WORLD FEED GRAIN PROJECTED PRODUCTION-CONSUMPTION BALANCES, U.S. EXPORTS, AND PRICE VARIABILITY

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CHAPTER I

INTRODUCTION

Feed grains play an important role in the United States agricultural economy. Cash receipts from farm marketings of the four major feed grains--corn, sorghum, oats, and barley--have gradually increased from approximately $2 billion in 1948 to over $13 billion in 1976. Not only are these grains important cash crops, they are primary inputs in livestock production and key commodities in the American export situation.

Domestic feed demand constitutes the single largest utilization category for the four feed grains, typically accounting for 60 to 70 percent of the total disappearance. In the 1973-1976 period, the four grains accounted for 95 percent of the total feed grains fed which in turn were a major input in generating $41 billion in cash receipts from livestock.

Exports constitute the next largest utilization category. From 1970 to 1976, feed grain exports as a percentage of total U.S. disappearance increased continuously from 12 to over 28 percent. Taking all the feed grains together, the U.S. usually produces 25 to 30 percent of the world supply and provides about 60 percent of total world feed grain exports (Farmers' Newsletter, 1978). These exports have contributed over $4 billion or approximately 22 to 25 percent of the total value of all agricultural exports from 1974 to 1976.

Domestic demand of feed grains for food and industrial purposes has exhibited a fairly stable growth pattern over the study period. In recent years this utilization category has accounted for four to six percent of feed grain disappearance.

Historical Background

The direct relationship between the livestock and feed grain sectors as well as the increased export demand for these grains are important factors in determining feed grain prices. Other variables which influence these prices are related to the industry's structure. In an historical examination of the study period, 1948 to 1976, two time periods are important for the analysis of the structure and the variables.

From 1948 to the early 1970's, the feed grain supply and corresponding prices were mainly influenced by the increased use of technology associated with chemicals, fertilizers, pesticides and plant breeding which resulted in excess supplies with huge stock accumulations. Market prices remained at or near support prices for most of this period (Womack, 1976). The federal government influenced crop output through the use of acreage control programs and price support operations, of which the latter also resulted in increased stockpile accumulations (Keith, 1978). The general economy of the U.S. was characterized by fairly stable growth in personal income and relatively low rates of inflation.

After the early 1970's, a number of factors contributed to increase market price fluctuations. First, looking at the world scene, there were several short grain crops abroad and one in the U.S. between 1972 and 1975 as a result of poor weather. The decreases in production led to the decision by some Communist bloc countries, including the Soviet

Union, Eastern European nations, and the People's Republic of China, to increase their grain imports in order to avoid excessive liquidation of livestock. Second, the devaluation of U.S. currency led to growth in export activity which reduced U.S. grain stocks and increased market prices. During this period, U.S. feed grain producers became more reliant on the market place as the principle source of income, and the importance of government price operations diminished. This sequence of events caused many people to believe that government support of commercial agriculture might not be necessary in years to come (Keith, 1978). However, large harvests in 1976 and 1977 replenished stocks and depressed prices to the loan level. Market developments during this latter period have cast doubt that government nonintervention in agriculture would exist. Grain stocks have risen to burdensome levels as producers have again proven that overcapacity of U.S. agriculture still exists (Keith, 1978).

Objectives

The expansion of export demand has been one of the contributing factors to the increases in cash receipts from feed grains and to the year-to-year fluctuations in farm prices and incomes. Much of the food price instability during the 1970's as well as potential inability to accurately forecast future price movements, can be attributed to the export market (Blakley, 1974). Not only have increased American exports during this period caused markets to become more volatile, but they have also caused U.S. farmers and foreign consumers to become irreversibly banded together (Mackie, 1977). Mackie states that due to economic disruptions from several sources in the 1970's, the world has been looking increasingly to American supplies for more of its food and feed imports, and the U.S. farmer has become more dependent upon foreign markets for a larger share of his total income (p. 23). Furthermore, he said that maintenance of farm prices and income levels acceptable to the U.S. farmer has become increasingly difficult to achieve without continued expansion and growth in export markets. Because of the increased variation in exports and the subsequent affect on feed grain prices, particularly as related to actions of some countries, there is need to disaggregate at least some portions of the export sector in order to better evaluate the production and consumption trends of the individual feed grains by major countries or world regions.

The purpose of this study will be to analyze the supply and demand relationships in the world feed grain market and develop a model (or models) which will use annual data to project feed grain production, utilization and prices and permit analysis of the impact of certain variables on the feed grain economy. Specifically, this study will:

1) Identify market information which will be useful in determining the nature of the price discovery process for feed grains. The information examined will include:

   a) a review and analysis of predictive models;

   b) the collection of data on feed grain balance sheet components for the United States and the major feed grain importing and exporting countries of the world;

   c) an examination of government agricultural policies and institutions which would affect the price and flows of feed grains between the U.S. and foreign markets.

2) Construct a model (or models) which will use the information from objective 1 to improve the accuracy of feed grain price projections.

3) Measure the impact of variations in export demand on the United States feed grain economy.

Thesis Organization

Chapter II includes an examination of the basic theory necessary for the specification of the analysis. A brief literature review of balance sheet models of the U.S. and world feed grain economies is also included.

The classification of the world into major feed grain importing and exporting countries or regions is contained in Chapter III. Regression equations used to explain the variation in feed grain supply and demand for each of these countries or regions are developed and estimated.

Chapter IV reports the 1985 supply and demand balance sheet projections for the specified countries or world regions. These individual projections are then aggregated to determine the potential export demand for American feed grains at average price relationships.

The 1985 projections and estimates are used in Chapter V to define a set of equations for the United States and foreign feed grain economies. These equations are then used to analyze the impacts of specific levels of variations in world supply and demand quantities.

Chapter VI consists of a summary of the study, the conclusions and a discussion of implications of the analysis. The limitations along with some suggestions for future research are also considered.

CHAPTER II

THEORETICAL CONSIDERATIONS AND REVIEW OF LITERATURE

The quantitative formulation of this feed grain model deals with the disaggregation of the balance sheet components into the individual supply and demand functions. The purpose of this chapter is to identify factors which are hypothesized to influence these relationships and to review previous research efforts in this area of study. Relevant theory applicable to the estimation of the balance sheet relationships is examined. Also included is a discussion of interregional trade theory and why countries engage in trade. Finally, recent national and international feed grain research is reviewed.

Theoretical Considerations

Supply may be defined as the schedule of quantities of output that producers are willing to place on the market at a given place or time at given prices. This economic concept assumes that the technology of the production process, the prices of alternative products, and the supply curves of the factors of production are held constant. Of course, the supply curves for the factors of production will vary as one moves from the firm level to the industry level and from the short run to the long run.

For feed grains, the breakdown of the supply balance sheet components includes relationships for production, carry-in stocks, and imports. The production of feed grain may be a real-world example of a firm operating under pure competition. The producers are generally small relative to the market as a whole and cannot appreciably affect the prices paid for inputs or prices received for outputs. The individual entreprenuer may desire to maximize his output level for a given cost, or he may desire to minimize the cost of producing a given output. In a competitive market, the profit maximizing output is found where marginal cost equals the price of the product. Assuming that the supply curves of the factors of production are perfectly elastic for all firms, the horizontal summation of the individual marginal cost curves is the supply curve for the industry. In general, one can hypothesize that the aggregate output of feed grains is related to its own price, prices of competing crops, and input prices. Over the long run, output of feed grains is also a function of technology in its own production process relative to other commodities competing for agricultural resources.

The demand for feed grains is derived from the demand of some final product. According to Friedman (1976):

> . . . The demand for final products reflects the 'utility' attached to them, the demand for factors of production does so indirectly, being derived from the demand for the final products. The link between the demand for the final product and the demand for factors is closest when the amount of factor required is rigidly and technically linked to the amount of the product . . . (p. 153).

The balance sheet components of feed grains can be broken into feed use, food use, seed use, carry-out stocks, and exports. In developing the theoretical relationship between livestock and feed grain production, feed grains are viewed as an input to livestock production. Assuming that the livestock producer desires to maximize current and anticipated net revenue, it can be hypothesized that the derived demand for feed grains to be used as an animal feed is a function of the number of grain-consuming units fed, price of the livestock and livestock products, price of feed grains, and the price of other feeds.

There are also numerous non-feed uses for feed grains. Feed grains are consumed directly as a food and used by industry for such diverse products as processed foods, cooking oils, starch products, alcoholic beverages and alcohol for fuel. The demand for feed grains for human purposes herein was assumed to depend on the price of feed grains, the prices of related products, population, and income.

