inter-year stabilization. To these two domestic demands for stocks, can be added food aid reserves and emergency reserves.

Stocks are held at a cost to the stockholder. The most direct opportunity cost of withholding grain from the market is the price at which output may be sold.

$$ST_{xit} = h(Pd_{xit}) \qquad (8)$$

Pd_{xit}represents the private opportunity cost of holding stocks. voluntary private stockholding (by producers, consumers or business) will depend on the expected price of grain, as well as on the current level of stocks relative to working-stocks (pipeline) demand.

Government stockholding behavior is also expected to be sensitive to price, not only through the concept of opportunity cost but also through the motive of influencing producer and/or consumer prices. It is also possible that governments may enter directly into stockholding activities, for example for food security reasons, as well as indirectly through manipulation of consumer and/or producer prices. Although the relationship between price and government-held stocks is expected to be negative, the levels of desired price maintenance may involve lags in this response. Further discussion on this point is presented later.

Net Import Demand

The basic economic relationship to be modelled in this study is derived from the identity that domestic consumption (C) plus exports (X) (or total domestic demand) is equal to domestic production (S) plus imports (M) (or total domestic supply). It is from this relationship that the international component of domestic demand is obtained.

$$C+X = S+M \tag{9}$$

From this identity, net imports (NM) (imports net of exports) are defined as:

$$NM = M-X = C-S \tag{10}$$

Ex post, net imports represent the difference between domestic consumption and production (including change in stocks).

OTHER FACTORS IN NET IMPORT DEMAND

Food Aid

In some studies, food aid has been taken into account as a separate variable in trade analyses. For example, Abbott (1976, 1979) includes food aid in his net import equation. Abbott notes, however, that aid should not be treated simply as an addition to imports since some aid may substitute for commercial imports. A study of the effects of food aid on the Colombian economy (Grisby, 1983) concluded that aid affects domestic price more than domestic consumption. A recent IFPRI study (Huddleston, 1984, p. 44) points out that growth in cereal imports among less developed countries has increased fastest in those areas where the importance of food aid has fallen. Such evidence indicates that the demand creation component of aid may be significant, at least for some countries.

The Exchange Rate

As concluded earlier, the precise role of exchange rate changes on current net imports has yet to be resolved. However, two exchange rate effects have been identified. These are the short-run relative-price effect between countries and the long-run income effect within a country. The latter operates through changes in imports and exports (expenditures and revenues) which arise from changes in the exchange rate.[11]

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[11] As a currency's relative value deteriorates, a larger amount of what it exports can be purchased for the same amount of foreign currency. Conversely, its imports become more expensive. As domestic production increases in response to these changes in demand, theoretically, domestic income will increase.

A theoretical argument for another short-run effect of the exchange rate on domestic consumption and production has been suggested by Chambers and Just (1979). The exchange rate is postulated to be a proxy for a price index for all other traded goods. In this argument, the relative price effect refers not to prices between countries for the same good but prices within a country between tradable and nontradable goods. When a change in the exchange rate makes imports more expensive for a country, there may be goods within the country that can substitute for the now more expensive traded good. Similarly, an exchange rate variable is suggested to capture choices of producers between substitute crops. Changes in the exchange rate are thus used to capture cross-price effects.

Differences of opinion over the exchange rate specification appear to arise out of differences in accepted theory. Where the ceteris paribus assumption is made that, given a price change of one good, all other relative prices are held constant, the only short-run effect of a change in exchange rates is on the price of the particular commodity. This assumption may be too restrictive, even in partial equilibrium analyses. Exchange rate changes do change all relative prices and, importantly, thus change the relative ranking of products under comparative advantage theory. Somehow these changes should be taken into account in determining the impact of exchange rate changes on the demand for a commodity.

The position taken in this study is that it is worthwhile to test the ceteris paribus assumption implicit in trade demand theory that relative prices do not change. A means of doing this is to include the exchange rate as a separate variable in the net import demand function. It can be expected that where relative ranking has indeed changed as a result of exchange rate changes, there will be a noticeable effect on net imports.

Foreign Exchange Availability

Foreign exchange availability has been treated by Abbott as having an impact on price, consumption and production. It also has been used in place of income to represent the level of economic activity in LDCs.[12] As noted earlier, the growing foreign debt of many LDCs has been related to their ability to import or to continue to import at historical levels. In this study, the level of foreign exchange reserves is included as a variable to test whether it has an independent impact on net imports.

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[12]This has been suggested by Leamer and Stern (1970) and empirically tested by Jabara (1982).

CHAPTER 4

ESTIMATION OF NET IMPORT DEMAND

The purpose of estimating a net import demand equation for grains is to examine how its determinates behave under various economic and policy conditions. Also of interest is whether inclusion of international financial variables add significantly to the explanation of import demand. The structural equations provide a conceptual base for the construction of a single net import demand equation. This reduced form equation forms the basis for estimating net import demand.[13]

In this chapter, estimates of net import demand are presented for sample countries representative of world trade in wheat and coarse grains, excluding centrally planned economies. Although these excluded countries are important components of world grain trade, data necessary for the testing of hypotheses with respect to financial variables were not available.

THE ESTIMATING EQUATION

A generalized reduced form equation of the demand for net imports of wheat and of coarse grains expresses net imports as a function of independent variables relating to the structural framework. The reduced form equation in this study is specified as:

$$NI_{xit} = a_{0xi} + a_{1xi} P_{xit} + a_{2xi} I_{it} + a_{3xi} PRO_{xit} + a_{4xi} ST_{xit} + a_{5i} FX_{it} + a_{6i} XR_{it} + u_{xit} \qquad (11)$$

where:

NI	=	net imports (imports less exports);
P	=	a border price estimate of world price;
I	=	gross domestic product;
PRO	=	annual level of production;
ST	=	annual beginning stocks;
FX	=	foreign exchange availability;
XR	=	domestic exchange rate relative to the U.S. dollar;
u	=	the error term; and subscripts:
x		refers to an individual commodity group;
i		refers to an individual country; and
t		refers to the time period t=1,2,...T.

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[13]Construction of a reduced form net import demand equation follows that presented by Leamer and Stern (1970) and Richardson (1976).

To determine the influence of treating financial variables independently, two equations per country are estimated. One includes all variables in equation (1) and the other omits foreign exchange availability and the exchange rate.

A linear functional form is used, largely for pragmatic purposes. Although a non-linear form is likely to fit the net import relationship of some countries better than others, it is desirable for the purposes of comparison that the functional form be consistent across countries studied. The period from 1960-81 is used in estimation of net import demand. Annual data are used throughout the study.

A distinction can be made between the long-run and the short-run. In the short-run, it is assumed that habits in consumption and standard production practices do not change. Therefore, short-run elasticities are expected to be smaller than those for the longer-run. Here, only short-run influences on net import demand are estimated.

VARIABLE SPECIFICATION

All physical variables are expressed in metric quantities while financial variables are either in domestic currency (price and income) or in United States currency (foreign exchange reserves). The exchange rate is a ratio of domestic currency per unit of United States currency.

The basic explanatory variables are suggested by neoclassical economic theory. Income, the price of the product in question, production, and stocks enter as separate variables in the net import demand function.

All monetary variables are measured in real terms, assuming no money illusion by consumers on average.[14] Therefore, a choice must be made as to the price deflator to use in transforming nominal values into real values. Use of the domestic consumer price index as deflator appears to be a reasonable choice for national price changes for purposes of this study and is the only price index available for a number of countries under consideration here. Also, a consistent estimate of domestic inflation rates is achieved since the same source can be used for all estimates.

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[14]This is a simplification to the model which Leamer and Stern (1970, p. 47) note may be too strong to impose a priori. However, given that this is a multiple-country study, it is felt that there is an overall advantage to using real estimates of monetary variables.

Net Imports

The quantity of imports rather than value of imports is preferable on theoretical grounds since using quantities directly avoids variation introduced through prices (Leamer and Stern, 1970, p. 8). Quantity data are readily obtained for agricultural commodities. It is assumed here that wheat and coarse grains each form a homogenous product. Thus the distinctions in quality of grains as well as individual components of coarse grains are ignored. As with income and all physical variables, net imports are expressed on a per capita basis. This allows population to be incorporated into other variables. For market demand studies, per person relationships are likely to be more meaningful and stable than relationships between aggregates. Specifically,

$$NI_{xit} = (M_{xit} - X_{xit})/POP_{it} \qquad (12)$$

where:

NI_{xit} = physical net imports, in kilos per person;

M_{xit} = quantities of imports, in '000 metric tonnes;

X_{xit} = quantities of exports, in '000 metric tonnes; and

POP_{it} = annual population, in millions.

Price

The price variable used represents a border-price equivalent of the world price (PW) in real domestic currency. The base price used for all countries is the United States price for both wheat and coarse grains. This proxy world price is transformed into a particular country's domestic currency in real terms via an official exchange rate with the U.S. dollar, and then deflating that price is deflated by the domestic consumer price index of the country.

$$P_{xit} = (PW_{xt} * XR_{it})/CPI_{it} \qquad (13)$$

where:

P_{xit} = price, expressed in real domestic currency;

PW_{xt} = world price, in U.S. dollar per metric tonne;

XR_{it} = exchange rate; and

CPI_{it} = consumer price index.

Income

Gross domestic product for each country is expressed in real rather than nominal values and put on a per capita basis.

$$I_{it} = (GDP_{it}/POP_{it})/CPI_{it} \qquad (14)$$

where:

I_{it} = income per person in units of domestic currency;

GDP_{it} = gross domestic product in millions of domestic currency;

POP_{it} = population; and

CPI_{it} = consumer price index.

Production

Annual physical supply variables are expressed in per capita terms (as are net imports and income). The production variable represents domestic output of the specific commodity group in question.

$$PRO_{xit} = Q_{xit}/POP_{it} \qquad (15)$$

where:

PRO_{xit} = domestic production, in kilos per person;

Q_{xit} = domestic production, in '000 metric tonnes; and

POP_{it} = population.

Stocks

A separate stocks variable is used to capture national stockholding behavior which is distinct from production considerations. A priori, it is reasonable to expect that stockholding policy represents an independent influence on imports. A variant of specifying per capita stock levels would be to use a stocks-to-use ratio. In this analysis, beginning stocks are included as a separate variable.

$$ST_{xit} = STT_{xit}/POP_{it} \qquad (16)$$

where:

ST_{xit} = beginning stocks, in kilos per person;

STT_{xit} = beginning stocks, in '000 metric tonnes; and

POP_{it} = population.

Foreign Exchange Availability

The level of foreign exchange availability, here represented by foreign exchange reserves, is included in the specification since a priori, the ability of a country to import is dependent upon its access to the foreign currency used in the transaction. Foreign exchange reserves are defined as all claims available in the event of a balance of payments deficit[15] expressed in United States dollars per capita. This variable includes changes in the value of a country's exports and imports of goods and services, inflows of foreign capital, and its access to credit denominated in foreign currency.

$$FX_{it} = (FEX_{it}/POP_{it})/CPI_t^{us} \qquad (17)$$

where:

FX_{it} = foreign exchange reserves, in real U.S. dollars per capita;

FEX_{it} = foreign exchange reserves, in nominal U.S. dollars;

CPI_t = consumer price index for the United States; and

POP_{it} = importing country population.

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[15]This variable is an annual stock estimate of foreign reserves which incorporates changes in the current account over the year, measured at 31 December. As defined in the International Financial Statistics, IMF, (1980) it is: "Foreign exchange includes monetary authorities' claims on foreigners in the form of bank deposits, treasury bills, short term and long term government securities, and other claims usable in the event of a balance of payments deficit, including nonmarketable claims arising from intercentral bank and intergovernmental arrangements, without regard to whether the claim is denominated in the currency of the debtor or the creditor."

Exchange Rate

Besides its influence on price and on long-run income levels via the trade balance, exchange rates may have direct bearing on the relative prices between importables and exportables. Exchange rates are included as a proxy for the domestic prices of alternative goods in consumption and/or alternative products in national output relative to prices of imported grain (expressed in local currency). Exchange rates are represented by an official annual estimate of the value of a domestic currency obtained for a unit of United States currency.

XR_{it} = domestic currency value/U.S. dollars.

DATA SOURCES

Physical variables used in this study were obtained from the Foreign Agricultural Service (FAS), USDA. These include estimates for imports, exports, production and stocks, all expressed in thousands of metric tons. Periods of collection for physical variables differ among certain countries. Essentially, physical data on grains are reported on a crop-year basis, from 1 July of the indicated production year. Early harvests of grain in the Northern Hemisphere are included in the July accounting period.

It has been noted that estimates of physical variables from different sources (Food and Agriculture Organization, USDA) are in close agreement for developed countries. However, totals for developing countries are less in agreement; and for centrally planned economies they diverge the most (Paulino and Tseng, 1980, p. 10). The USDA data which were used here were typically lower than FAO estimates.

Data obtained from the International Monetary Fund are used for variables such as gross domestic product, population, foreign exchange availability, exchange rates and domestic consumer price indices. Consistency in measurement of these variables particularly over time was difficult to attain, even for certain, developed countries.

The consumer price index (CPI) is chosen to measure domestic inflation rates. CPI estimates are annual averages of domestic price changes over the year, the base year being 1981 for all countries. The choice of CPI as price deflator reflects in part an attempt to capture changes in a general measure of prices faced by consumers and producers, not being concerned with a specific commodity or use group. However, the choice is necessarily pragmatic in that the CPI is the index most frequently used to report changes in national price levels over the range of countries used in this study. It should be noted that there existed national differences in which commodities (market basket) comprise individual CPIs and, further, that within a single country over time no one series contained the same basket of goods throughout the full 22-year period studied.