The demand for feed grains to be held in the form of carry-out stock increases when the stock holder believes future earnings from the sale of his holdings will exceed the sum of foregone earnings from a current sale and storage costs. Stocks also accumulate when government support prices exceed market prices causing the stock holder to sell to the government. This relationship can be defined to be a function of current price, which reflects supply relative to demand, the loan rate, and expected prices in the next year.

Exports are the difference between the quantity supplied and the quantity demanded for feed grains in other countries. Feed grain exports from the United States are assumed to be largely determined by the difference in production and utilization in the rest of the world and the export price in the U.S. relative to the market prices in other grain exporting countries.

For a closed economy, the specification of the domestic feed grain supply and demand curves would be sufficient to determine price.

Equilibrium would be achieved in the feed grain market when a price was established where the quantity of feed grains demanded exactly equaled the quantity offered for sale. However, in reality the economy is not closed and there are feed grain imports and exports. This is best illustrated by the simple interregional trade model depicted in Figure 1.

Assume that there is a single commodity (for example, feed grains) produced and consumed in two regions. In the absence of trade between regions, the demand curve D_X and the supply curve S_X in region X would result in a competitive price of P_X while in region Y the lower demand durve D_Y and higher supply curve S_Y would yield an equilibrium price of P_Y. The excess supply curves for each region, ID for region Y and ES for region X, can be plotted by taking the horizontal difference between the respective supply and demand curves. Note that the prices in Y are lower than in X by the difference equaling the transfer cost t. By allowing trade between these two regions, part of the feed grain supply in region Y is transferred to region X. However, the price in X will decline while the price in Y increases. Interregional equilibrium will be reached between these two regions when the feed grains exported from Y, fg, is just large enough to equal the amount imported in X, ab, at the equilibrium price P. The prices of feed grains are P in X and P + t in Y.

Although the interregional trade model provides a framework for the analysis of interaction between two regions, it does not answer the question of why regions engage in trade. This question is answered by the theory of comparative advantage which states that whether or not one of two regions is absolutely more efficient in the production of every good than the other region, if each specializes in the product in which

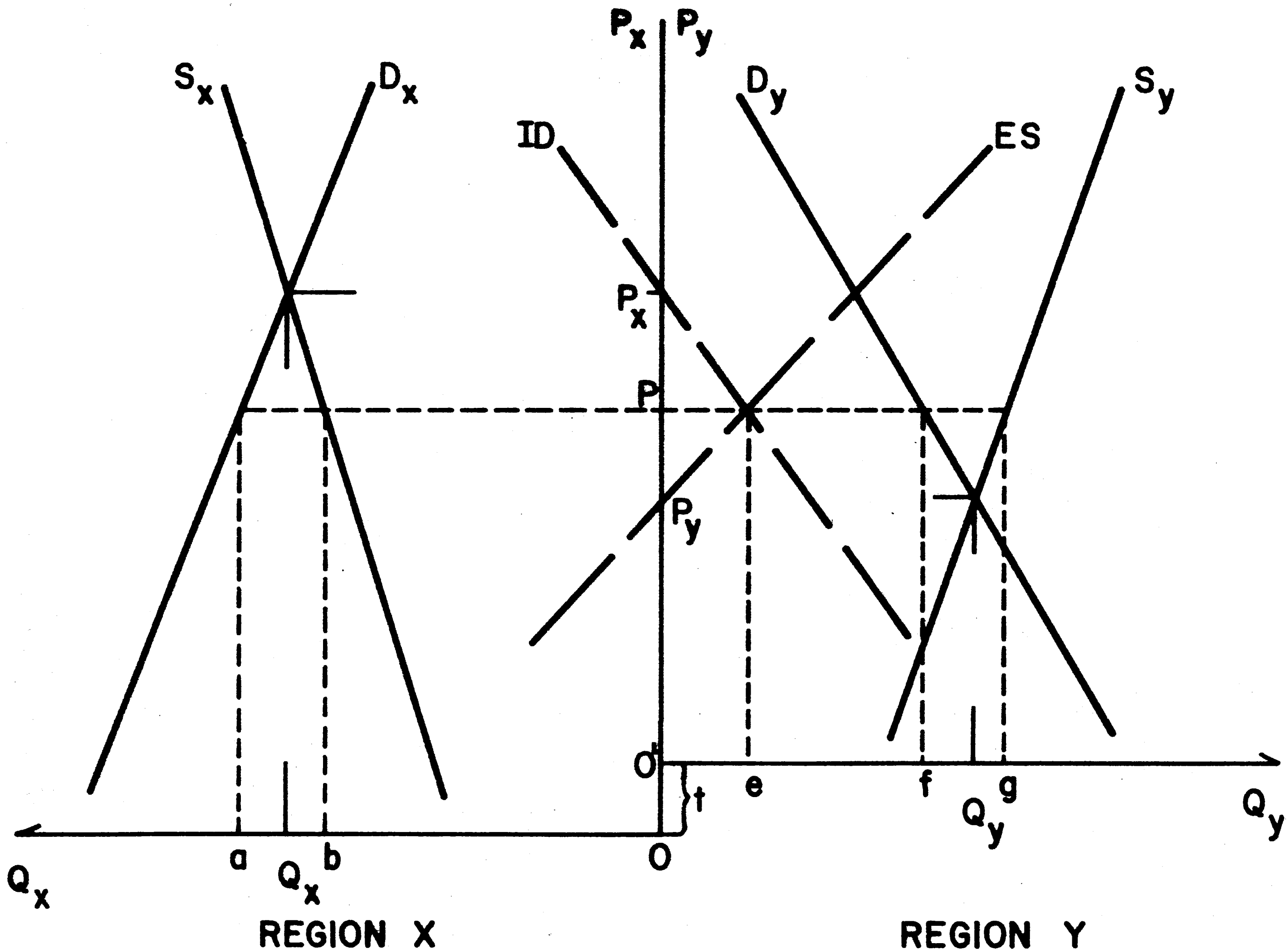

Figure 1. Trade Between Two Regions as a Result of Differences in Supply and Demand Functions

it has a comparative advantage (greatest relative efficiency), trade will be mutually profitable to both regions. This concept is illustrated in Figure 2. The agricultural resources of regions, X and Y, will produce goods A and B in the combination indicated by the production possibility curves PP. These curves show the maximum quantities of A and B attainable with either region's resources. Also shown in this figure is a set of indifference curves which are the locus of all combinations of goods A and B which yield the consumer the same level of satisfaction or utility. The indifference curves correspond to higher and higher levels of utility as these curves shift up and to the right.

In the absence of trade between regions, the highest indifference curve that can be reached in either region is I_0 at C, where the quantities of A and B consumed are A_1 and B_1 and, the rate of substitution in consumption and production are equal. These rates of substitution in equilibrium will determine the price ratio of the two goods which is equal to the slope of the line tangent to point C.

If trade occurs between regions, Y will specialize in the production of A (A_3) while X specializes in the production of B (B_3). However, more of A (A_3) is now consumed in region X and more of B (B_3) in Y after trading than in isolation. The quantity A_2A_3 is now traded by Y for B_2B_3 units of B, enabling each region to move to a higher indifference curve. The new terms of trade, line T, would represent the same price ratio for both countries in the absence of trade barriers.

Review of Literature

Several studies have developed models for either the United States or world feed grain economies. The models range from very aggregate

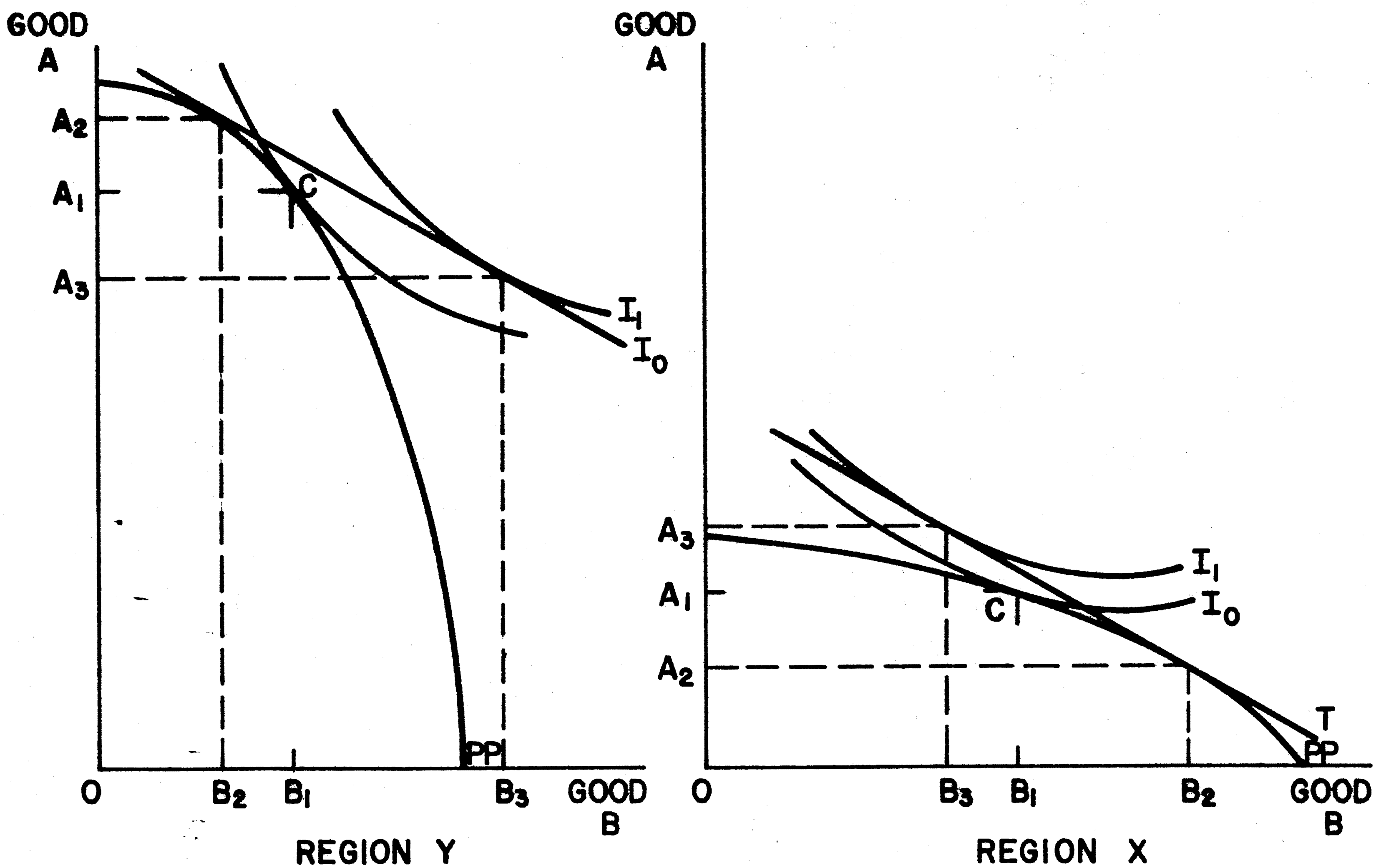

Figure 2. Production Possibility Curves and Indifference Curves for Two Regions Producing and Consuming Two Goods

single equation models to highly disaggregated simultaneous equation models; however, none of these studies has attempted to disaggregate the major feed grains into individual grains and the world into major feed grain importing and exporting countries or regions. Although the research efforts reviewed herein are not directly comparable, all have had some influence on this study due to the similarity of the area of study.

In a 1978 dissertation, Keith developed a simulation model of the livestock-feed grain subsector to analyze policy alternatives and provide outlook information. This study disaggregated acreage, yield, and carry-over stocks by individual feed grains but aggregated food, feed, seed, and export utilizations. Using the 1976 crop year as a base, the simulation model projects an increase in feed grain export demand and domestic utilization but a decrease in production. The estimations for 1982 in million tons were 63.8 for exports, 145.3 for utilization, and 211.9 for production.

In 1976, Houck and Ryan developed a methodology incorporating both government price supports and acreage restrictions into a single price response variable for the production of each feed grain. This approach improved the predictive accuracy for crop production for years when government programs were the dominant force in determining crop acreage.

Womack (1976) specified a model for the United States in which the quantity demanded of each feed grain was dependent upon its own price, the price of competing feed grains, the price of high-protein feeds, livestock prices, inventories, and technology. He discussed the effects of short- and long-run decisions made by livestock producers on feed grain demand. Womack concluded that the demand for corn in the U.S. was not cross-price elastic with oats, sorghum, and barley. However, each of the feed grains investigated by Houck and Gallagher. In general, the dependent variables were specified as functions of their own prices, government policy variables, prices of competing crops, and trend.

Some studies have been conducted that disaggregate the demand of feed grains for a specific country or region. One such study was done by Austin (1977). In this work, the author attempted to determine how demand for grain for feed in Australia explains some of the wide year-to-year fluctuations in its grain exports. Demand for barley and sorghum was found to depend to a large extent on changes in grain prices and livestock inventories. It was estimated that a small change in the world barley price could result in a 25 percent increase in the amount of barley available for export by Australia. Demand for oats and corn exhibited little or no response to price or livestock inventory changes.

Houck and Ryan in 1976 examined the relationships in the East European feed-livestock sector and analyzed the import demand for feed grains in the principal importing nations. This analysis applied an econometric framework commonly employed in studying the trade behavior of nations, relying predominantly upon open markets and decentralized decision making. In general, the framework employed by these authors was that annual quantity of any commodity imported by a country is the difference between the amount demanded and the amount supplied domestically from production and inventories. Some observers argue that the centrally-planned East European nations do not respond systematically to price and other economic variables because 1) they are not open-markets countries, and 2) their trading behavior is administratively determined. However, the authors justified their approach by arguing that these government policymakers would typically take actions similar to those that would have resulted from open market forces. Their findings supported their argument. Based on these results, they hypothesized that feed grain importers respond to changes in 1) international prices, 2) domestic grain production and livestock numbers, and 3) domestic economic policies.

The most comprehensive world model is the grain, oilseed, and livestock model (GOL) developed by U.S.D.A. This model projected coarse grain supply and demand to the year 1985 for each of 28 geographic regions. Using 1970 as the base year, GOL projected world coarse grain production to be 527.1 million metric tons, domestic utilization to be 521.3 million metric tons, and exports to be 50 million metric tons. The principal contribution made by this effort is an improved understanding of the interrelationships within the coarse grain complex and its relationships to other sectors in world agriculture. The GOL model also provided a balance sheet breakdown of supply and demand for each country or world region.

CHAPTER III

ESTIMATED EQUATIONS

This chapter reports the results of parameter estimation for the United States and the foreign regions being analyzed in this study. Variable names and the unit of measurement are listed in Appendix A for U.S. equations and Appendix B for foreign equations. A discussion of the justification for the specification is included with each equation or set of equations.

Estimation results are listed in Tables I through XXII. Under each coefficient is given the t-statistic associated with a hypothesis that the coefficient equals zero. Also included with each estimated equation are the R^2-value, the proportion of variation in the dependent variable explained by the equation, and the Durbin-Watson d-statistic, a measure of autocorrelation in the residuals. The equations of the model were estimated with different numbers of observations depending on data availability. The estimation period was from 1948 to 1976 for the United States equations and from 1960 to 1976 for the equations of the foreign countries.

There were a number of occasions when the dependent variable exhibited little variation during the study period. This lack of fluctuation led to difficulties in model estimation. In these situations, mean values of the dependent variables were used for the projected 1985 values. In other cases the estimation techniques proved useful but, because of the use of trend as an exaplantory variable, major turning points were missed and the projected values, computed from these fitted equations, were unrealistic. Therefore, three- or five-year averages were used for some 1985 projections. A three-year average was selected for use over a five-year average if it appeared to best represent recent events. A discussion of these values is included in each section.

Specification of United States Equations

United States corn, sorghum, barley, and oats equation results are listed in Tables I, II, III, and IV, respectively. As previously stated, these equations were for projection purposes. However to obtain good fits, some exogenous variables and simultaneous relationships had to be used. When applicable the dependent variables were measured in billion pounds to facilitate future conversion to metric tons.

Houck and Ryan (1976) developed and applied the concepts of "effective support prices" and "effective diversion payments" as a means of summarizing the impact of Government programs on planted acreages of feed grains. For each feed grain the researchers measured the effective price support in any given crop year as:

$$PF^i = \Gamma \, PA^i = \left[\frac{1}{2} \left(\frac{A^i \min}{A^i_0} + \frac{A^i \max}{A^i_0} \right) \right] PA^i$$

where

PA^i = Announced support price for feed grain i,

A^i_0 = Base acreage of feed grain i,

A^i_{min} = Minimum acreage of i allowable under price program,

A^i_{max} = Maximum acreage of i allowable under price program, and

PF^i = Effective price support.