Gross domestic product estimates are reported in either millions or billions of domestic currency; all are transformed into millions for calculation purposes. Estimates are based on end-of-year levels, representing transactions which have taken place over the year. Population data are all reported in millions of people, estimated at a mid-year point.

Foreign exchange availability is estimated as the year-end stock level of foreign exchange reserves held by an individual country. Such reserves represent foreign purchasing power available to a country for imports over the year. They include the net value of imports and exports over the year as well as net inflows of foreign capital, including credit over the year.

Exchange rates reflect annual averages expressed in national currency per unit of U.S. currency. The estimates provide conversion factors that report rates in reference to 'par' rates (official or central rates) and take into account changes in exchange rate regimes, such as between periods of fixed and floating exchange rates of the rates covered by the IMF.

International price estimates are obtained from USDA estimates.[16] United States prices are used as proxies for world prices for wheat and coarse grains. Corn prices are used to represent all coarse grain prices on the basis that, given close substitutability in use, coarse grain prices tend to move together. The wheat price is an annual estimate of the United States wheat price, f.o.b. Chicago; the corn price in an annual estimate of the United States gulf price.

EXPECTED RESULTS

Traditional Variables

The coefficient on price measures the response of an individual country's net imports with respect to a change in the world price, expressed in real domestic currency. It is hypothesized that many countries attempt to isolate their internal prices from changes in the world price, at least in the short-run. It is expected, therefore, that the impact of price on the level of net imports of grains for most countries is not large and that price as a variable in explaining net imports is not highly significant. Following economic theory, the price coefficient is expected to have a negative sign.

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[16]Wheat prices were obtained from USDA, Wheat Situation, ERS, various issues; and corn prices from USDA (1973) World Agricultural Situation, WAS-20, ESCS (Oct. 1979), p. 30.

Because of the plethora of government policies impinging on the flow of world trade, the response of net imports to world price changes can be expected to vary considerably among countries. For example for countries within the European Community, it is expected that the import response to changes in the border price will be small relative to that of more open trading regions, ceteris paribus. This is expected for both wheat and coarse grain equations. Indeed, under the European Community's variable levy system, net import demand can be expected to be very inelastic over a range of prices. On the other hand, in the sample of LDCs examined here, price insulation may be difficult to maintain for some low income countries because of budget constraints). In general, however, individual LDC consumer price policies are expected to keep price elasticity estimates small. Typically, price elasticities for coarse grains are expected to be higher than those for wheat.

The sign on gross domestic product is expected to be positive in accordance with neoclassical demand theory. However, for some countries, this relationship may be negative. This result is considered possible where, in the process of economic development and income growth of countries for which production self-sufficiency is a feasible national goal, higher incomes permit more investment in domestic agricultural production (Magee, 1975, p. 190). A negative coefficient on income is more likely to be the case in the wheat import demand equation than in the coarse grains equation. This reasoning follows from the historical tendency for LDC's to consume less wheat protein and more animal protein as incomes rise. This result has been evident in some industrialized countries, where wheat consumption has been declining over time as incomes rise.

Import elasticity with respect to domestic production will be negative to the degree that imports provide a substitute for domestic output. The size and significance of the elasticity estimate are anticipated to relate to a combination of factors. Perhaps the most dominant criterion is the degree to which domestic production satisfies domestic demand requirements. Where production is a small proportion of total demand, changes in production are unlikely to have much impact on imports. Hence, the production elasticity of import demand is expected to be smaller than when domestic production forms a large proportion of domestic requirements. This is the case for both wheat and coarse grains.

Another factor affecting the relationship between domestic production and net imports is the level of self-sufficiency desired within a country. Where domestic production is small and non-traditional but a concerted effort is being made to funnel resources into import-substitution production, production is likely to be more variable.

When such a policy is coupled with a desire to maintain or increase domestic demand for the product, import responsiveness is expected to remain high. However, a smaller production elasticity can be expected if maintenance of effective domestic demand is less of a concern or if policies are pursued to maintain/increase domestic consumption through heavy government subsidies.

The nature of stockholding elasticities are also expected to be country-specific, dependent in part on the level of world supplies and the role which stocks play in each country. In particular, when world supplies are low, a higher level of stocks may be held for security reasons in countries which feel particularly vulnerable to changes in supply. In this case, net imports and stocks are expected to have a positive relationship, at least until reserves have been built up. However, in a more normal supply situation, stocks are expected to show a negative relationship with net imports in performing their role as buffer for short term market variations. Thus, when beginning stocks are low, imports are used to rebuild them; when they are high, imports can be reduced.

Financial Variables

The sign on the elasticity estimate for foreign exchange availability is expected to be positive, in that greater foreign exchange availability reduces a constraint on a country's imports. It is likely that for smaller countries which have a low ratio of export earnings to foreign interest payments, foreign exchange availability will have more significance than it would for more solvent countries.

In its role as an independent variable separate from price,[17] the exchange rate does not lend itself to a priori expectations about sign of the elasticity. As a proxy for relative domestic prices between tradables and nontradables, theoretically, the sign on this variable may be positive or negative. A negative sign would indicate that, as domestic currency depreciates (XR increases--i.e., traded goods are more expensive than nontraded goods in the domestic market), some domestic substitution for imported grain is taking place. A positive sign would indicate that there is some complementarity between domestic goods and imports of grain, so that as the currency depreciates, the increased use of domestic goods or services warrants increased imports of grains. For

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[17]The impact of the exchange rate on price will be positive and, through price, its impact on net imports under normal demand conditions is expected to be negative. That is, as the value of domestic currency falls (XR increases), the value of world price in domestic currency will increase and, ceteris paribus, net imports will fall.

example, as the value of a domestic currency increases relative to the United States dollar, internal opportunities stemming from a change in relative domestic prices (tradables versus nontradables) may dictate a change in production or consumption patterns which either discourage imports or induce them.

STATISTICAL RESULTS

Countries chosen for empirical estimation represent a cross-section of grain importers (excluding centrally planned economies), with emphasis on less developed countries. Some importing countries were excluded at the outset on structural grounds. For example, the separation of Bangladesh from Pakistan and the entry of the United Kingdom into the European Economic Community were events which occurred over the time period covered in the study.

Some countries initially selected for examination were excluded because of large gaps in available data. For example, consumer price index estimates were not available for Algeria, a relatively major importer of wheat, for nine of the 22 years. Other countries excluded for this reason include Indonesia, Iran, Iraq, Zaire, Zambia, and Kuwait.

Generally, countries included in the study were net importers of both wheat and coarse grains over the period. However, the sample is not exactly the same for both commodities. Specifically, net import demand equations were estimated for 24 wheat importing countries and 18 coarse grain importing countries. A complete list of countries covered in this study is given in Appendix A.

Overall Model Performance

The estimated net import demand equations for wheat and coarse grains are presented in Appendix B. Two model specifications were estimated for each country: the traditional model includes the independent variables, price, income, production and stocks, as defined earlier. The financial variables of foreign exchange availability and exchange rates were added to the second specification.

Several important observations may be made on these equations. First, the signs on the coefficients estimates appear to concur generally with prior expectations. In particular, the signs on the traditional variables in both model specifications (with and without financial variables) appear relatively consistent. Where there is a change in sign the estimate typically has low statistical significance. Coefficients on income and production were usually statistically significant and of the expected positive and

negative signs, respectively. However, for stocks, both negative and positive signs were obtained, although more commonly, as expected, the sign was negative. As predicted, the coefficient on border price is often nonsignificant, indicating the limited role price plays in determining year to year changes in net imports of grain by most countries.

The coefficients on the financial variables are less in line with prior expectations. Neither appear highly significant overall. The sign for foreign exchange reserves is more often positive than negative for both wheat and coarse grain equations, whereas a positive sign was expected throughout. As discussed below, other factors may have to be taken into account when assessing this variable. In its role as a proxy price for substitutes and complements, the sign of the exchange rate cannot be predicted a priori. For wheat, the exchange rate is more often positive; whereas for coarse grains it is more often negative, indicating more countries have substituted domestic food sources for imported wheat as relative domestic prices are altered through exchange rate changes.

Second, the statistical properties of the equations are generally acceptable. Judging from the $\bar{R}^2$ and the overall F statistic, the wheat equations appear weakest for countries in South East Asia and Korea, plus some countries in South America. For Asian countries, this is understandable given the importance of rice in diets. Except for Chile, the equations which are weak in explanatory power in South America are for countries with relatively high corn consumption levels.

Among the coarse grain equations, statistical results are weakest for Germany, Chile and Libya. These countries have somewhat different characteristics, although they are all countries with significant domestic production. Germany and Chile were exporters throughout the period (though not **net** exporters). Germany shows the strongest production response, whereas financial variables are more important for the other two countries.

Third, given the nature of this study and the national aggregate level on which data are reported, it is perhaps not surprising to find some serial correlation among the equations. However, in the majority of cases, the Durbin-Watson statistic, indicative of first order serial correlation, generally falls within the upper and lower bounds of statistical acceptability at the five percent level. If it is outside these bounds, it is usually on the high side by no more than 2 percentage points. A Durbin-Watson statistic exceeding this range is found in four wheat equations (Bolivia, Israel, Libya and Colombia) and in three coarse grain equations (Colombia, Ecuador and Nigeria). In these countries, the presence of positive serial correlation may cause standard errors to appear lower than is actually the case. No correction has been made for these effects.

Another consideration in multiple regression analysis is the degree of multicollinearity between independent variables. To the extent included variables are collinear, it is difficult to determine their separate effects on the dependent variables. Using the admittedly cursory check on the presence of multicollinearity, that of simple correlation between independent variables, the countries where there is likely to be a problem have already been identified. For wheat equations, these are located largely in Southeast Asia (Korea, Malaysia, Sri Lanka and the Philippines) and in South America (in particular Bolivia and Chile). The variables with highest correlation are the financial variables, more commonly the exchange rate, income and, to a lesser extent, foreign exchange reserves. Other countries in South America (for example Peru and Brazil) show that domestic production and/or beginning stocks variables may also cause multicollinearity problems in their close linear association with income.

For coarse grains, Malaysia, Philippines and Chile show gross domestic product data as highly correlated (relative to the $\bar{R}^2$) with foreign exchange reserves, and to some extent with exchange rates. Tunesia is also in this category.

The wheat and especially coarse grain equations for Germany demonstrate high correlation between financial variables. Production is also highly correlated with exchange rates and income in the wheat equation.

For the above-mentioned countries, the likelihood of multicollinearity implies that where financial variables are included, it is difficult to interpret their coefficients and also the coefficient associated with income. Price, on the other hand, appears little affected, except in the coarse grain equations for Malaysia and Chile, and in the wheat equation for Germany. Despite these problems with interpretation, the theoretical and practical reasons for attempting specification of net import demand by inclusion of financial variables is considered worthwhile.[18]

For large trading countries, there is the possibility of simultaneous bias, where price cannot be considered independent of net imports. The countries treated here do not fall into this category. Although it is possible that the European Community as a whole could have such an influence, it is not considered likely for individual country imports. Simultaneous bias is more likely in the coarse grain equations for Japan. At least in recent years, Japan has been a significant in this market, importing approximately 20 percent of world coarse grains exports.

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[18]These arguments are presented by Pindyck and Rubinfeld (1981, p. 8) and Leamer (1983, pp. 31-43).

Elasticity Estimates for Wheat

Elasticity estimates obtained from wheat net import equations are presented in Tables 7-9. Table 7 covers those for low-income developing countries, Table 8 for middle income countries and Table 9 for industrial countries. Results from both specifications are provided.

The response of net imports to a change in price is generally negative but small, and statistical significance levels are low. For most countries, price elasticity is in the range of -0.1 to -0.3 and in four cases it is less than -0.1. This negative relationship holds consistently within low-income developing countries, but less consistently for industrialized countries. This result supports the hypothesis that domestic pricing policies, which exist in some form in each of the sample countries, to some extent isolate domestic markets from a change in the world price. Moreover, the marginally higher price elasticity in the low income group suggests that the effectiveness of such policies in lower income countries may be hampered by internal constraints.

Countries in the European Community plus Israel and Chile, among middle-income countries, show a positive price elasticity. This result indicates that European Community pricing policies which benefit producers (Jabara, 1981; Josling and Pearson, 1982) and Israeli policies which benefit consumers (USDA, 1983, p. 9) are effective in insulating domestic prices from changes in the world price over the short run. Chile also has had a policy of low producer prices, a factor contributing to a separation of imports from import price changes.

The largest wheat price elasticity, in the range of -1.0 was obtained for Saudi Arabia, a country in the Organization of Petroleum Exporting Countries (OPEC). Although the Saudi Government has operated a food subsidy program (including wheat) since 1974, actual imports are carried out by private traders, with Government involvement made subsequently (Royle, et al., 1983, p. 40). The relatively large negative price elasticity is indicative of private trader response to change in the world price. Libya, by contrast, imports largely under long term contracts (Royle, et al., 1983, p. 3) and is less sensitive to short-run changes in world prices.

Income elasticities are generally positive and somewhat higher than expected. The changing pattern in tastes and preferences for different grains associated with changing income levels emerges from the results. Indeed, wheat income elasticities for low-income countries are generally larger than in middle-income countries. Income elasticities for industrial countries are unexpectedly high. However, the income elasticity for Germany from the equation using only traditional variables is negative, indicating wheat is an inferior good to German consumers.