The average proportion of base acreage eligible for planting was used as the measure of Γ. This allowed adjustment of the effective price support variable whenever minimum or maximum provisions were altered. The coefficient Γ fluctuated between zero and unity for corn, sorghum, and barley. Since no acreage restrictions were imposed on oats, Γ equalled 1.0 for oats throughout the historical period.

Diversion payment rates were constructed in a similar way, except that varying payment rates for different levels of diversion were considered. The authors expressed this idea for a given crop year as:

$$DP^i = \frac{1}{2}\left(\frac{D^i\ min}{A^i_0}\right) PR^i_1 + \frac{1}{2}\left(\frac{D^i\ max}{A^i_0}\right) PR^i_2$$

where

PR^i_1 = Diversion payment rate for levels of diversion near the minimum requirement,

PR^i_2 = Diversion payment rate for levels of diversion near the maximum requirement,

D^i_{min} = Minimum acreage diversion requirement,

D^i_{max} = Maximum acreage diversion requirement, and

A^i_0 = Base acreage.

Houck and Ryan concluded that the effective diversion payments were negatively related to crop acreage since higher diversion payments induced farmers to leave more land idle. Effective support prices were found to be positively related to acreage responses. That is, the estimated results suggested that an increase in the effective price support level for any one feed grain tended to increase the acreage planted to that crop.

From 1948 to 1971 the major price support and acreage-controlling policies were in effect and the support rates and market prices for each feed grain were at or near the same level for a majority of the years.

During this period, variations in the effective support price variables explained the variations of each feed grains acreage better than the own lagged market prices. In the early and mid-seventies, however, market prices received by farmers rapidly rose above support levels. Because of this increase in market prices, the authors concluded that the specification of the effective support price as the supply-inducing price was not appropriate.

Therefore, the authors constructed a new variable as the appropriate supply-inducing price. From 1950 to 1971, this variable was the same as the effective support price. From 1972 to 1974 it was the lagged market price received by farmers. They adopted the 1971 "splicing" point for this variable since the two series take on approximately the same value in that year.

For purposes of this study, the same explanatory variables were reconstructed and adjusted to the present estimation period. That is, the spliced price variable was the effective support price from 1948 to 1971 and the lagged market price received by farmers from 1972 to 1976.

It was also felt that there was a need for a price deflator to account for the increase in prices paid for agricultural inputs. The parity index could have been used. This index does account for the increase in production costs which have caused the cost per acre harvested to increase. However, it does not reflect technological progress which has contributed to increasing yields per acre, a phenomenon that has tended to drive down the production cost per bushel. Therefore, the parity index was adjusted for the changes in technology reflected in yields as used by Keith (1976).

To calculate the specific deflator for each crop, Keith divided the parity index by a variable hypothesized to reflect expected yield for the crop. The base year used for measurement of expected yields was 1956. Expected yield for years thereafter was expressed in terms relative to 1956 in the form: (Expected yield for year t) ÷ (Expected yield in 1956). Keith used this variable in conjunction with the parity index to develop price deflators on a crop-by-crop basis. Each deflator took the form:

$$\frac{\text{Prices Paid by Farmers}}{\left(\frac{\text{Expected Yield in Year t}}{\text{Expected Yield in 1956}}\right)}$$

This deflator form assumes that the per acre cost changes are reflected by the parity index. Assuming that expectations are a function of previous experience, Keith used a three-year moving average to represent expected yield per acre in year t.

Deflators were constructed for each grain as demonstrated by Keith's methodology. In this study, they were used to deflate the various price series appearing in the production equations.

Estimated United States Corn Equations

Corn is the major feed grain in the U.S. and world. In 1976 the U.S. produced 48 percent of total world production and supplied 72 percent of total world exports. Corn accounted for 83 percent of total U.S. feed grain production, 83 percent of feed grains fed to livestock, and 82 percent of feed grains exported.

Estimated results of the corn equations are listed in Table I. Discussion of the estimated equations for each balance sheet category, area harvested, yield, and feed, human, and seed utilizations, follows.

Corn Area Harvested. Grown mainly in the Midwest, corn is a primary crop with soybeans as a major competing crop. Other crops hypothesized to compete with corn for available tillable acreage are alternative feed grain crops and wheat. The coefficients for soybean acreage planted (SAPLT) and the lagged market price for wheat (WMPL) do reflect competitive relationships between these crops and corn. Intercorrelation between other feed grain prices and corn prices reduced the significance of both price series when they entered the same equation. Therefore, price variables for the other feed grains were not included in this equation. The own price variables for corn that are included are the effective diversion payment (CDDVP) and the spliced price variable (CP). The dummy variable DV66 reflects the Government policy change in the method of calculating direct support payments in 1966 and following years.[1]

Corn Yield. The yield per acre for each of the feed grains increased substantially during the study period. This phenomenon has resulted from both improved varieties and better farming practices (Keith, 1976).

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[1]Program provisions in 1977 were changed to limit support payment to only 50 percent of base acreage. A separate payment for directed acreage was also discontinued. Set-aside acreage was still required to qualify producers for support payment such that the payment offered functioned as a diversion payment rather than as a support payment. Therefore, support payments above loan rates offered in 1966 and following years were calculated as part of the effective diversion payment. The dummy variable allows for a possible change in response patterns of producers to revised program payment definitions.

TABLE I

SELECTED REGRESSION STATISTICS FOR THE UNITED STATES CORN EQUATIONS, 1948-1976

Variable[a]	Area Harvested	Yield	Feed Use	Seed Use
Intercept	77549.667	2083.156	-148223.425	513.924
(t)	(42.68)	(5.89)	(-2.28)	(10.55)
T		101.595	2386.61	
(t)		(13.28)	(8.23)	
SAPLT	-0.333			0.0082
(t)	(-3.31)			(3.95)
CDDVP	-14787.326			-214.862
(t)	(-6.00)			(5.24)
DV66	7806.237			123.314
(t)	(4.03)			(2.12)
CP	1281.145			
(t)	(2.03)			
WMPL	-1211.061			
(t)	(-2.27)			
PPFCPR		-228.865		
(t)		(-2.45)		
TOTDA		0.016		
(t)		(4.16)		
JULPRC		3.861		
(t)		(2.73)		
DV70		-630.985		
(t)		(-2.45)		
AINUNFD			2.988	
(t)			(3.14)	
HCR			2147.449	
(t)			(2.83)	
FBP			1846.759	
(t)			(2.80)	
CPRM			-9684.272	
(t)			(-2.14)	
R^2	0.92	0.96	0.95	0.83
D.W.	0.89	1.62	1.63	1.71

[a]Variable definitions are given in Appendix A.

Trend was used in the corn yield equation as a proxy for these technological improvements. This variable was very significant and indicated a stable growth in yields over the estimation period. The own price response for corn and the influence of increased fertilizer prices on yields were accounted for by the ratio of prices paid by farmers for fertilizer divided by the spliced price variable. The negative sign indicates that as the prices paid for fertilizer increased relative to the corn price and farmers applied less fertilizer, yields decreased. July precipitation (JULPRC) was used as a proxy for the influence of weather on production. This month's precipitation was selected because the need for rainfall during pollination is especially critical for kernal development in July (Butell and Maive, 1978). The coefficient for total acreage diverted from feed grain production had a positive sign. This supports the hypothesis that producers divert marginally productive land, thus increasing yields. The dummy variable DV70 reflects the unusual occurrence of the southern corn blight in 1970.

Corn Feed Utilization. Domestic feed demand constitutes the largest utilization category for corn. This demand is derived as an input demand in the production of livestock and is related to both the number being fed and the value of the units. To account for these relationships, the number of grain consuming animal units fed (ANUNFD) and the average price of choice slaughter steers (FBP) were used in the estimated corn demand for feed equation. The positive signs on the parameter estimates for these variables indicate that the amount of corn demanded for feed tends to increase in response to increases in either the number of animal units fed or the slaughter steer price. The hog-corn price ratio (HCR) was also included in this equation. As the price of a hundredweight of hogs decreases relative to the price of a hundred pounds of corn, less corn will be demanded as an input for hog production. Trend was used to account for the increase in the amount of corn fed per animal unit. This variable was very significant and indicates a steady increase throughout the study period. Multicollinearity among explanatory variables was again a problem when more than one grain price entered into the same equation. Although several ratios of the corn price to other grain prices were tried, none of these variables were significant. Therefore, the corn market price was the only price variable included in this equation.

Corn Human Utilization. Although the domestic demand for corn for food and industrial purposes has exhibited a stable growth pattern since the mid-fifties, this utilization category is small relative to the U.S. feed and export utilization categories. In 1976 corn utilized for human purposes accounted for nine percent of the total U.S. corn disappearance.

There are two methods to estimate the domestic corn demand for human purposes. One is to estimate this utilization category directly including population as an explanatory variable. When using population as an independent variable in this method, increases in population and the implicit changes in tastes and preferences are actually being measured. In the second method, the per capita corn consumption is used as the dependent variable and is regressed on per capita disposable income. Corn consumed for human purposes can then be calculated by multiplying both sides of the estimated equation by population. It was felt that this second estimation procedure would yield more stable projections and was, therefore, used in this study. This method is illustrated below using the actual estimation results.

$$\frac{CDHUM}{US\ POP} = 0.0719 + (0.0082 * PCDI)$$

$$CDHUM = (0.0719 + (0.0082 * PCDI)) * US\ POP$$

where

CDHUM = Corn Utilized for Human Purposes,

US POP = U.S. Population, and

PCDI = Per Capita Disposable Personal Income, All Sources.

Corn Seed Utilization. Corn seed utilization is by far the smallest utilization category, accounting for only 0.3 percent of total U.S. corn usage in 1976. Resembling the corn area harvested equation, the corn seed utilization equation includes soybean acreage planted, the corn effective diversion payment, and the dummy variable DV66. Several own and competing price variables were tried in the equation but multicollinearity problems and insignificance resulted in their omission.

Estimated United States Sorghum Equations

Sorghum is the second largest feed grain in the U.S. in terms of total feed grain production, feed usage, and export supply. In 1976 sorghum accounted for nine percent of all feed grains produced and fed to livestock and 11 percent of total U.S. feed grain exports.

Like corn, the U.S. typically produces and exports more sorghum than any other country in the world. The U.S. produced approximately 35 percent of total world supply and provided 52 percent of total world sorghum exports in 1976.

Estimated results for the U.S. sorghum equations are listed in Table II. Discussion of these equations, area harvested, yield, and total utilization, follows.

Sorghum Area Harvested. U.S. sorghum production is concentrated primarily in Texas, New Mexico, Oklahoma, Kansas, Colorado, Nebraska, Missouri, and California. Crops competing with sorghum for tillable acreage in these states are: winter wheat in all of the states; cotton in Texas, Oklahoma, and Missouri; and corn and soybeans in Missouri, Kansas, and Nebraska. The explanatory variables included in this equation to account for the competitive relationships were the acreage of winter wheat planted in eight states (WWIN) and cotton acreage planted (CNAPLT). Multicollinearity problems resulted when acreages for the other competing crops entered the equation. Also included in the equation were the effective diversion payment variable for sorghum (GSDDVP) and the dummy variable DV66 to reflect the change in calculation of the effective support rate. Various price variables were tested but omitted from the final equation because their coefficients were inconsistent with the hypothesized relationships with area harvested.

Sorghum Yield. Increases in sorghum yield per acre were aided by improved varieties, greater applications of fertilizer, and increases in the area of sorghum irrigated (Green, 1973). A large proportion of sorghum acreage is in the southern and western states which obtain the majority of their irrigation water from the Ogallala formation. This formation is a "varitable lake of underground water" which underlies a large percentage of the land used to produce sorghum, ranging from the High Plains of the Texas Panhandle to the southwest corner of South Dakota.

TABLE II

SELECTED REGRESSION STATISTICS FOR THE UNITED STATES SORGHUM EQUATIONS, 1948-1976

Variable[a]	Acres Harvested	Yield	Total Use
Intercept	28870.672	182.66	9593.438
(t)	(12.88)	(1.11)	(1.45)
WWIN	-0.293		
(t)	(-3.14)		
GSDDVP	-3043.326		
(t)	(-3.71)		
CNAPLT	-0.397		
(t)	(-4.05)		
DV66	1327.107		
(t)	(1.29)		
GSP		93.598	
(t)		(2.86)	
IRRTX		0.231	
(t)		(4.17)	
TOTDA		0.024	
(t)		(5.76)	
CCFED			2.675
(t)			(14.95)
GSCSPR			-19982.411
(t)			(-2.63)
DV58			5267.395
(t)			(4.36)
R^2	0.82	0.88	0.93
D.W.	2.49	1.07	2.48

[a]Variable definitions are given in Appendix A.

As more government restrictions were placed on cotton and wheat production during the mid-fifties, farmers shifted their irrigated land from wheat and cotton production to sorghum production. Originally imported because of its drought-resistant qualities, sorghum yields rapidly increased as it became more extensively irrigated. Not only has this addition of water played a major role in increasing sorghum yields but it also appears to be a limiting factor in future years as irrigation water becomes more difficult to find and more expensive to pump. Therefore, the amount of irrigated acreage in the Texas and Oklahoma Panhandles (IRRTX) was selected as a proxy variable for the total amount of irrigated land receiving water from the Ogallala formation in this sorghum producing region. Also included in this equation were the spliced price variable for sorghum (GSP) and the total amount of acreage diverted from feed grain production.

Sorghum Total Utilization. Feed demand consistutes the largest domestic utilization category for sorghum, typically accounting for approximately 99 percent of total domestic consumption. Because other sorghum utilization categories, seed and human usages, were relatively small and stable compared with feed demand, the total utilization category was not disaggregated for estimation. Therefore, the specification of the total sorghum demand equation is very similar to the specification of a feed demand equation.

Sorghum utilized for feed is primarily an input for the cattle-feedlot industry. Structural changes within the industry during the study period, 1948 to 1976, have significantly affected sorghum demand (Womack, 1976). Since the late 1950's, as the production of sorghum increased in the high plains and western states, there has been a rapid growth in the number and size of feedlots in this area (Green, 1973). As more feedlots were placed in operation, the feed demand of sorghum increased.

The derived demand for sorghum includes the number of cattle and calves on feed (CCFED) and the ratio of the sorghum market price to the corn market price (GSCPR). The corn price was included to account for the competitive relationship between corn and sorghum as an input in the feedlot industry. This ratio was constructed to overcome the multicollinearity problems that resulted when these two price variables entered the same equation separately. The negative sign of the coefficient indicates that as the sorghum market price decreases relative to the corn market price, more sorghum will be demanded for feed. The dummy variable DV58 was used to pick up the structural change associated with the feed industry.

Estimated United States Barley Equations

In recent years, the United States has ranked fourth or fifth in barley production and third or fourth in barley exports among world countries. The five leading barley producing countries in 1976 with shares of world production in parentheses were the U.S.S.R. (38 percent), the People's Republic of China (8 percent), Canada (6 percent), France (5 percent), and the U.S. (4 percent). Canada, Australia, and the U.S. were the three leading barley exporting countries in 1976, providing 29, 13, and 7 percent, respective, of total world exports.

In the United States, barley accounted for four percent of total feed grain production, and three percent of the feed grains fed to livestock and exported in 1976.

Estimation results for U.S. barley equations are listed in Table III. Discussion of the equations for yield, and feed and human utilizations follow. Explanations for the use of averages instead of the 1985 projected values for area harvested and seed utilization are also presented.

Barley Area Harvested. Barley is produced primarily in the Northern Plains, with the heaviest output in North Dakota and Montana. Although competitive with other feed grain acreages, barley competes primarily with spring wheat for available tillable acreage. When restrictions were placed on wheat production in the 1950's, barley acreage increased to a high of 15 million acres from 1964 to 1973. In 1974 this acreage again decreased and remained at a steady level of about 9 million acres for the rest of the study period.

The barley area harvested equation was similar in specification to the corn acreage equation. Although actual variations in acreage were tracked by the estimated equation through most of the study period, the turning point in 1975 was missed. This resulted in the underestimation of the actual 1975 and 1976 acreages, and an unrealistic 1985 projected value. Therefore, a five year average, 1972 to 1976, was used for the 1985 projected value.

Barley Yield. Explanatory variables included in the barley yield equation are trend, the total amount of acreage diverted from feed grain production, and the ratio of index of prices paid for fertilizer to the average barley price received by farmers lagged (PPFBPR). As indicated by the trend coefficient, barley yield has been increasing but at a slower rate than corn yields.