Table 7

WHEAT ELASTICITY ESTIMATES, LOW-INCOME COUNTRIES

Country	Price	Income	Production	Stocks	Foreign Exchange Availability	Exchange Rate
Philippines	-.101 -.271**	.927** .367**	(a)	-.079* -.064	-1.440*	-.031
Sri Lanka	-.102 -.257	1.242* .414	(a)	.049 .072	-.225*	-.481
Thailand	-.391** -.380*	2.156*** 1.861***	(a)	-.203*** -.144*	-.414**	1.056
Egypt	.011 .046	.915*** .671***	-.429 -.349	.-44* .062***	-.034	-.232
Morocco	-.032 -.231	2.111*** 2.123***	-.959* -1.075*#	-.137	-.276*	-.775
Nigeria	-.210 -.107	.599 .512**	.007 .011	.072*** .064	.008	.237
Tunisia	-.169 -.068	1.758*** 1.904***	-1.731*** -1.925***#	-.271*	.136	-.175
Peru	-.277*** -.224***	.759* .604***	.224 .138*#	.041	-.487	.344*
Colombia	-.252* -.412***	1.222* 2.204***	-.170* -.074	-.284*** -.242***	.118	.106
Ecuador	.025 -.008	.782** .937***	-.457*** -.513***#	-.063	.042	-.033

Table 7 (continued)

Country	Price	Income	Production	Stocks	Foreign Exchange Availability	Exchange Rate
Bolivia	-.103	.923*	-.109	-.013	.103	-1.040**
	-.166	.176	-.208#			
Paraguay	-.022	-2.994***	-.038	-.117*	.477***	
	-.521*	-.611**	-.189*	-.197**#		

Note: all elasticity estimates are calculated at the mean of variables.
*** indicates significance level of at least 99%.
** indicates significance level of at least 95%.
* indicates significance level of at least 80%.
(a) indicates variable equals zero from 1960-81.
production and stocks are combined.

Table 8

WHEAT ELASTICITY ESTIMATES, MIDDLE-INCOME COUNTRIES

Country	Price	Income	Production	Stocks	Foreign Exchange Availability	Exchange Rate
Saudi Arabia	-.993***	.332	.223	-.077*	-.261*	-2.426*
	-1.106***	.287*	.100	-.049*		
Libya	-.068	.535***	-.127*	-.032***	-.080*	-1.244*
	.006	.625***	-.113*	-.040***		
Korea	-.060	-.024	-.233	.146**	-.109	.297
	.042	.072	-.226	.165**		
Malaysia	.040	.092	(a)	-.009	.057	.222
	.023	.082		-.020		
Israel	.318***	.749***	-.620***	-.326***	.075	-.096***
	.201	.327*	-.344***	-.148		
Brazil	-.082	.730***	-.317***	-.154**	-.060	-.025
	-.047	.558***	-.313***	-.117**		
Chile	.420**	-.401	-.075	.042	.171	.104
	.280**	.644**	.265#			
Venezuela	-.159	-.303	.072	-.030*	.075	1.505***
	-.180	.088	.003#			

See Table 7 for notes.

Table 9

WHEAT ELASTICITY ESTIMATES, INDUSTRIAL COUNTRIES

Country	Price	Income	Production	Stocks	Foreign Exchange Availability	Exchange Rate
Japan	-.269*	.349	-1.119***	-.533	-.064	.499
	-.273	1.408***	-.765***//			
Italy	.155	1.162**	-5.442***	-.802***	-.231	-.888*
	.188	.272	-4.642***	-.648**		
Portugal	-.107	.936*	-.968***	-.265*	-.079	.378*
	.015	.926*	-1.264***	-.085		
Germany	.859	.998	-1.060	-2.227**	1.198***	5.282*
	.337	-2.574*	-.660	-2.947***		

See Table 7 for notes.

Another significantly negative income elasticity is found for Paraguay. Here, domestic production has grown from 11 percent of total consumption of wheat in 1960 to 37.5 percent in 1981.

The largest wheat income elasticities are found in the North African countries of Morocco and Tunisia, and surprisingly Thailand. Wheat is a traditional staple in North Africa whereas consumption is very low in Thailand (USDA, 1983, p. 19).

In general, the relationship between domestic production of wheat and net imports is negative, as expected. Where production elasticities are positive, they are statistically nonsignificant. Elasticity estimates are somewhat larger for higher income (industrial) countries than for the LDCs. In larger wheat-producing areas in the Middle East, domestic production elasticities are also relatively high and significant. For most countries, the expectation is substantiated that production elasticities are higher for countries having large production bases relative to consumption. For example, production elasticities are larger in Tunisia and Morocco than in Libya, and those in Ecuador are high relative to Peru, Colombia and Bolivia.

In areas with smaller domestic production, production elasticity is typically less than -0.5. Brazil, Egypt and Israel all have growing production bases but also are countries that have been concerned with maintaining or increasing consumption (USDA, 1983, Suppl. 5 and 8). There was no production of wheat recorded for South East Asia over the study period.

Wheat net imports are typically inelastic with respect to beginning stocks. Both positive and negative elasticities are observed. As predicted a negative relationship is found for most countries, indicative of at least some buffer role for stocks. Those countries with a significantly positive stock elasticity are Egypt, Nigeria and Korea, all of which have a low domestic production/total consumption ratio and have begun holding stocks since the mid-1960s. This result may reflect either an increase in domestic milling capacity, as occurred in Nigeria over the 1970s (CIMMYT, 1982), and/or a desire for food security in these countries (Eaton, 1980).

The foreign exchange availability variable has the expected positive sign in only 40 percent of sample countries. Further, this variable has the least overall significance of the six independent variables tested. Except for Germany and the Philippines, elasticity estimates are below 0.5, indicating a relative small response of net imports to a change in foreign exchange reserved over the sample period.

A negative sign indicates that when reserves increase (decrease) over the year, net imports fall (rise). In light of the sign, size and significance resulting from empirical test of this variable, several possible explanations can be explored. As discussed in the

following chapter, one partial reason for the poor performance of foreign exchange reserves in explaining net imports is that credit available to most countries during the study period permitted countries to make import decisions independent of this variable. If this is the case, the credit situation for some countries can be expected to impose a greater constraint on imports in the 1980s than in earlier periods (USDA, 1983, Suppl. 5, pp. 4-5). Another possible reason for the weak link between foreign exchange reserves and wheat imports is the failure of this study to take into account the proportion of foreign exchange used for domestic economic development and, in particular, industrial development. It is beyond the scope of the current research to delve more deeply into this aspect of reserves but country choices with respect to the use of reserves may warrant further study.

The exchange rate has a negative relationship with net imports in 13 out of the 24 countries sampled. This result points to countries which have to some extent substituted domestic food grains for imports as exchange rates increase (domestic currency depreciates); and substituted imports for domestic grains as exchange rates decrease (domestic currency appreciates). Larger negative exchange rage elasticities are generally found in major wheat-consuming areas which also enjoy established production bases for wheat. The largest such effects are found in Saudi Arabia and Libya. Others include Morocco, Tunisia, Egypt and, to some extent, Israel. Both Bolivia and Ecuador produce greater quantities of corn than they do wheat, but in proportion to domestic production, they consume more wheat. The substitution can also be made by other grains, such as rice in Southeast Asian countries or different types of coarse grains in countries such as Brazil.

Where changes in net imports of wheat are positively related to exchange rate changes, coarse grains tend to be the predominant domestic grain crops (excluding rice). Exceptions are found in Germany and Chile, both of which consume and produce more wheat than coarse grains. The largest positive elasticities are found in Thailand and Venezuela, countries with virtually no wheat production. Although data on internal use of resources have not been included in this study, a positive relationship between exchange rate changes and net imports would suggest that wheat, as a food grain, is a complement to domestic use of other crops and/or domestic milling capacity exists to an extent to warrant the importation of wheat.

Earlier in this paper, it was noted that the degree to which total domestic grain requirements are met out of domestic production may have a substantial impact on both the production and price elasticities of import demand. Knowledge of the nature of this relationship may provide insights into the way countries respond in world grain markets.

It is hypothesized that the price elasticity of demand for wheat and coarse grain imports is negatively correlated with the degree of self-sufficiency of the country in terms of that grain. That is, for countries in which domestic production (P) of the imported good, say wheat, is a relatively high proportion of total domestic consumption (C) requirements for that good (i.e., the P/C ratio), it is hypothesized that net imports will be less responsive to the own-price than when the P/C ratio is low, ceteris paribus. When the P/C ratio for wheat is low, and hence the volume of imports is a large component of given consumption requirements, the own-price level will be a significant factor in the quantity of wheat imported by that country. A small change in price may have substantial consequences for a country wherein wheat is a staple food and particularly where there are severe budgetary constraints. Therefore, this relationship is likely to be strongest for low-income countries and least strong for industrialized countries in which wheat for domestic food consumption is relatively less important. Also, the importance of agriculture and of agricultural imports in national income of many low-income countries may be a further reason to expect this result in those countries. The same general inverse relationship is expected in the case of coarse grains although it may be less clear among low-income countries. First, wheat is dominant as an imported food grain in developing countries (CIMMYT, 1983),[19] whereas most coarse grains are imported by middle-income and industrialized countries for animal feed. Therefore, the relationship is expected to be strongest for these countries.

The data on wheat and coarse grains, which are summarized in Figures 3 and 4, respectively, provide preliminary support of the above hypothesized relationship. The hypothesized direction of this relationship is indicated by the arrow in these figures. As expected, the relationship between the P/C ratio and price elasticity of wheat imports is strongest among the low income countries. Less clear is this relationship for middle-income and industrialized countries where the value of wheat imports is a less important of the value of total imports and, indeed, of the value of the national income.

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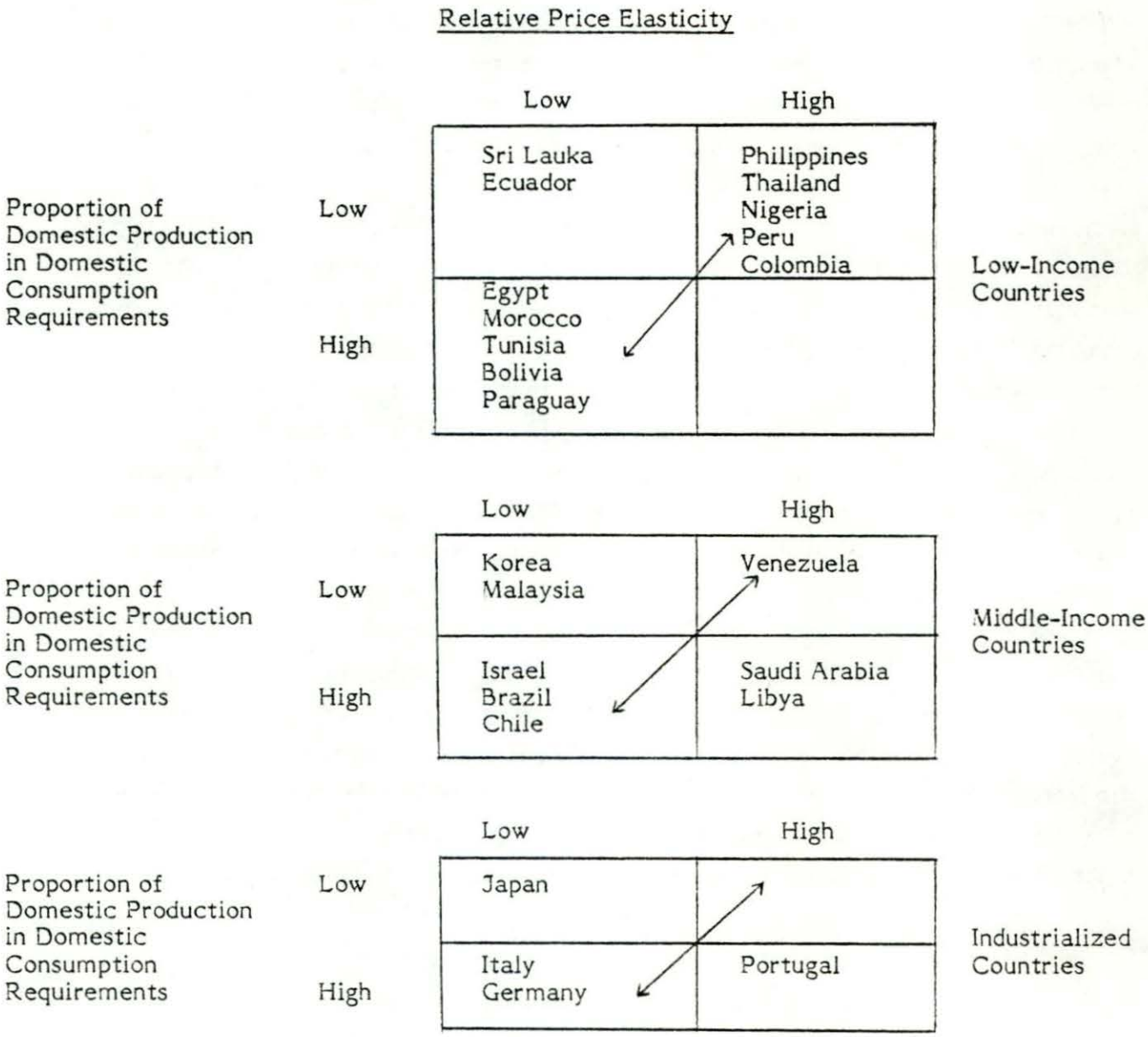
[19]CIMMYT (1983, p. 4) report that 70% of calories consumed in developing countries are provided by starchy staples, which also provided half the increase in these calories over the past two decades! Significantly, by far, the largest contribution to this increase came from wheat which is second only to rice as the most important single food source in developing countries.

Figure 3

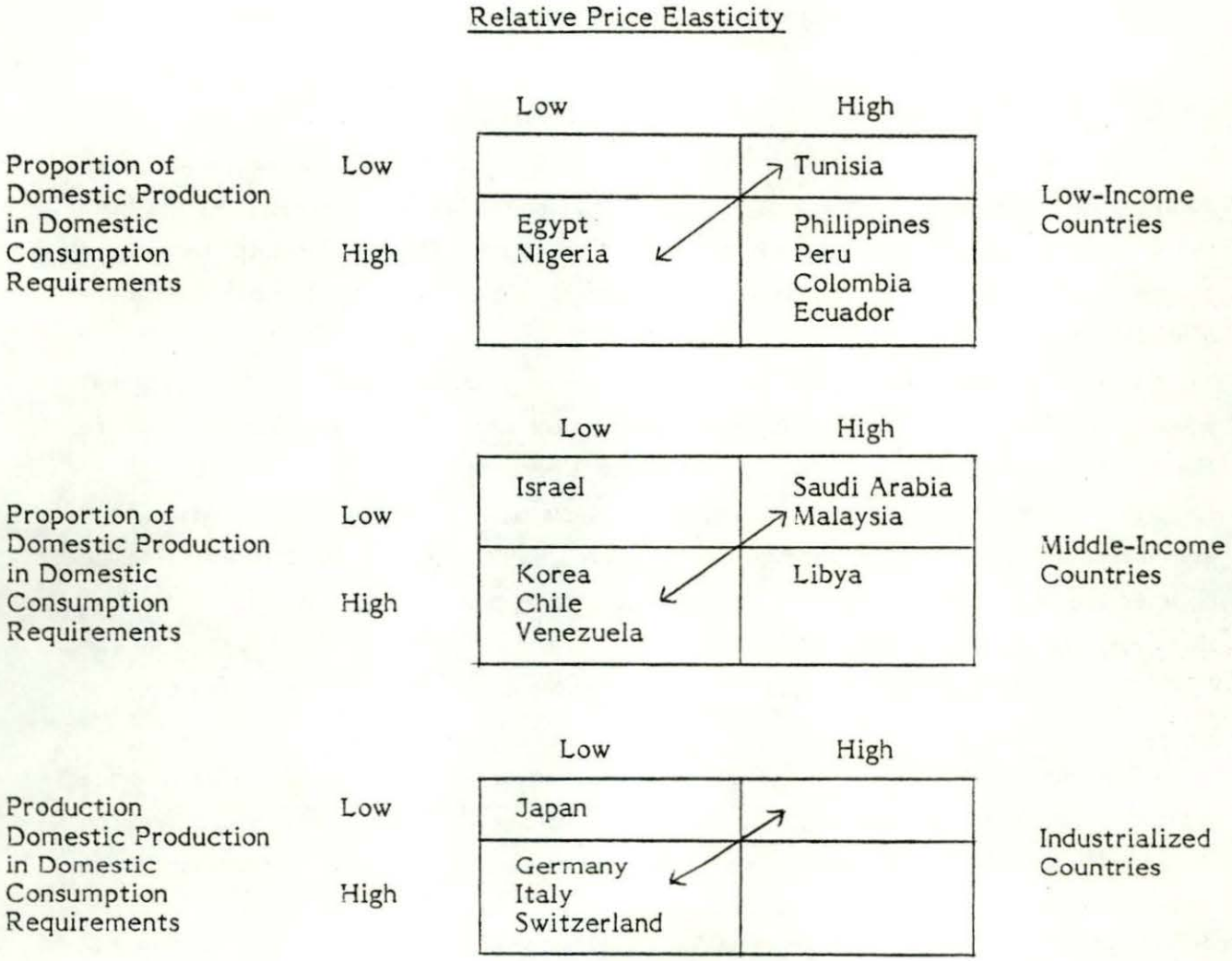
Relationship Between Price Elasticity of Import Demand for Wheat and Proportion of Domestic Wheat Production in Domestic Wheat Consumption Requirements: Countries by Income Level



Notes:
1. Hypothesized relationship is shown by direction of arrow in each square.
2. Consumption and production data used to construct ratio is three year average of 1979-1981.
3. Elasticity estimates were obtained from Tables 7-9 for wheat and Tables 10-12 for coarse grains.

Figure 4

Relationship Between Price Elasticity of Import Demand for Coarse Grains and Proportion of Domestic Coarse Grains Production in Domestic Coarse Grains Consumption Requirements: Countries by Income Level



Note: See Figure 3.

By contrast, this negative relationship evident in Figure 4 between the P/C ratio and price elasticity of import demand for coarse grains appears strongest for the middle-income countries in which growth in coarse grain imports and domestic use has been highest. The relationship appears weakest for low-income countries. Again, this is to be expected since it is higher income countries which receive the bulk of coarse grain imports, primarily as feed for livestock, subsequently consumed as meat products.

Elasticity Estimates for Coarse Grains

Coarse grains elasticity estimates are given in Tables 10 to 12 for low-income, middle-income developing countries, and industrial countries, respectively. Again, both the traditional and financial specifications are reported. Elasticity results for coarse grains parallel those for wheat in many respects and therefore will be discussed more briefly.

In general, statistical properties are stronger in coarse grain equations than wheat equations. The poorest performing equations are for Libya, Chile and Germany, where the $\bar{R}^2$ is low and F tests are insignificant at the 1 percent level.

Price elasticity estimates for coarse grains are usually negative and, as with wheat estimates, significance levels are generally low. This is to be expected where domestic policies are effective in insulating the domestic price from changes in the world price. However, price elasticities are a little larger than those for wheat. Even so, ten of the 18 countries examined had price elasticities estimates at or below -0.5 for at least one of the specifications.

The distinctions between groups in the size and sign of coarse grain price elasticities are not as clear as for wheat. Some of the lowest elasticities are found in industrial countries, indicating more effective government pricing policies in these countries than in many LDCs.

Two of the four highest price elasticities for coarse grain equations are found in the low income group (Philippines -2.1, and Ecuador -1.3). Both countries fill less than 10 percent of their consumption needs with imports. The other two countries with price elasticities at or greater than -1.0 are in the middle income group (Libya -1.0, and Saudi Arabia -1.5). These two countries are members of the OPEC. Where positive price elasticities are found, they are small and not statistically significant.

Table 10

COARSE GRAINS ELASTICITY ESTIMATES, LOW-INCOME COUNTRIES

Country	Price	Income	Production	Stocks	Foreign Exchange Availability	Exchange Rate
Egypt	.415 .135	2.661* 1.685***	-2.170 .466***	-.034	-.046	-1.305
Nigeria	-.378 -.321	.033 -.719*	-.339 .321	.551*** .459***	.146	8.070***
Tunesia	-.405 -1.572*	3.398*** 2.451***	-.544 -.315#	-.055	-.947	-1.405
Philippines	-2.094** .288	-.810 7.423**	-5.967** -4.303*	.370 .122	1.509**	3.099*
Peru	.070 .528	3.123* 4.556***	-3.287* -3.178**#	.169	.037	-.053
Colombia	-.213 -1.017**	.204 4.090***	-2.348* -1.545#	-.296	.527*	.617
Ecuador	-1.273*** -.982**	-1.996* 1.942***	-1.262* -2.128*#	-.207	1.295**	1.415*

See Table 7 for notes.

Table 11

COARSE GRAINS ELASTICITY ESTIMATES, MIDDLE-INCOME COUNTRIES

Country	Price	Income	Production	Stocks	Foreign Exchange Availability	Exchange Rate
Libya	-1.049* -.917*	-.898 .140	-.410 -1.012**	(a)	1.037**	-.241
Saudi Arabia	-1.505** -.617	2.179** 1.242*	-.202 -.997	.127*** .266***	-2.206**	-1.768
Israel	.253* .177	.623*** .438*	-.078* -.104**	.111 .064	-.203*	-.011
Korea	-.236 -.257	1.373** 1.560***	-.401 -.396*#	-.090	.081	.044
Malaysia	-.671* -.207	.235 1.209*	.102 .294*#	.243	-.401	-3.503**
Chile	.033 -.174	1.115 .926*	.892* 1.083*	-.198 -.103	.754***	-.565**
Venezuela	-.278 -.329	3.958*** 2.980***	-1.338** -1.082**	.089 .116*	.299*	.042

See Table 7 for notes.

Table 12

COARSE GRAINS ELASTICITY ESTIMATES, INDUSTRIAL COUNTRIES

Country	Price	Income	Production	Stocks	Foreign Exchange Availability	Exchange Rate
Japan	-.176**	.899***	-.119**	-.070	-.140***	-1.023***
	-.186**	.859***	-.083*	.183***		
Germany	.120	1.599**	-1.658**	-.745*	.029	.974
	.159	1.551*	-1.770**	-.603*		
Italy	-.284**	1.632***	-2.134***	-.175*	-.103**	-.119
	-.154	1.634***	-2.561***	-.146		
Switzerland	-.026	1.816***	-.382*	-.647**	-.162*	-.170
	.056	1.919***	-.392*//			

See Table 7 for notes.

Coarse grain equations appear more sensitive to the specification used than did those for wheat. In two cases (the Philippines and Chile) the sign changes on the price elasticity when financial variables are excluded, and in three more cases (Colombia, Tunisia and Saudi Arabia) the estimated elasticity changes by more than 0.5.

In general, income elasticities for coarse grains are positive, as expected, and are more statistically significant than those of other independent variables. These elasticities are often larger than those for wheat, as expected, given the pattern of grain use associated with changes in income levels. The relatively large size of income elasticities in low-income countries is surprising. However, many of the countries involved have increased consumption of coarse grains at a rate faster than their own production bases, with the effect that net imports of coarse grains have grown along with income in these areas. In Nigeria, the Philippines and Ecuador, all of which show some tendency toward declining imports while income increases, changes in domestic production has paralleled changes in consumption. This result indicates that some effort is being made in these countries to increase self-sufficiency in coarse grains.

As in the wheat equations, coarse grain production elasticities are almost all significant and negative. In eight countries, production elasticities are consistently greater than -1.0 in both specifications, and Libya and Egypt have high elasticities in one specification. These countries all have large domestic production bases for coarse grains relative to consumption levels. As with wheat, the larger producers of coarse grains relative to consumption also have the highest production elasticity estimates. The size of a negative elasticity estimate for production indicates the degree to which countries use imports to offset variation in their own production through imports.

Where production elasticities are less than -1.0, its size is also related to the size of the domestic production base relative to consumption. Where the domestic production/consumption ratio is very small (as in Saudi Arabia, Israel, Malaysia and Japan), production elasticities are less than -0.2. Where this ratio is larger (in the neighborhood of one-quarter to one-half) (as in Korea, Tunisia and Switzerland), production elasticity estimates are closer to -0.5. An exception here is Nigeria, where domestic production closely approaches domestic consumption but the elasticity estimate is -0.3.

Stocks elasticity estimates are generally smaller (in the range of -0.5 to -0.1) and less significant in developing countries than in industrial countries. As with wheat, the sign of the stocks elasticity is negative for industrial countries, but is more often positive in LDCs than found for wheat equations. Significant positive stocks elasticity estimates are typically found in countries with small stocks-to-consumption ratios

(Nigeria, Philippines, Peru, Saudi Arabia, and Venezuela). A significant positive elasticity estimate indicates the importance to these countries of maintaining at least small stocks for security purposes. Where the stocks elasticity is positive but insignificant (Israel and Malaysia), stocks are larger than domestic production bases and also are large relative to consumption levels.

The negative stocks elasticity estimates found in six LDCs (Korea, Chile, Egypt, Tunisia, Colombia and Ecuador) and also in industrial countries indicates the use of stocks as a buffer against short-run market variations. There are fewer LDCs holding coarse grain stocks for this use than for wheat. However, coarse grain stocks elasticities are marginally larger than those for wheat.

Four countries (Saudi Arabia, Nigeria, Egypt and Peru) have held coarse grain stocks for less than half the period. Libya did not hold stocks of coarse grains for any of the 22 years.

The foreign exchange availability elasticity for coarse grains conforms more closely to a priori expectations than for wheat. Here, ten out of 18 countries show a positive sign--indicating that as foreign reserves increase, so do imports. The relationship is most often positive in the low income group, followed by the middle income group. Moreover, elasticities are larger for LDCs in general, compared with industrial countries. The sign and size of foreign exchange availability elasticity estimates provide some support for the hypothesis that lower income countries are more constrained by this variable in their imports of coarse grains than are industrial countries.

However, there are still eight out of 18 countries (five of 14 LDCs) for which a negative relationship is found between foreign exchange availability and net imports of coarse grains. The elasticity for Saudi Arabia is the largest and most significant of these. This result is somewhat surprising in that this country, (as compared with Libya for instance) consumes a larger quantity of coarse grains. However, the income elasticity is larger and more significant in Saudi Arabia than in Libya and the difference in the foreign exchange elasticity may reflect different priorities in the distribution of reserves between economic sectors.

As for wheat, the sign of the exchange rate elasticity cannot be predicted from theory. In eleven out of 18 sample countries, the relationship between exchange rates and net imports is negative, indicating some substitution between domestic products and imports has occurred. The magnitude of the exchange rate elasticity is generally larger than that for wheat.

The largest elasticities (greater than 1.0, absolute) tend to be more significant than smaller elasticities, especially those that are large and positive (Nigeria, Philippines and Ecuador). These are all countries which have large coarse grain production bases relative to consumption. As with wheat, Germany is an exception, having a relatively larger wheat production and consumption bases but showing a positive (through insignificant) exchange rate elasticity.