TABLE III

SELECTED REGRESSION STATISTICS FOR THE UNITED STATES
BARLEY EQUATIONS, 1948-1976

Variable[a]	Yield	Feed Use	Human Use
Intercept	1443.641	-10140.620	1361.221
(t)	(8.35)	(-1.63)	(7.50)
T	30.693		
(t)	(10.64)		
TOTDA	0.005		
(t)	(3.53)		
PPFBPR)	-8.533		
(t)	(-1.97)		
ANNUNFP		0.165	
(t)		(1.94)	
BAPROD		0.470	
(t)		(6.72)	
BMP		-266.21	
(t)		(-1.09)	
BRPD			0.035
(t)			(16.29)
MALTPR			-79.929
(t)			(-1.19)
R^2	0.92	0.79	0.95
D.W.	1.94	1.73	1.63

[a]Variable definitions are given in Appendix A.

Barley Feed Utilization. Barley feed usage reached a record high of 289 million bushels in 1970 before declining in the following years. Heid and Leath (1978) state that,

> The declines in feed usage during the seventies corresponds closely with declines in domestic supply that occurred during the same period. Thus, feed usage of barley depends to a large extent upon the availability of feed barley. Barley is the major feed grain produced in many states in the West, and the quantity available appears to be the major constraint on feed use in that region (p. 15).

Therefore, the annual production of barley (BAPROD) was included as an explanatory variable in the barley feed demand equation. Also used in this equation are the number of animal units fed and the barley market price (BPM). The coefficients for these two variables, although not significant at the five percent level, are consistent with the hypothesized relationships with feed demand. It was felt that both variables were important in the explanation of barley feed usage and were therefore left in the equation.

Barley Human Utilization. The demand for malting barley, the major grain used in making alcoholic beverages, has increased annually since 1960. This grain is used by the malting industry to make a barley malt which is distributed for use in making alcohol and alcoholic beverages, for food usages, and for export (Heid and Leath, 1978). Heid and Leath (1978) state that,

> . . . the growth that occurred in domestic use of barley malt after 1960 is due almost entirely to increases in utilization by the brewing industry. The increased use was brought about by that industry's growth, which in turn reflects the increasing consumer demand, primarily for beer (p. 18).

Thus, to account for the increase in barley demanded for human consumption, annual U.S. beer production (BRPD) was used in the equation.

This variable is very significant and depicts a stable growth in barley demanded for human purposes over the estimation period. Malt barley price (MALTP) is included in the equation even though the t-value indicates little statistical significance.

Barley Seed Utilization. Typically accounting for either four or five percent of total domestic utilization, barley seed use has exhibited little variation since 1963. Because of this lack of fluctuation and the difficulties in estimating an equation, the average amount of barley utilized for seed from 1963 to 1976 was used for the 1985 projection.

Estimated United States Oats Equations

The United States has ranked second or third among the major world oat producing and exporting countries in recent years. The U.S.S.R. and the U.S. were the two leading producers of oats in 1976, accounting for 37 and 16 percent of total world production. The major oat exporting countries in 1976 were Canada, Australia, and the U.S., supplying 30, 24, and 10 percent, respectively, of the world total.

Taking all the U.S. feed grains together, oats accounted for four percent of total feed grain production, six percent of the feed grains fed to livestock, and one percent of total feed grain exports in 1976.

Estimation results for the U.S. oat equations are listed in Table IV. Discussion of the yield and utilization equations are presented in the following sections. Also included is an explanation for the use of a five year average for the projected 1985 acreage harvested.

Oats Area Harvested. Oat acreage is scattered throughout the corn and barley producing regions, with the greater concentrations in North

TABLE IV

SELECTED REGRESSION STATISTICS FOR THE UNITED STATES OATS EQUATIONS, 1948-1976

Variable[a]	Yield	Feed Use	Human Use	Seed Use
Intercept	1598.815	4472.222	5359.313	5966.466
(t)	(9.50)	(1.90)	(41.66)	(5.86)
T	23.22			-38.663
(t)	(10.10)			(-2.16)
PPFOPR	-14.210			
(t)	(3.59)			
MCW		1.5708		
(t)		(15.44)		
OMP		-3918.369		
(t)		(-3.27)		
PFNO		3435.536		
(t)		(2.70)		
PCEGG			-8.546	
(t)			(-22.51)	
OAT COM				-0.0503
(t)				(-2.52)
TOTDA				-0.0269
(t)				(-3.55)
OWPR				899.952
(t)				(1.99)
R^2	0.83	0.94	0.95	0.93
D.W.	1.61	1.13	1.11	0.92

[a]Variable definitions are given in Appendix A.

Dakota, South Dakota, Minnesota, Iowa, Wisconsin, and Indiana.

The area harvested of oats has decreased substantially during the study period, declining from over 40 million acres harvested in 1954 to less than 14 million acres in 1972. Since 1972, oat acreage has remained relatively stable. Because trend was used to account for the downward movement, the turning point in 1972 was missed by the estimated equation. This missed turning point resulted in the underestimation of the actual acreage values for the rest of the years in the study period, and in the projection of a negative value for the 1985 acreage. Therefore, it was felt that the five year average (1972 to 1976) of the area harvested of oats was a more realistic estimate for the 1985 projection.

Oat Yield. Resembling the other feed grain equations, the yield per harvested acre equation for oats includes trend and the ratio of the index of prices paid for fertilizer to the lagged farm price for oats (PPFOPR). Total acreage diverted from feed grain production was tested in this equation but the effect was not consistent with the hypothesized relationship with yield.

Oat Feed Utilization. Normally utilized as a ground mixture in bulk concentrate, oats compete with other feed grains as an input in dairy rations (Womack, 1976). According to Womack,

> . . . oats would be used (as a dairy ration inputs) whenever the price relative to other grains is cheaper on a digestible nutrient basis. Nutrient value weighted in favor of oats apparently accounts for the fact that the dairy industry is the single highest consumer of oats. Also, declining dairy population is reflected in the downtrend in oat feed demand (p. 61).

To account for this relationship, the number of milk producing cows (MCN) was included in the derived demand for oats equation. The market price of oats (OPM) and the weighted prices of other feed grains (PFNO) were also used. The coefficient for the weighted price variable displays a competitive relationship existing between oats and the other feed grains.

Oats Food Utilization. Used as primarily an input in the breakfast cereal industry, the consumption of oats for human purposes has increased steadily since 1953. Womack (1976, p. 77) hypothesized that this increase "may be attributed to taste changes associated with rapid population growth in the urban areas after the Korean War period." He also stated that urban dwellers require a "less hearty breakfast" than people living in rural areas.

Assuming that this change in taste did occur, it was hypothesized that an explanatory variable which measured the annual consumption of a "traditional" breakfast food (for example, eggs, bacon, and sausage) could be used to account for the increase in oats demanded for food. The per capita consumption of eggs (PCEGG) was selected as this variable. The coefficient indicates that there is a strong competitive relationship between the consumption of eggs and oat food demand. Several own price series for oats were tested but the coefficient's signs were not consistent with the hypothesized relationships with the demand of oats for human purposes.

Oats Seed Utilization. Typically accounting for approximately seven percent of total domestic utilization, fluctuations in oat seed usage were similar to those displayed by the area of oats harvested.

The specified equation for this derived demand is listed in Table IV. Oats demanded for seed is considered to be influenced by trend, the total acreage diverted from feed grain production, the ratio of the spliced price variable for oats to the wheat farm price (OWPR), and the acreages of crops in the six major oat producing states (OAT-COM) that compete with oats for tillable acreage.

Specification of Foreign Feed Grain Equations

As previously explained, there are two areas of disaggregation in this model: a disaggregation of the four major feed grains into their supply and demand balance sheet components and a disaggregation of the world into the countries or regions which are significant in international feed grain trade. For purposes of estimating the foreign countries' feed grain supplies and demands, corn and sorghum balance sheet components were estimated individually while the barley and oat components were aggregated into a single balance sheet. The major importing or exporting countries for each feed grain or feed grain grouping were then identified for an individual balance sheet analysis. Foreign countries of lesser importance in international feed grain trade were aggregated by feed grain into major geographic regions for balance sheet estimations. A discussion of the feed grain groupings and their individual geographic breakdowns is included with each set of equations.

The annual feed grain balance sheet data for the foreign countries were obtained from the United States Foreign Agricultural Service. This data had been adjusted to the "world" production year beginning July 1. Thus the 1976 production data include all harvests occurring within the

July-June 1976-1977 year, except that data from the early harvesting Northern Hemisphere areas were "moved forward"; that is, the May 1976 harvests in these areas are actually included in the 1976-1977 accounting period which begins July 1, 1976. For some foreign countries where stocks data were unavailable, "total consumption" represents apparent consumption, that is, consumption inclusive of annual changes.