Where elasticities are large and negative (Tunisia, Saudi Arabia, Malaysia and Japan), domestic production bases tend to be smaller relative to consumption levels. An exception is Egypt, where the exchange rate elasticity is large (but insignificant) and the domestic production/consumption ratio is also large.

These results can be compared with wheat exchange rate elasticities. For both wheat and coarse grains net imports, substitution as a result of relative price changes due to exchange rate changes occurs most often when countries are major wheat producers and consumers. Partial explanations for this outcome can be suggested, although in-depth country studies are needed to confirm such suggestions. For example, wheat may substitute for coarse grains in more situations than coarse grains do for wheat, thereby providing wheat-producing countries greater flexibility in substituting domestic crops for imports when their relative prices change. Further, wheat production practices may be more flexible than those for coarse grains in many countries (for example in equipment used or knowledge required in production), thus allowing a larger output effect in the short run when price incentives change.

COMPARISON OF PRICE ELASTICITY ESTIMATES

An evaluation of results of this study is made by comparing estimates obtained in other studies. Studies by Coffin (1970), Abbott (1976) and Jabara (1982) provide direct comparison with current results since they all employ some version of the direct net import demand estimation procedure rather than inferring trade elasticities from domestic demand and supply elasticities.

Table 13 provides estimates from two of these studies for countries which are also included in this research. Jabara's price elasticity estimates are -0.18 (significant at the 90% level) for the non-wheat production region[20] and -0.07 for the wheat production region.[21]

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[20]Countries in this group include: Colombia, the Dominican Republic, Ecuador, El Salvador, Indonesia, the Philippines, Taiwan, Venezuela and the Republic of Korea.

[21]Countries in this group include: Algeria, Brazil, Chile, Iraq, Mexico, Peru, the Sudan, Tunisia, Morocco and Egypt.

Table 13

PRICE ELASTICITY ESTIMATES FROM OTHER STUDIES

	Wheat			Coarse Grains	
Country	Coffin	Abbott	This Research	Abbott	This Research
Japan	-.32	+.069	-.269*	(a)	-.176**
West Germany	+3.91*	-.047	+.859	-.250	+.120
Italy	-11.75***	+.024	+.155	+.066	-.284**
Portugal	-3.74	-.063	-.107	+.059	(b)
Switzerland	-.76	(b)	(b)	(b)	-.026
Israel	-.19	(b)	+.318***	(b)	+.253*
Egypt	(b)	+1.17**	-.046	+.420	+.415
Bolivia	+1.44	(b)	-.103	(b)	(b)
Brazil	+.20	-2.48	-.082	+.250*	(b)
Chile	-1.92	-.28	+.420**	-.370	-.174
Colombia	-.02	-.52	-.412***	+1.900*	-1.017**
Ecuador	-.73	(b)	-.008	(b)	-1.273***
Paraguay	+.78	(b)	-.521*	(b)	(b)
Peru	-.32	(b)	-.277***	(b)	+.528
Venezuela	+3.07	(b)	-.159	(b)	-.278
Sri Lanka	-.41	(b)	-.102	(b)	(b)
Korea	-.08	(b)	-.060	(b)	-.236
Philippines	-.18	+.15	-.271**	-.033	-2.094**
Thailand	(b)	+1.60***	-.391**	+.760*	(b)

(a) reported as having an incorrect sign
(b) not estimated
*** significant at the 99% level
** significant at the 95% level
* significant at the 80% level

Source: Coffin (1970, pp. 61-63); Abbott (1976, pp. 176-179).

It should be noted that these studies differ with respect to methods used in estimation, variable coverage and time period. Differences between those studies and the present research make a direct comparison of results difficult. Coffin combined all country data into one matrix and estimated the effect of changing slopes and parameter levels through the use of dummy variables. Variables in his net import demand equation included substitute cereals and animal units as well as price, income and production. The estimation period was 1959-77. Abbott combined instrumental variables with the ordinary least squares regression technique for individual country equations, covering a

period from 1951 to 1973. His specifications varied among countries but variables such as foreign exchange availability and aid could potentially be included. Jabara used a generalized least squares method on data pooled across countries for the period 1976-79. Foreign exchange availability was used in her study as a proxy for income, and aid was included as a separate variable. None of these studies treated the exchange rate independently.

Individual country elasticity estimates from these studies generally are statistically insignificant and show a mixture of positive and negative signs.

Abbott's study is the closest approximation to this one in terms of methodology and estimation techniques. Differences exist with respect to variable selection and specification. In particular is his inclusion of aid (which has been omitted here for reasons cited earlier) and his candid omission of cross-price effects. Here the exchange rate has been included to capture such effects. Abbott's inclusion of aid may be a reason for differences with this study in wheat price elasticity estimates for some countries--notably Egypt and Brazil.

Coffin's estimates are on average higher than those of the other two studies or of the current study. Most notably, however, except for one industrial country (Italy), none of the estimates obtained using a direct estimation approach are close to those of either Tweeten (1967) or Collins, Meyers and Bredahl (1980). Recall that in these studies trade elasticities were estimated indirectly from domestic elasticities. Clearly, direct estimation of net import demand yields much lower estimates of price elasticity than would be expected from traditional trade theory analysis.

ECONOMIC AND POLICY SENSITIVITY ANALYSIS

Three broad types of sensitivity analyses may be undertaken with each estimated net import demand equation. First, for a given equation, the impact on the level of net import demand may be examined by changing the value of the intercept term. This simulates an increase or decrease in demand represented by a parallel shift in the curve, caused by the intercept change. For example, the effect of removing or lifting an import quota for a good with a perfectly elastic demand could be simulated by adjusting upward the value of the intercept by the increase in the quota.

Second, an impact on net import demand may be simulated by changing the level of one or more exogenous variables, ceteris paribus. A change in the own-price level represents a movement along the curve, while a change in the level of other variables represents a parallel shift in the net import demand curve.

Third, important demand changes may be simulated by changing the slope

coefficient of one or more exogenous variables. These changes are identified as structural changes which involve the "process by which a set of economic variables is believed to be generated" (Foote, 1958, p. 213). Changing the slope coefficients of other exogenous variables shifts not only the curve, but also changes its slope. The attraction in simulating slope changes is that is provides a very useful and direct way of examining the impact of various structural changes arising from changes in economic policies via their impact on particular elasticities of demand.

Economic and policy changes which affect the markets for wheat and coarse grains will have, in reality, one or more of these impacts on their demand curves. Knowing the nature of the impact of a specific policy change, i.e., that it will tend to increase or decrease a particular elasticity of demand, enables that change to be simulated using an estimated demand equation for that component of the overall market. In reverse, by imposing a certain type of change on a given import demand curve, it is possible to simulate a particular type of structural change arising from an economic policy change.

The latter approach is used in this research since the interest here lies more in illustrating the impact of net import demand of broad types of policies rather than of a specific type of policy operating in a particular country. For example, a 10 percent increase in a direct import price subsidy will effectively reduce that product's price level by 10 percent, and in turn, affect net import demand. On the other hand, an economic policy change which leaves prices unchanged but which causes a shift in consumption patterns away from, say, wheat to some other substitute good will be manifested by a change in the slope coefficients, say, on price. In turn, this change will, via the elasticity, impact on the level of net import demand for wheat. Also, other sensitivity analyses may be undertaken by varying incrementally, say, income for given levels of the other exogenous variables or changes in stock levels related to the use of futures markets. When mapped out, these price-quantity combinations produce, for a given experimental design, a series of import demand curves illustrating the sensitivity of demand to equal change in income (or some other exogenous variable).

The breadth of coverage of countries for which wheat and /or coarse grains import demand equations were estimated was, by necessity, limited on structural, data and estimation grounds (see earlier discussion on model estimation). This resulted in a sample of countries, too small in number to effectively group by income levels or geographical location. In Tables 7 to 12 elasticity estimates for selected countries are presented by three income classes, namely, low-income, middle-income and industrialized countries. However, generalized influences about these broad income groups should be made with caution. In particular, conclusions based upon averages of

responses of countries in each income group may be misleading unless careful weighting procedures are followed (see later discussion on further research).

For these reasons, sensitivity analyses are undertaken on an individual equation basis for illustrative purposes. That is, net import demand equations for wheat of selected countries are used to illustrate a specific genre of economic and policy scenarios and not an actual policy. From these illustrations, insights into an expanded agenda of policy research may be obtained. The scope of such extension of this type of analysis is discussed later.

The selection of countries from Appendix Table 1 for these purposes was done on the somewhat arbitrary basis of classification. As stated above, it is for the illustrative purposes of undertaking sensitivity analyses of types of economic policies that individual country equations are chosen. Each of these countries is a major importer and consumers of wheat. It should also be noted that for each equation, the economic model of net import demand, discussed earlier, provided a reasonable fit to the data and explanation of changes in the quantities of wheat imported by these countries over the period 1961-1981.

In Table 14 two types of import analyses are illustrated. The figures in the body of Table 14 are arc elasticities and measure the responsiveness of import to changes in levels or changes in the combined levels and slope coefficients of selected exogenous variables.

In the first part of the table, three specific economic and policy changes, which affect the level of selected exogenous variables, are examined for their impact on net import demand in the five wheat importing countries identified earlier.[22] These results represent the scenario of no structural change. However, it is often important to know how the results change if the underlying demand structure changes. Therefore, in the second part of the Table 14, these same policy changes are each re-examined under a related scenario of structural change.

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[22]This sensitivity analysis is conducted for wheat only. A similar approach could be used for coarse grain demand analysis.

Table 14

IMPACT OF ECONOMIC AND POLICY CHANGES EFFECTING THE LEVEL AND SLOPE COEFFICIENT OF SPECIFIC EXOGENOUS VARIABLES: EACH IMPACT APPLIED INDIVIDUALLY UNDER CETERIS PARIBUS CONDITIONS

COUNTRY	BASE LEVEL		10 PERCENT ONE-PERIOD CHANGE IN THE 1981 LEVEL OF EXOGENOUS VARIABLE DUE TO:			COMBINED IMPACT OF ONE-PERIOD CHANGE IN EXOGENOUS VARIABLE WITH STRUCTURAL (SLOPE) CHANGE IN IMPORT DEMAND DUE TO:		
	Actual 1981	Estimated 1981	Import Price Subsidy	Income Growth	Run-down in Stock Levels	Increased Govt. Interference of Trade	Decreased Income Responsiveness	Reduced Stockholding Responsibility
	[kg per person]		[percentage change in net imports from base level (estimated)]					
LOW INCOME COUNTRIES								
NIGERIA	19.45	17.65	.39	2.47	-7.45 [a]	.24	-.14	-11.39 [a]
MOROCCO	107.89	102.56	.18	12.81	.83	.11	1.87	1.27
MIDDLE INCOME COUNTRIES								
SAUDI ARABIA	73.18	86.14	4.14	6.50	4.63	-.26	-.37	5.46
BRAZIL	36.05	36.55	.60	11.90	1.83	.04	5.88	2.15
INDUSTRIALIZED COUNTRY								
ITALY	24.48	25.56	1.31	14.16	4.9	.37	2.18	5.85

Source: Calculations based on equations in Appendix B.

[a] The positive relationship between stocks and imports in the case of Nigeria is contrary to prior expectations.

POLICY IMPACTS ON THE LEVEL OF EXOGENOUS VARIABLES

The base level for these simulations is the estimated value of net imports in 1981, the last year of observation used in actually estimating the net import demand equation. A starting point other than 1981 could have been chosen for this sensitivity analysis. However, 1981 represented the most recent estimated data point and was representative of levels in recent years.

Three broad policy changes were chosen, each impacting directly on the level of a particular exogenous variable. These policies, an import price subsidy, income growth and a run-down in wheat stock levels, impact on each of import price, income per person and wheat stocks per person, respectively, to increase net imports of wheat (except for Nigerian stock changes).[23] An import price subsidy, represented by a 10 percent, one-period decrease in the 1981 level of the import price, had only a small impact (except of Saudi Arabia) of increasing net imports compared with the relatively elastic response from a 10 percent increase in income per person arising from overall income growth. The third policy change involved a 10 percent decrease in the level of wheat stocks held by these countries. The response of net imports from this run-down in wheat stocks was greater than the price subsidy effect, but less than the income growth scenario. Such a run-down in commodity stocks may arise from economic factors impacting directly upon stock levels themselves. For example, high and rising storage costs to both private and government stockholders may result in stock levels being allowed to run-down, causing increases in net imports of wheat. In general, net imports of wheat are relatively insensitive to the level of wheat stocks in each of these wheat importing countries. It would seem, therefore, the greatest increase in wheat imports may be brought about by policy measures aimed at increasing income growth. This conclusion, however, is predicted on the assumption that the underlying demand structure will continue unchanged. In the next section, the impacts which these policy changes have on net wheat imports are re-examined in scenarios of structural changes in import demand.

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[23]The positive relationship between stocks and imports in the case of Nigeria is contrary to prior expectations.

POLICY IMPACTS WITH STRUCTURAL CHANGE IN IMPORT DEMAND

In addition to changes in the levels of exogenous variables, changes in the underlying relationships between import demand and the exogenous variables influencing demand may also be important. The relationships may themselves be changed by economic and government policy changes. Simulation of these changes, referred to as structural changes in demand relationships, may be illustrated by allowing discrete or continuous changes to the slope coefficients of selected variables.[24] The effect of a continuous change in slope is examined.

In the previous section, three broad economic policy changes affecting the levels of input prices, incomes and wheat stock levels were examined. The assumption that the underlying demand structure does not change made in that analysis is now relaxed. Superimposed over each policy result are three influences which affect the structure of import demand. These influences, applied respectively, are (a) increased government interference with domestic wheat imports, (b) decreased preferences for wheat in human consumption caused by reduced income responsiveness, and (c) a reduced wheat stockholding responsibility borne by wheat importing countries.

The primary concern here is not the source of these structural influences, as potentially there may be many. More important are the impacts such influences may have in changing demand structure and, in turn, in altering the effectiveness of existing policies on import demand. It is possible to construct likely scenarios of these influences. This construction is discussed below with the results of Table 14. Before this, however, it may be necessary to briefly describe the assumptions underlying these calculations.

As already noted, a level change in an exogenous variable is achieved by a 10 percent, one-period change in the 1981 base level of that variable, ceteris paribus. A structural change in import demand is simulated in this analysis through a continuous increase or decrease in the slope coefficient of the particular exogenous variable, ceteris paribus. A major focus in this paper has been the impact which government and domestic government policies have had on the responsiveness of net imports to changes in import prices. The evidence suggests that governments, through various domestic policies, have tended to isolate their domestic market prices for wheat from the world import price. The intuitive reasoning for this slope coefficient change, in the case of, say, price,

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[24] A detailed discussion of these methods and their applications is contained in Cornell (1983).

follows from the notion that government interference causes a reduction in the import price elasticity of import demand. Hence, the .39 percent increase in net imports from a 10 percent reduction in the import price (due to the subsidy) will be less if the government were to further isolate the domestic price from world prices of wheat. In elasticity terms, net import responsiveness from the price reduction, decreases following the structural change due to greater government interference in the wheat import market. To simulate the mechanics of this change in the elasticity, the slope coefficient on price must be increased.

Since each of the structural changes are assumed to impact on wheat import demand in a continuous manner, then somewhat arbitrarily, a percentage change in slope, similar to the 10 percent change in the price level, is assumed. Although this simulated effect on import demand is one calculation, the slope change is equivalent to a 2 percent rate compounded annually over five years.[25] Hence, this compound rate over the five-year period is a little more (less) than 10 percent when the slope coefficient is increased (decreased). The effect on import demand of each structural change when superimposed on each respective economic or policy change is presented in the second part of Table 14. A result of this government intervention scenario is that the effectiveness of the one-period, 10 percent import price subsidy on net imports of wheat is reduced. The elasticity of import demand for wheat with respect to the import price has decreased and is lower than what might prevail in the absence of that interference by government.

In the case of Nigeria, the import response from a simulated 10 percent import price subsidy fell from .39 percent to .24 percent. For Saudi Arabia, the response declined from 4.1 percent to -.26 percent,[26] and for Italy from 1.31 percent to .37 percent ceteris paribus. In effect, this structural change implying greater government interference with the price transmission mechanism substantially undermines the effectiveness of the import price subsidy. A further result of this reduction in import price elasticity is to shift greater instability of domestic supply of wheat onto the world market and export prices.

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[25]The impact on net imports is equivalent to the maximum effect of the compounded slope change coinciding with a 10 percent import price subsidy occurring in year five.

[26]The negative sign indicates that the import augmenting effect of the import price subsidy ismore than offset by the reducing effect of government interference with price transmission in the wheat trade.

A phenomenon observed in many countries where wheat is consumed as a major human food staple is that wheat forms a smaller component of the food budget as imcomes rise. Wheat has become an inferior good through its declining preference in human consumption. Hence, these consumers are spending a proportionally smaller amount of their food budget on wheat. To simulate the effect of this development in wheat import demand, the slope coefficient of income is reduced, hence, reducing the income elasticity under ceteris paribus conditions. Where this underlying change in the structure of import demand, i.e., decreased income responsiveness, is occurring, income growth will have a smaller augmenting effect on the demand for wheat imports. From Table 14, this simulated change in the character of food consumption results in a large decline in the response of net imports of wheat arising from the growth in income per person. For example, the import response from a 10 percent, one-period increase in income per person fell from 12.8 percent to 1.9 percent in Morocco and from 11.9 percent to 5.9 percent in Brazil, ceteris paribus.

In addition to the issue of domestic policies of government shifting their price instability problems onto residual world grain markets, the responsbility for stabilizing commodity prices by sharing the burden of stockholding has also been an important trade issue. A criticism leveled at most wheat importing countries is that they have taken little responsibility for carrying other than pipeline wheat stocks, a responsibility primarily borne by the USA and, to a lesser extent, by Canada and Australia.. The consequence of this behavior for wheat trade is to increase the responsiveness of net imports to change in stock levels. This, in turn, may create considerable uncertainty in the market and risk continuity of wheat exports to these countries. A simulated scenario of this behavior of reduced stockholding responsibility of wheat importing countries is illustrated in the last column of Table 14. This structural change in net import demand results in an increased stocks elasticity of import demand. Therefore, for a given run-down in stock levels, a proportionally greater decline in net imports is experienced. In Morocco the import response from a simulated 10 percent run-down on wheat stock levels rises from .8 percent to 1.3 percent; from 4.6 to 5.5 percent in Saudi Arabia and from 1.8 percent to 2.2 percent in Brazil, ceteris paribus.

SCOPE FOR EXTENSION OF THE ANALYSIS

Analysis of the impact of a change in the level of an exogenous variable is quite straightforward. Similar results may be obtained by applying the elasticity estimates calculated earlier at their mean values and presented in Tables 7 to 12. However, both this analysis and the simulated impacts of structural changes in demand may be more

extensively and dynamically examined within a sectoral or industry model of agriculture. In a multi-equation model such as the Michigan State University Agriculture Model, the interactions among equations may be examined. The analysis presented here, by comparison, is limited in that first, a single equation model is used, and second, only immediate one-period impacts, and not continuous changes through time, may be easily assessed.

For instance, a one-period decrease in the import price of wheat resulting from an import price subsidy will, over time, affect net imports of wheat and coarse grains, which, in turn, affect U.S. wheat exports and production of wheat. Production and prices of other grains and of livestock will similarly be affected. Alternatively, the impact of a continuous import price subsidy may provide further insights into the dynamic interactions among equations. This type of analysis may identify short-run versus long-run dynamics of particular economic policies. From these results, multipliers may be calculated. One-period policy impacts may then be compared with continuous policy impacts.[27] In these analyses, simulations beyond the current period may be more simply made. This is particularly valuable in tracking the dynamic character of policy changes made in the current period.

Examination of structural changes in market relationships are also possible within a broader, integrated model such as the MSU Agriculture Model. For example, the effect of increasing the own-price elasticity for wheat imports on the international and U.S. grain markets may be investigated. To do this, a base model run to, say, 10 years beyond the current period is compared with a model run where the slope coefficient of the wheat price is increased annually over the projection period by some function with respect to time (Cornell, 1983, pp. 363ff). This change may represent a continuation of a historical trend or a substantial departure from it.

A particular advantage of the simulation approach to agricultural sector modelling is that constituent agricultural commodities may be analyzed simultaneously. Important cross-commodity effects may be considered. For some analyses of the effects of policy changes, a simulation model of this kind has advantage over the alternative multiplier analysis (Labys, 1973, p. 199). For instance, analysts may consider in a simulation analysis varying rates of change or various changes in the level or slope coefficient of an exogenous variable or of several exogenous variables together. This flexibility provides a

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[27] Simulations of these and other types using the MSU Agriculture Model are presented in Cornell (1983).

considerable advantage in the evaluation of different policy and economic scenarios in agriculture. Examination is possible of joint effects of these economic and policy scenarios or structural changes impacting dynamically over time. They provide a powerful extension of the type of analysis presented here.

A further extension of this analysis concerns the possible aggregation of individual country relationships into regions or other groupings; for example, by income classes. Initially an objective of this research, aggregation was prevented, however, by the unavailability of certain data, inconsistency of the form of some data and various other problems discussed earlier. It may be possible to overcome some of these difficulties by concentrating the effort on one region. This region may represent grain importers, for example, for Latin America, Africa or OPEC. The aggregation would provide more than an individual country analysis, but may be more meaningful than a fully aggregated analysis of import behavior. This will at least permit the testing, at a regional level, the hypothesis concerning the relative magnitude of the price elasticity of import demand for wheat or coarse grains. Furthermore, this degree of regional aggregation would prove useful in commodity forecasting and in economic policy analysis of the region.

CHAPTER 5

POLICY CONSIDERATIONS

The results of this study relate most directly to policies of importing countries with implications for major exporting countries. There are many different policy instruments and policy mixes which are used to achieve national objectives with respect to agriculture (Jabara, 1982). The policies to be discussed here are not exhaustive of those having an effect on agriculture but have been selected as having particular relevance to trade elasticities estimated in this study. These include price and income policies, stock policies and financial policies.

Price and Income Policies

Price and income policies can be used for a variety of objectives; for example to improve the welfare of producers or consumers, to raise government revenue, or to acheive long-run development objectives (Jones and Thompson, 1978). Most importing countries operate some kind of domestic agricultural price and/or income policies. Often price policies are a means of achieving income objectives for domestic consumers or domestic producers or both, and may also be used to enhance domestic government revenues.

The European Community

The Common Agricultural Policy (CAP) of the European Community is an example of a comprehensive policy which uses common border controls as a pivotal instrument to influence the internal situation (Josling, 1980). While initial objectives included consumer and producer welfare, operation of the CAP favors the latter group. Josling (1980) has inputed subsidy equivalents of the CAP which are positive for domestic producers and negative for domestic consumers for most of the period 1968-76. These estimated impacts of the CAP demonstrate a domestic price incentive structure lacking orientation to changes in the world price.

The impact of CAP import levies is reflected in the low and insignificant price elasticities estimated for European Community countries. The response of these countries' grain imports to changes in the world price (expressed in real domestic country

currency) appears very weak in the short-run. For wheat, price elasticity estimates[28] for Italy and Germany were 0.19 and 0.34 respectively. For coarse grains, these are -0.15 and 0.16 respectively. These results do not imply European demand responds positively to domestic prices but only that the cushion between domestic prices and import prices provided by the import levy is strong enough to offset any immediate import response to market conditions outside the European Community.

One implication of this result for exporters is that they can no longer compete with European Community producers on the basis of price. Moreover, production incentives in the Community not only have encouraged a higher level of self-sufficiency in many agricultural commodities including grains over the last 20 years, but also have brought the European Community into export competition for some grains (Elleson, 1983).

However, if the link between European Community import demand and import prices is weak, the world market situation still has an impact on the Community as it affects the budget costs of the CAP (Josling and Pearson, 1982, p. 2). It is the level of support above import prices rather than the specific instruments used that is of concern (Gifford, 1980). There is evidence in the press and elsewhere that budgetary pressures now exist (Wall Street Journal, July 27, 1983; New York Times, October 11, 1983; Josling and Pearson, 1982, p. 27). Despite the pressures, the European Community has thus far been reluctant to significantly reduce the level of this support to agriculture. To the degree that pressure within the European Community to reduce farm support levels is related to the difference between the world price and the internal support level, there is some incentive to major exporters to maintain a low world price.

Less Developed Countries

Under the nomenclature of less developed countries lies a heterogeneous group of nations, each with its own set of resources, goals and priorities. However, one relatively common thread in LDCs is government intervention in grain prices, particularly food grain (wheat and rice) prices (USDA, 1983; CIMMYT, 1982). Low grain prices protect consumer interests often at the expense of producer interests. As has been suggested by Timmer (1982, p. 122), political considerations provide one important reason for this strategy: "a government that cannot raise food prices because it will no longer be the government, will not raise food prices, no matter how critical that is to long-run efficiency."

The effect of such pricing policies in LDCs can be seen in the low price elasticity

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[28]Using the traditional four-variable specification.

estimates obtained here for net imports of coarse grains and especially of wheat. A CIMMYT (1982) study has documented urban consumer-oriented policies in many LDCs, which set domestic prices at levels 'reasonable' in light of domestic political and economic concerns. Governments are often effective in insulating domestic wheat-produce prices from changes in the world wheat price, though less so for coarse grains. Low price elasticities of imports with respect to changes in the domestic border price of grains can be expected where government policies have more of an effect on domestic demand and supply conditions, and thus on imports, than does the external environment. Here, LDC import price elasticities were lower for wheat than for coarse grains (typically between -0.3 to -0.05 as compared with -0.5 to -0.1). This result concurs with the CIMMYT finding that domestic wheat price policies are more complete than those for caorse grains in many LDCs.

Further, in the case of wheat, elasticity estimates of net imports with respect to domestic production are small for many LDCs (less than -0.5 in 13 out of 16 countries) in comparison with those for wheat in developed countries and for coarse grains in general. These relatively low domestic production elasticities are less likely to indicate higher production levels relative to consumption than the presence of domestic pricing policies, typically favoring higher-income urban consumers (USDA, 1983; Mellor, 1978). Further, a lack of physical marketing channels through which to market domestic grain can effectively separate the domestic production/net import relationship. Abbott (1976), for instance, actually treats in his model specification, a part of the domestic grain production base as an enclave, isolated from the urban market.

One important implication of the apparent price-insulating effect of LDC policies is that international prices are a poor medium through which exporters can influence the level of net imports, at least in the short-run. Given the positive, significant income elasticities for net imports of grains in many LDCs, a more appropriate means to achieve higher net imports may be by increasing purchasing power in these areas. This might involve increasing income directly, for example by increasing export goods from these LDCs, or the use of other options such as aid or consessional credit.

Related to income in LDCs is the issue of aid. Although aid has not been an integral part of this study, Grigsby (1983) has demonstrated that aid has both a direct consumption effect and an income-augmenting effect (see also CIMMYT, 1982). Thus aid can affect trade volumes in two ways. First, aid may be tied to policies which directly increase consumption. Such policies might include market promotion policies or the improvement of marketing infrastructure for wider dissemination of imports. Second, aid may induce income growth. For example, aid can permit a country to save foreign

exchange, which can then be used for development purposes. The income effect of aid on net imports is likely to be longer-run than the price effect.