To account for the relationship between the feed grain and livestock sectors an animal unit variable was constructed. The United States average annual concentrate feed rates[2], for the 1959-1960 period, by type of livestock were used as a base index in constructing this variable. This base was selected because it was assumed that feeding technology in many of the foreign countries would lag that in the U.S., and that 1959-1960 average would approximate present feeding practices.

Although there was a lack of data of certain types (e.g., cattle on feed), total livestock numbers by class were located for each country. The U.S. base index for milk cows was set equal to one and the base indicies for the other types of livestock were adjusted relative to milk cows to get the weighted value for each livestock class. The types of livestock included in this variable, their U.S. base index, and their weighted values used in constructing the animal unit variable are listed in Table V.

[2]Measured in feed unit pounds - the quantity of feed that is equivalent to the feeding value of a pound of corn (containing 78.6 percent Total Digestible Nutrient).

TABLE V

WEIGHTS USED TO COMPUTE TOTAL ANIMAL UNITS FROM NUMBERS OF LIVESTOCK CLASSIFIED BY TYPE

Type of Livestock	United States Base Index[a]	Animal Unit Weighted Value
Milk Cows	2429[b]	1.0
Cattle on Feed	2318	0.954
Sheep	72	0.03
Hogs Fed	1179	0.485
Chickens Raised	27	0.025
Horses and Mules	1044	0.43

Source: United States Department of Agriculture. Livestock-Feed Relationships, National and State, 1974.

[a]1959-1961 = 100.

[b]Feed unit pounds.

The animal unit variable for each country or region took the form:

$$\text{Animal Unit}_i = (1 * \text{Milk Cow Numbers}_i) + (0.954 * \text{Beef Cow Numbers}_i) + (0.03 * \text{Sheep Numbers}_i) + (0.485 * \text{Hog Numbers}_i) + (0.025 * \text{Chicken Numbers}_i) + (0.43 * \text{Horse and Mule Numbers}_i)$$

where

i = country or region.

Specification of Foreign Corn Equations

Corn was selected for individual balance sheet analysis because it dominates international feed grain trade, and accounts for approximately

68 percent of world feed grain exports. During the study period corn exports increased from 14 million metric tons in 1960 to over 60 million metric tons in 1976. Much of this growth in international corn trade was due to increased demand for livestock products in the Western European countries, the Soviet Union, and Japan, where corn is a major input in livestock production.

The foreign countries and regions for which the supply and demand balance sheet components of corn were estimated are listed in Table VI. With the exception of the People's Republic of China, all of the individual countries shown accounted for at least five percent of the world corn import or export market at some time during the study period. The data for the People's Republic of China (PRC) are not from Chinese sources, but represent general trends estimated by USDA sources. Because there was little variation around these trends, this country was singled out for a separate balance sheet analysis.

The major countries competing with the United States in the international corn export market are Argentina, South Africa, and Thailand. Taken as a group, these countries provided an average of 21 percent of world corn exports during the study period. In 1972-1976, as the United States increased its dominance in international corn trade, the percent of world corn exports supplied by these competing countries declined to 16 percent. However, corn continues to be a principal export crop for these foreign nations.

France is the only country in the European Economic Community (EEC) self-sufficient in corn production, accounting for over four percent of world trade in 1972-1976. The other eight EEC countries, taken as a group, account for most of the world's corn imports. Imports in these

TABLE VI

FOREIGN COUNTRIES AND REGIONS USED FOR CORN EQUATIONS, 1960-1976

Continent	Country or Region
Africa	South Africa
	Rest of Africa
North and Central America	North and Central America (less U.S.)
South America	Argentina
	Rest of South America
Asia	People's Rep. of China
	Japan
	Thailand
	Rest of Asia
Europe	West Germany
	Italy
	Netherlands
	United Kingdom
	France
	Rest of Western Europe
	Eastern Europe
	U.S.S.R.
Oceania	Oceania

countries increased at a steady rate during the estimation period and averaged 19 million metric tons in 1972-1976, over 37 percent of world trade. Much of this corn is imported from the United States and Argentina. France and the major corn importing EEC countries, West Germany, Italy, the Netherlands, and the United Kingdom were selected for individual balance sheet analysis. The four remaining EEC countries were aggregated with the rest of the Western European countries.

Japan was selected for separate balance sheet analysis because it has imported more corn than any other country in the world since the late 1960's. In 1972-1976, Japan's imports averaged over seven million metric tons, or 16 percent of world trade. Most of Japan's corn imports come from the United States; however, the current trend is toward increasing its imports from developing nations, primarily Thailand and other Southeast Asian countries (Regier and Goolsby, 1970).

The U.S.S.R. was not a major corn importer until the early 1970's when a poor harvest led to the decision to increase grain imports to avoid excessive liquidation of livestock. Since 1972 corn imports have exhibited a great amount of variation, ranging from two million metric tons in 1972 to over 12 million metric tons in 1974. Due to its increased importance in the world corn market, the Soviet Union was singled out for a separate balance sheet analysis.

Foreign Corn Area Harvested. The area of corn harvested increased in most of the foreign countries or regions during the study period. Factors responsible to a certain extent for the increased areas harvested are: 1) bilateral trade agreements that assure a market for a country's exportable corn surplus, 2) governmental agricultural policies that emphasize increased corn production, either to obtain self-sufficiency or to increase corn exports, 3) land reclamation and development projects which increased the country's total amount of arable land, and 4) favorable market prices which induce farmers to shift land from other crops to corn production.

The estimated corn area harvested equations for the foreign countries and regions are listed in Table VII. If a corn price series for an individual country was available, that price was tested in the country's area harvested equation. When two or more corn prices were available for a region, the price series of the country accounting for the most corn production was used in the equation as a proxy for the price of corn in that region. If a corn price could not be located for a country or region, the United States corn export price was used to represent the level of corn price in the world. Although this variable does not fully account for variation in the corn price of each country, most of the world corn prices are highly correlated. If a price variable is not included in an equation, the prices tested were either statistically insignificant or the coefficient signs were inconsistent with the hypothesized relationship with area harvested. This procedure was followed for the other corn and feed grain equations.

Thailand's corn area harvested equation contains the trend variable (T) and the United States corn export price, lagged (US ECPL). The coefficients carry the expected signs and the t-values are significant. Specification of the equations for the other countries or regions are similar to that for Thailand. The trend variables for these equations indicate a stable growth in corn area harvested over the estimation period; however, the difference in the relative magnitude shows that

TABLE VII

SELECTED REGRESSION STATISTICS FOR FOREIGN CORN AREA HARVESTED EQUATIONS, 1960-1976

	Country or World Region								
Variable[a]	Eastern Europe	U.S.S.R.	Rest of Western Europe	People's Rep. of China	Thailand	Rest of Asia	Argentina	Rest of South America	Rest of North and Central America
Intercept	8214.4555	6269.0	9576.118	11634.559	59.579	12118.992	2600.471	9166.002	7445.499
(t)	(121.26)	(20.86)	(62.40)	(104.26)	(1.27)	(44.35)	(17.34)	(36.91)	(55.35)
T	-76.295		144.647	153.089	59.479	124.534	110.339	355.428	
(t)	(-5.28)		(9.66)	(14.06)	(11.40)	(2.67)	(5.67)	(8.75)	
DV—[b]	-140.163	-2765.33							
	(-1.54)	(-7.73)							
—Soy[c]							-4.265	-0.211	
							(-5.91)	(-2.24)	
Other	5.834[d]				84.197[e]	9.376[f]			1182.757[g]
(t)	(4.58)				(2.23)	(1.35)			(18.60)
R^2	0.74	0.80	0.86	0.93	0.97	0.80	0.72	0.93	0.96
D.W.	1.71	1.84	1.97	1.02	1.33	2.84	1.84	1.83	2.39

[a]Variable definitions are given in Appendix B.

[b]Dummy variable as follows: DVCC, DV65.

[c]Soybean variable by country as follows: AR SOY, SA SOY.

[d]YULCP.

[e]US ECPL.

[f]ID WCPL.

[g]TL06.

this increase has been more gradual for some countries than others. The only trend variable with a negative coefficient is in the East European equation, indicating a steady decrease in the area of corn harvested. A possible explanation is that until the mid 1960's, production in these countries was increased by planting more marginal land. Most of the arable land is now in production and in competition with the industrial sectors. Thus, as the East European countries increase the use of land for industrial purposes there is less land for crop production.