The existence of consumer-oriented price policies in many LDCs reflects an underlying tradeoff among governments' many social objectives and can lead to import dependency. In the short-run, low consumer prices allow more consumers greater exposure to the imported grain. However, through increased imports, income can be drained away from a country in the longer-run. Especially where wheat is not a traditional staple (such as the tropical belt of the world[29]) and increased domestic production is difficult to sustain relative to consumption, dependency on food imports can potentially strain domestic resources (CIMMYT, 1982). This issue is one where exporter and importer objectives appear to coincide in the short-run but in the long-run may lead to deleterious effects for both. Where greater import dependence inhibits growth in LDC income, a greater rather than a smaller concessional role may be required by aid donor countries. It may be to the long-run advantage of exporters to build up local markets for indigenous staples in order to maintain income growth and political stability and thus build stronger markets for the future.

Returning to the issue of instability, several authors have pointed out that world market price instability is likely to increase in the presence of national price-insulating policies, and in the absence of buffer stocks (Grennes, Johnson and Thursby, 1978; Shei and Thompson, 1977; Zwart and Meilke, 1979; White, 1984). Blandford (1983) examined the relationship between net imports of both wheat and coarse grains on one hand and domestic production and world prices on the other hand. He regressed the change in net imports of each grain against the change in domestic production and the change in world prices. A positive price response found for all countries (except the U.S.) was interpreted as destabilizing to world trade. As with the current study, this price elasticity was often found to be insignificant in Blandford's study. A negative production response was interpreted as the transmission of domestic production variability on world markets. Among importers, Blandford found that most countries pass at least some of their production variability onto world markets. In the current study, elasticity

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[29]This region is defined by CIMMYT as a subgroup of developing countries that is entirely between 23 degrees N. and 23 degrees S. latitude. It includes all countries of Subsaharan Africa (except South Africa and Lesotho), Southeast Asia, Central America and Caribbean (except Mexico), Andean Region, Sri Lanka, Yemen Arab Republic and Yemen Democratic Republic.

estimates of net imports with respect to domestic production are typically small but negative, lending some support to Blandford's conclusion.

The impact of state trading organizations on world market price instability is inconclusive. Typically state trading organizations are formed as an instrument of domestic policy rather than of foreign trade policy (McCalla and Schmitz, 1982, p. 65). Where they concentrate on domestic stabilization goals, they are an effective instrument in separating domestic prices from world prices (Kostecki, 1982, pp. 24,30), rendering price response of import demand less elastic and thus contributing to world price instability. Further, there is an opportunity for state trading organizations in increase market instability where one side of the transaction is carried on by private traders. McCalle and Schmitz (1982, p. 71) cite the Soviet Union as being in the position to intentionally 'manufacture' price instability to their own advantage.

However, as opposed to private traders who tend to maximize short-run profits, state traders focus more on absolute price levels in achieving their objectives for domestic producers. In this sense, greater market stability may be introduced through state trading operations. In a study on the operation of state trading organizations, Kostecki remarks that the grain futures markets, which provides a mechanism to shift risks arising from market volatility, may not function if all trade were on a government-to-government basis.

Stockholding Policies

Willingness to hold stocks relates to associated costs and benefits facing each country. Costs associated with stockholding include physical and institutional characteristics of individual countries and technical knowledge about storage. Generally in exporting countries, the environment, including climate, pests, existing infrastructure, and technology, is more conducive to lower stockholding costs than in more tropical, less developed regions (Morrow, 1980). Beyond the necessary pipeline stocks, there are benefits of holding stocks to buffer short-run market variation and also to enhance food security.

The United States and other major grain exporters traditionally have held the majority of grain stocks. This has been largely a corollary of domestic price and income policies than a result of concerted stockholding policies (Hillman, 1981, p. 131; Morrow, 1980, p. 25). Elasticity estimates presented in this study show that between 1960 and 1981, the majority of LDCs and all industrial countries used stocks largely as a buffer against short-term market variations. However, in recent years LDCs appear to have increased their grain stocks for other purposes.

A USDA (1983, p.3) report on food policies in LDCs notes that "after the international grain price instability during 1973-75, many developing countries shifted the focus of their food policy objectives toward food self-sufficiency and domestic price stability." It is somewhat ironic that the pressure for LDCs to bear the costs of stockholding, i.e., the cost of grain price instability, is itself being increased by LDC pricing policies. Further, a positive relationship between net imports and stocks found in this study for some LDCs can add pressure on world prices, especially when world supplies are tight.

Morrow (1980, p. 26) has documented shifts in stockholding of wheat between major exporters and importers for two periods--1960/1-1970/1 and 1972/3-1978/9. Carryover stocks for four major exporters (the United States, Canada, Australia and Argentina) as a percentage of world stocks declined from 83.8 percent to 52.9 percent between the two periods; stocks in the European Community rose from 7.3 percent to 9.5 percent; while stocks in the 'rest of the world' category rose from 4.7 percent to 24.7 percent.

Morrow then traced the effects of these shifts at different levels of world supply. It appears that when supplies are high, stocks fall below optimal levels in the absence of exporter efforts to hold grain for the purpose of increasing price. This is because domestic market insulation policies (high producer prices) discourage private stockholding under such conditions. However, as Morrow notes, when supplies are short, food security concerns dominate and world stocks tend to exceed profitable levels.

Morrow's study reveals that many developing countries absorb, especially under tight market conditions, some cost in maintaining stocks within their technical and financial constraints. This is corroborated by the relatively small stocks elasticities (generally less than 0.2) estimated in this study. The overall increase in world stockholding costs, arising from higher carrying costs in many importing countries and the tendency to overstock when world supplies are tight, appears to be balanced by benefits felt by importers in having control over an adequate supply of grain.

However, maintenance of a stable supply by major producers may enhance export markets in the longer run (by reducing the costs of LDCs in maintaining consumption levels). Further, as Kostecki (1982) argues, state trading organizations in importing countries and also in some exporting countries may play a role in reducing costs, either by passing on economies of scale in marketing, or by subsidizing such market functions as storage, transportation or credit at levels unlikely by private traders.

FINANCIAL POLICIES

Financial policy instruments typically fall into the category of trade policy rather than agriculture policy per se. However, this study and others (Chambers, 1984; USDA,

1984; Schuh, 1983) have remarked on growing importance of such instruments for agricultural trade.

With respect to the level of foreign exchange reserves, external debt has been cited as a direct cause of current lagging imports by many LDCs (USDA, 1984, p. 3). The response of net imports to a change in foreign exchange reserves estimated in the current study provides some evidence that low income countries are affected more by foreign reserve constraints than are countries in higher income groups. However, in general the response is small (less than 0.2) and of low significance. These results raise some questions with respect to the importance of credit on imports during 1960-1981 and also to the pervasiveness of the global debt problem.

To what extent has credit availability mitigated the expected positive relationship between the level of reserves and net imports? The USDA (1984, p. 5-6) reported that an expansion of commercial lending to LDCs had a positive effect in bringing about economic recovery in these countries after the first oil price shock in the early 1970s. However, the same recovery did not occur after the 1978 oil price shock and currently, commercial banks have reduced their LDC lending below levels of the late 1970s. Further, the USDA notes that the International Monetary Fund financing is increasingly associated with conditions that are aimed at increasing exports and reducing imports of countries perceived to have serious debt problems. In such an environment, credit policies of major exporters can be expected to have a significant impact on their level of exports to certain LDCs.

Another question concerns how recent and how widespread is the 'debt crisis.' It has been estimated that growth of external debt in LDCs averaged 21 percent annually during much of the 1970s. The USDA (1984, p. 3-4) reports that until 1981/2 exports from these countries "kept pace with the debt buildup," implying that the level of reserves had not been reduced to critical levels during the time period 1960-81. However, in future years there may be cause for concern among exporters and importers alike over the ability for some LDCs to pay for food imports. In-depth cross-sectional studies could help in answering this question better than the time-series data used here. Consideration of this question could also include the credit aspects discussed above.

Exchange rates have been included here as a separate variable in estimating net import demand. As such, a negative relationship between net imports and exchange rates indicates some substitution of domestic food grain supply for imports may have taken place. That is, as foreign currency becomes stronger vis a vis the U.S. dollar (a reduction in the exchange rate variable), prices of indigenous, nontraded grains rise relative to imported grains. A positive relationship indicates either the existence of country-

specific characteristics which are not conducive to substitution or some complementarity between domestic nontraded good and grain imports.

Exchange rates also affect net import demand by directly altering the actual cost of imports through price. A developing-country policy report by the USDA (1983, p 7) found that overvaluation of foreign currency was 'symptomatic' of policies of developing countries. If this latter analysis is accurate, exchange rate policies of LDCs have operated as a tax on exports and a subsidy on imports. However, as discussed earlier in this report some studies have hypothesized that recent appreciation (post 1981) of the U.S. dollar has hurt the competitive position of the United States as a grain exporter. In fact, financial pressure on many LDCs has led to recent devaluations of their currencies against the U.S. dollar. This is seen throughout the world, in Latin America, the Middle East and North Africa, South Asia, and South East Asia. A strong dollar will be an incentive to many LDCs to reduce their reliance on imported food, particularly from the United States.

APPENDIX A

COUNTRY LIST

WHEAT	COARSE GRAINS
Less Developed Countries-Low Income[1]	
Philippines	Egypt
Sri Lanka	Nigeria
Thailand	Tunesia
Egypt	Philippines
Morocco	Peru
Nigeria	Columbia
Tunesia	Ecuador
Peru	
Columbia	
Ecuador	
Bolivia	
Paraguay	
Less Developed Countries, Middle Income[3]	
Korea	Israel
Malaysia	Chile
Israel	Venezuela
Brazil	
Chile	
Venezuela	
Oil Exporters[2]	
Saudi Arabia	Saudi Arabia
Libya	Libya
Industrial Countries	
Japan	Japan
Germany	Germany
Italy	Italy
Portugal	Switzerland

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1. Average per capita income $400 - $1630,
2. Average per capita income $8450 - $24,660,
3. Average per capita income $1700 - $5670, according to the World Bank Annual Report.

APPENDIX B

COUNTRY EQUATIONS FOR WHEAT AND COARSE GRAINS

BOLIVIA

CONST.	PRICE	GDP	PROD.	STOCKS	FX	XR	F	DW	$\bar{R}2$
WHEAT									
50.91	- .567	.166	- .397	- .785	.181	-2.642	2.987	2.595	.362
	(.582)*	(1.849)	(.490)	(.228)	(.960)	(2.739)			
49.31	- .915	.316	- .469#				1.045	1.886	.641
	(.957)	(1.036)	(1.215)						

BRAZIL

CONST.	PRICE	GDP	PROD.	STOCKS	FX	XR	F	DW	$\bar{R}2$
WHEAT									
25.74	- .149	.200	- .795	-1.302	- .446	- .557	10.135	1.724	.723
	(1.079)	(4.832)	(5.464)	(2.442)	(1.098)	(1.200)			
26.02	- .853	.153	- .787	- .987			14.957	1.561	.727
	(.702)	(7.189)	(6.331)	(2.572)					

CHILE

CONST.	PRICE	GDP	PROD.	STOCKS	FX	XR	F	DW	$\bar{R}2$
WHEAT									
42.77	.297	- .346	- .403	.103	.146	.643	2.585	1.639	.312
	(2.543)	(.448)	(.143)	(.197)	(.907)	(.558)			
-10.97	.198	.555	.117#				4.800	1.657	.352
	(2.302)	(2.144)	(.719)						
COARSE GRAINS									
-15.67	.771	.250	.257	- .394	.167	- .905	4.314	1.334	.486
	(.152)	(1.167)	(1.556)	(1.062)	(3.295)	(2.378)			
-11.21	- .413	.210	.312	- .205			2.080	1.012	.171
	(.880)	(1.988)	(1.855)	(.440)					

COLUMBIA

CONST.	PRICE	GDP	PROD.	STOCKS	FX	XR	F	DW	$\bar{R}2$
WHEAT									
3.77	- .306	.311	- .602	-1.709	.350	.626	20.496	2.055	.848
	(1.977)	(2.039)	(1.754)	(6.585)	(1.302)	(.536)			
6.95	- .500	.561	- .262	-1.460			26.490	2.500	.829
	(4.480)	(6.147)	(.947)	(6.038)					
COARSE GRAINS									
12.48	- .116	.178	- .217	- .472	.534	.126	6.124	2.718	.594
	(.314)	(.065)	(1.634)	(.795)	(1.559)	(.496)			
- 2.60	- .553	.357	- .135#				11.130	2.644	.591
	(2.267)	(5.726)	(1.176)						

ECUADOR

CONST.	PRICE	GDP	PROD.	STOCKS	FX	XR	F	DW	$\bar{R}2$
WHEAT									
14.53	.902	.621	-1.077	- .499	.177	- .314	82.911	1.922	.959
	(.304)	(2.739)	(2.849)	(.993)	(.555)	(.134)			
12.07	- .280	.744	- .933#				165.485	1.439	.959
	(.108)	(4.023)	(3.107)						
COARSE GRAINS									
8.83	- .837	- .224	- .118	- .818	.764	.191	21.680	2.651	.855
	(3.648)	(2.006)	(1.544)	(.998)	(4.631)	(1.410)			
6.33	- .645	.218	- .161#				16.946	1.818	.695
	(2.201)	(3.696)	(2.070)						

EGYPT

CONST.	PRICE	GDP	PROD.	STOCKS	FX	XR	F	DW	$\bar{R}2$
WHEAT									
64.08	.010	.294	- .777	.555	- .322	-45.370	19.262	1.610	.839
	(.077)	(3.348)	(1.223)	(1.381)	(.499)	(.892)			
58.06	- .043	.215	- .631	.785			30.390	1.653	.848
	(.383)	(5.445)	(1.084)	(2.853)					
COARSE GRAINS									
15.74	.603	.103	- .235	- .199	- .525	-30.698	4.492	1.365	.499
	(.703)	(1.802)	(.864)	(.205)	(.137)	(1.128)			
-13.67	.197	.650	.426#				8.081	1.670	.503
	(.285)	(3.083)	(.577)						

GERMANY

CONST.	PRICE	GDP	PROD.	STOCKS	FX	XR	F	DW	$\bar{R}2$
WHEAT									
-53.76	.255	.696	- .135	- .678	.358	22.068	9.618	2.248	.711
	(1.184)	(.324)	(.627)	(2.822)	(1.609)	(1.830)			
90.87	.100	_ .179	- .844	- .897			12.472	1.891	.686
	(.541)	(1.516)	(.384)	(4.167)					
COARSE GRAINS									
45.55	.244	.564	- .530	-1.158	.443	20.588	2.386	1.1	.284
	(.39)	(2.217)	(2.572)	(1.969)	(.104)	(1.132)			
166.61	.322	.257	- .566	- .937			2.86	.738	.262
	(.583)	(1.551)	(2.802)	(1.667)					

ISRAEL

CONST.	PRICE	GDP	PROD.	STOCKS	FX	XR	F	DW	R2
WHEAT									
101.97	.182	.192	-1.299	- .616	.135	-6.547	9.559	2.589	.710
	(2.985)	(4.041)	(6.248)	(3.446)	(.710)	(4.793)			
109.68	.114	.838	- .720	- .280			3.728	1.933	.342
	(1.297)	(1.581)	(2.836)	(1.138)					
COARSE GRAINS									
77.45	.411	.349	- .906	.478	- .795	-1.687	16.366	2.218	.814
	(1.651)	(2.904)	(2.019)	(.959)	(1.918)	(.795)			
105.27	.287	.245	-1.079	.274			19.138	1.811	.776
	(1.184)	(2.030)	(2.220)	(.510)					

ITALY

CONST.	PRICE	GDP	PROD.	STOCKS	FX	XR	F	DW	R2
WHEAT									
156.30	.163	.516	- .721	- .906	- .370	- .278	11.647	1.732	.753
	(.50)	(2.502)	(6.623)	(3.15)	(1.241)	(1.322)			
129.42	.197	.121	- .615	- .732			11.678	1.395	.670
	(.592)	(.711)	(5.235)	(2.284)					
COARSE GRAINS									
205.78	- .169	.309	-1.883	-1.431	- .703	- .163	13.572	2.149	.782
	(2.168)	(7.374)	(5.035)	(1.457)	(1.885)	(.519)			
210.21	- .920	.308	-2.260	-1.200			17.071	2.397	.754
	(1.278)	(7.214)	(8.213)	(1.164)					

JAPAN

CONST.	PRICE	GDP	PROD.	STOCKS	FX	XR	F	DW	R2
WHEAT									
59.37	- .325	.168	-1.176	- .384	- .349	- .124	79.546	2.284	.957
	(1.381)	(.632)	(6.717)	(1.30)	(.499)	(.740)			
58.60	- .331	.688	- .804#				120.721	1.369	.945
	(1.249)	(3.708)	(6.405)						
COARSE GRAINS									
159.94	- .365	.562	-1.269	- .626	- .974	- .323	252.998	1.508	.986
	(2.755)	(6.304)	(2.829)	(.955)	(3.737)	(4.172)			
22.18	- .389	.535	- .855	1.631			188.856	1.562	.973
	(2.124)	(4.646)	(1.406)	(3.010)					

KOREA

CONST.	PRICE	GDP	PROD.	STOCKS	FX	XR	F	DW	$\bar{R}2$
WHEAT									
38.71	- .164	- .159	-2.116	1.556	- .945	.327	6.235	1.533	.599
	(.357)	(.067)	(1.165)	(2.124)	(.669)	(1.015)			
37.23	.116	.482	-2.046	1.768			8.090	1.461	.575
	(.263)	(.368)	(1.096)	(2.620)					
COARSE GRAINS									
6.25	- .577	.625	- .240	- .112	.485	.334	36.072	1.963	.909
	(.858)	(2.755)	(1.089)	(.611)	(.373)	(.113)			
2.56	- .630	.710	- .160#				84.772	1.859	.923
	(1.209)	(15.630)	(1.319)						

LIBYA

CONST.	PRICE	GDP	PROD.	STOCKS	FX	XR	F	DW	$\bar{R}2$
WHEAT									
257.05	- .155	.405	- .451	-2.816	- .656	-478.357	40.625	2.390	.919
	(.931)	(4.772)	(1.817)	(2.871)	(1.327)	(1.901)			
67.12	.143	.474	- .403	-3.438			49.895	2.360	.903
	(.088)	(11.155)	(1.592)	(3.364)					
COARSE GRAINS									
76.05	- .738	- .157	- .250	(a)	.196	-21.702	4.090	1.963	.469
	(1.581)	(1.223)	(.874)		(2.768)	(.059)			
82.82	- .645	.244	- .617	(a)			4.242	1.437	.317
	(1.506)	(.553)	(2.277)						

MALAYSIA

CONST.	PRICE	GDP	PROD.	STOCKS	FX	XR	F	DW	$\bar{R}2$
WHEAT									
19.16	.315	.116	(a)	- .910	.954	2.585	.198	2.185	-.236
	(.276)	(.305)		(.119)	(.314)	(.320)			
29.32	.180	.103	(a)	- .199					
	(.204)	(.969)		(.296)			.316	2.193	-.108
COARSE GRAINS									
112.84	- .486	.208	2.633	2.059	- .472	-28.762	24.229	1.559	.869
	(1.849)	(.246)	(.816)	(1.092)	(.943)	(2.081)			
- 6.58	- .151	.107	1.877#						
	(.598)	(2.024)	(1.455)				42.921	1.222	.857

MOROCCO

CONST.	PRICE	GDP	PROD.	STOCKS	FX	XR	F	DW	$\bar{R}2$
WHEAT									
56.99	- .192	.352	- .508	- .382	- .599	-8.793	7.719	1.306	.658
	(.106)	(3.389)	(4.148)	(.876)	(1.352)	(.574)			
9.83	- .137	.354	- .479#				15.668	1.197	.677
	(.942)	(5.716)	(4.143)						

NIGERIA

CONST.	PRICE	GDP	PROD.	STOCKS	FX	XR	F	DW	$\bar{R}2$
WHEAT									.883
-17.88	- .638	.815	6.173	10.270	.136	24.366	27.374	1.298	~~.296~~
	(.521)	(1.067)	(.555)	(3.643)	(.439)	(.883)			
- .80	- .325	.696	9.665	9.171			44.021	1.228	.891
	(.354)	(2.236)	(.971)	(4.163)					
COARSE GRAINS									
- 7.39	- .215	.642	- .261	1.384	.355	2.547	39.390	2.906	.916
	(1.278)	(.044)	(.584)	(9.572)	(.851)	(3.139)			
1.41	- .183	- .138	.178	1.154			38.549	2.131	.877
	(.909)	(1.977)	(.363)	(8.684)					

PARAGUAY

CONST.	PRICE	GDP	PROD.	STOCKS	FX	XR	F	DW	$\bar{R}2$
WHEAT									
124.15	- .233	- .711	- .122	- .811	.253	(a)	8.634	1.746	.645
	(.108)	(5.296)	(.383)	(1.754)	(4.520)				
84.69	- .518	- .145	- .615	-1.366			2.653	.835	.239
	(1.892)	(2.043)	(1.397)	(2.095)					

PERU

CONST.	PRICE	GDP	PROD.	STOCKS	FX	XR	F	DW	R2
WHEAT									
12.27	- .145	.806	1.001	.747	- .518	.169	5.058	2.005	.537
	(3.668)	(1.814)	(1.294)	(1.271)	(1.147)	(1.400)			
22.00	- .117	.642	.496#				9.467	1.914	.547
	(3.358)	(3.869)	(1.386)						
COARSE GRAINS									
9.78	.111	.754	- .616	1.591	.895	- .588	8.086	1.031	.669
	(.092)	(1.327)	(1.898)	(.732)	(.106)	(.326)			
- 9.40	.840	.110	- .584#				17.216	.928	.698
	(.937)	(4.166)	(2.628)						

PHILIPPINES

CONST.	PRICE	GDP	PROD.	STOCKS	FX	XR	F	DW	$\bar{R}2$
WHEAT									
6.75	- .107	.306	(a)	- .586	- .795	- .890	2.767	2.141	.296
	(.864)	(2.105)		(1.422)	(1.833)	(.160)			
14.27	- .244	.121	(a)	- .476			3.241	1.878	.243
	(2.427)	(2.565)		(1.133)					
COARSE GRAINS									
9.27	- .347	- .323	- .208	.109	.997	1.063	6.739	1.822	.621
	(2.260)	(.211)	(2.087)	(1.292)	(2.508)	(2.011)			
- 4.79	.477	.296	- .150	.361			5.475	1.806	.460
	(.498)	(2.616)	(1.368)	(.442)					

PORTUGAL

CONST.	PRICE	GDP	PROD.	STOCKS	FX	XR	F	DW	$\bar{R}2$
WHEAT									
47.98	- .331	.331	- .750	- .671	- .267	.492	25.658	1.943	.867
	(.415)	(1.772)	(5.760)	(1.613)	(.864)	(1.524)			
61.15	.467	.328	- .978	- .216			28.967	2.028	.842
	(.054)	(1.663)	(9.423)	(.530)					

SAUDI ARABIA

CONST.	PRICE	GDP	PROD.	STOCKS	FX	XR	F	DW	$\bar{R}2$
WHEAT									
226.42	- .608	.101	.539	- .872	- .896	-32.105	8.898	2.204	.693
	(3.730)	(1.012)	(.876)	(1.662)	(1.858)	(1.618)			
95.16	- .677	.876	.243	- .555			10.632	1.634	.647
	(3.967)	(1.881)	(.379)	(1.459)					
COARSE GRAINS									
9.27	- .816	.451	- .316	4.712	- .258	-15.892	46.810	1.876	.929
	(2.777)	(2.943)	(.325)	(1.496)	(4.833)	(.614)			
- 4.79	- .336	.257	-1.559	9.895			28.529	1.036	.840
	(.810)	(1.983)	(1.106)	(2.984)					

SRI LANKA

CONST.	PRICE	GDP	PROD.	STOCKS	FX	XR	F	DW	$\bar{R}2$
WHEAT									
21.94	- .244	.157	(a)	.991	- .556	-2.452	2.717	2.287	.290
	(.385)	(1.713)		(.957)	(2.048)	(1.205)			
33.01	- .618	.523	(a)	1.464			1.319	1.727	.044
	(.866)	(1.023)		(1.295)					

SWITZERLAND

CONST.	PRICE	GDP	PROD.	STOCKS	FX	XR	F	DW	$\bar{R}2$
COARSE GRAINS									
24.58	- .912	.950	- .877	-1.623	- .162	-6.326	16.750	2.074	.818
	(.147)	(5.917)	(1.531)	(2.126)	(1.759)	(.697)			
-74.08	.196	.100	- .469#				28.999	1.621	.800
	(.379)	(6.613)	(1.828)						

THAILAND

CONST.	PRICE	GDP	PROD.	STOCKS	FX	XR	F	DW	$\bar{R}2$
WHEAT									
- 2.75	- .205	.434	(a)	-1.024	- .174	.116	28.167	1.090	.866
	(2.312)	(8.271)		(2.842)	(2.125)	(.600)			
- .84	.199	.374	(a)	- .574			35.125	1.118	.830
	(1.991)	(7.057)		(1.622)					

TUNESIA

CONST.	PRICE	GDP	PROD.	STOCKS	FX	XR	F	DW	$\bar{R}2$
WHEAT									
93.91	- .146	.312	-1.005	-1.106	.142	-24.581	24.912	2.011	.872
	(.776)	(6.134)	(6.796)	(2.035)	(.527)	(.234)			
70.34	- .589	.338	- .978#				52.213	1.796	.880
	(.357)	(12.148)	(9.085)						
COARSE GRAINS									
16.18	- .126	.165	- .284	- .945	- .261	-54.142	6.001	.703	.588
	(.286)	(3.639)	(1.096)	(.281)	(.969)	(.496)			
7.85	- .489	.119	- .132#				11.540	.758	.601
	(1.695)	(5.640)	(.602)						

VENEZUELA

CONST.	PRICE	GDP	PROD.	STOCKS	FX	XR	F	DW	$\bar{R}2$
WHEAT									
- 9.59	- .114	- .118	42.197	- .875	.134	21.748	6.415	2.331	.607
	(.799)	(1.120)	(.564)	(1.361)	(.666)	(5.692)			
65.36	- .129	.343	.720#				.488	.835	-.789
	(1.125)	(.519)	(.081)						
COARSE GRAINS									
-43.25	- .171	.102	- .821	.532	.350	.405	18.743	2.154	.835
	(.765)	(5.092)	(2.608)	(1.104)	(1.484)				
-27.14	- .201	.766	- .666	.697			27.187	2.164	.833
	(1.031)	(7.076)	(2.319)	(1.568)					

* T statistics are reported in parentheses.
(a) indicates series is zero from 1960-81.
\# indicates production and stocks are combined.

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