The only explanatory variable in the U.S.S.R.'s area harvested equation is the dummy variable DV65. This was used to account for the policy decision in the mid 1960's to deemphasize corn production and give greater priority to winter wheat and other crops in the subhumid regions where corn was previously grown.

The area of soybeans harvested (AR SOY and SA SOY) were included in the Argentina and South American equations to account for the increased competition between soybeans and corn for available land. Soybean production seems to be a limiting factor in future production of corn in these areas.

Due to lack of variation exhibited during the study period by the corn area harvested, mean values were used as the 1985 projections for South Africa and Western Europe and a five year average (1972-1976) was used as the Oceanic region's predictor.

Foreign Corn Yield. Much of the increase in world corn production during the last two decades was due to higher yields, resulting in part from improved plant varieties, increased fertilizer usage, better production practices, greater applications of herbicides and insecticides, and increased amounts of irrigated land. Trend was used in most of the estimated corn yield equations to account for these factors (see Table VIII).

Although improved technology contributed to higher yields, weather conditions continued to play a major role in corn production and trade. For example, soil moisture is a critical factor in South Africa where, in fortunate years, some parts of the country receive a few inches more rain than most parts of the northern plains of the U.S. Because no variable could be located that measured this fluctuation, dummy variables were used to account for low yields caused by droughts or floods.

The corn yield equation for the African region contains trend, the lagged Egyptian producer corn price (EG LCP), and the dummy variable DVAF to account for the years of adverse weather. Yield equations for the other countries or regions contain a similar set of explanatory variables. The coefficients carry the expected signs but the difference in relative magnitudes for these equations is interesting. The trend in increased corn yields in the aggregated African countries has been gradual as compared with the faster rates of increase in other areas of the world such as Western Europe.

Foreign Corn Production. The corn production equations for France, West Germany, and Italy are presented in Table IX. Explanatory variables included in the estimated equation for France are trend, the French index of prices paid for production requisites (FR PDRI), and the dummy variable DV76. The prices paid for production requisites are a measure of the increased costs of production inputs while the dummy variable DV76 accounts for a drought in Western Europe in 1976 that caused a decrease in French corn production.

TABLE VIII

SELECTED REGRESSION STATISTICS FOR FOREIGN CORN YIELD EQUATIONS, 1960-1976

	Country or World Region											
Variable[a]	Rest of Western Europe	Eastern Europe	U.S.S.R.	South Africa	Rest of Africa	People's Rep. of China	Thailand	Rest of Asia	Oceania	Argentina	Rest of South America	Rest of North and Central America
Intercept	1.297	1.847	2.066	1.376	0.949	1.486	1.887	1.029	1.003	1.662	1.258	1.027
(t)	(11.29)	(24.99)	(23.15)	(8.66)	(26.90)	(25.06)	(17.54)	(42.53)	(4.88)	(16.28)	(85.05)	(39.45)
T	0.141	0.108	0.071	0.047	0.009	0.053	0.032	0.0094	0.123	0.066		0.023
(t)	(11.89)	(15.92)	(7.95)	(3.40)	(3.09)	(0.49)	(2.72)	(3.96)	(5.38)	(5.36)		(9.95)
DV—[b]	-0.522	-0.287	-0.575	-0.547	-0.054	-0.302	-0.732			-0.409		-0.125
(t)	(-2.11)	(-3.92)	(-5.05)	(-4.00)	(-2.31)	(-4.28)	(-4.22)			(-3.73)		(-5.30)
Other					0.003[c]				0.526[d]	0.0011[e]	0.008[f]	
(t)					(1.74)				(3.18)	(1.38)	(9.66)	
R^2	0.92	0.95	0.85	0.70	0.84	0.88	0.57	0.51	0.91	0.84	0.86	0.91
D.W.	0.88	2.73	2.42	2.69	1.35	1.34	1.17	2.19	1.13	2.07	3.00	2.43

[a]Variable definitions are given in Appendix B.

[b]Dummy variables as follows: DV76, DVCC, DVRU, DVSAF, DVAF, DVCH, DVTH, DVAR, DVNA.

[c]EG LCP.

[d]US ECPL.

[e]AR PCPL.

[f]BZ WCPL.

TABLE IX

SELECTED REGRESSION STATISTICS FOR FOREIGN CORN PRODUCTION EQUATIONS, 1960-1976

Variable[a]	Country or World Region		
	France	West Germany	Italy
Intercept	4343.758	430.764	2034.933
(t)	(1.94)	(2.62)	(5.40)
T	677.616	64.612	
(t)	(5.60)	(8.28)	
DV67	2198.397		533.043
(t)	(6.43)		(2.81)
Other	-37.543[b]	-6.802[c]	214.039[d]
(t)	(-1.58)	(-3.02)	(4.42)
Other	-3332.358[e]		
(t)	(-2.17)		
R^2	0.88	0.92	0.85
D.W.	1.24	0.44	1.40

[a]Variable definitions are given in Appendix B.

[b]FR PDRI.

[c]WG PDRI.

[d]IT LCP.

[e]DV76.

The dummy variable DV67 was used to account for the effects of the EEC's Common Agricultural Policy (CAP), the unified farm policy applied by the member governments of the EEC. The first CAP regulations for grains were established in 1962 but common grain pricing did not take effect until July 1, 1967, to allow member countries to gradually adjust their national support prices into a unified pricing system. This system is based on three prices: a target price, an intervention price, and a threshold price. The target price is the desired wholesale price for Duisburg, Germany--the most deficit consuming area in the EEC--and is fixed for each grain. An intervention price is set a little lower than the target price and constitutes a market floor on EEC produced grain. Government agencies are required to buy any domestic grain offered to them at the intervention price if the target price is not achieved. Grain imports are prevented from selling at less than the target price by the threshold price, the minimum import price. This price is equal to the Duisburg target price minus transport costs from Rotterdam.

The West German production equation resembles France's equation while Italy's corn production was explained by the corn selling prices, lagged (IT LGP) and the dummy variable DV67.

Japan, the Netherlands, and the United Kingdom exhibited such little variation in corn production in recent years that attempts to estimate these equations proved unsuccessful. Therefore five-year averages were used for the 1985 predictor.

Foreign Corn Feed Utilization. In some of the estimated equations, such as the one for North Central America, the animal units variable was found to explain a large proportion of the variation in corn feed demand (see Table X). In other equations this independent variable did not explain as much of the total variation but tracked the fluctuations in the region's corn utilization near the end of the estimation period better than any of the other variables tested. For example, large R^2 values were obtained when trend and dummy variables were used to explain the variation in Italy's corn feed demand, but these variables did not account for a leveling off in utilization in the mid 1970's. Because this leveling off resulted from a decrease in livestock numbers, the animal units variable for Italy did a better job of tracking corn usage during this period. For projection purposes, it was felt that it was more critical for the explanatory variables to track the dependent variables better in the latter part of the study period than in the earlier years. Therefore, the animal units variable was used in the estimated equation for Italy. The equations for France and the Netherlands include the animal units variables for these countries for similar reasons.

The dummy variable DV68 was included in the equation for the Netherlands to account for a structural change in that country's feeding industry that occurred in 1968. Feed manufacturers in this country shifted from a mixture of energy feeds (including grains) to cheaper (and lower protein) energy sources and increased protein feed to maintain nutrient requirements (Grains; Foreign Agriculture Circular, 1976). This shift resulted in a decrease in the utilization of corn for livestock feed.

Trend was included in four of the estimated corn demand equations. Although livestocks number varied throughout the study period in these regions the amount of corn fed per animal unit continued to increase as

TABLE X

SELECTED REGRESSION STATISTICS FOR FOREIGN CORN FEED UTILIZATION EQUATIONS, 1960-1976

	Country or World Region											
	France	Italy	Netherlands	West Germany	United Kingdom	Rest of Western Europe	Eastern Europe	South Africa	Japan	Rest of Asia	Oceania	Rest of North and Central America
Intercept	-8203.676	-9414.778	-817.857	-8433.114	5656.1	-27499.039	4065.279	879.647	1227.044	-31375.672	145.848	-4974.361
(t)	(-4.71)	(-2.27)	(-1.59)	(-8.01)	(10.01)	(-4.70)	(14.64)	(14.70)	(5.61)	(-7.50)	(5.38)	(-9.57)
T							257.074	120.392	319.485		9.779	
(t)							(9.49)	(20.61)	(14.96)		(6.93)	
--AN[b]	0.382	1.1111	0.3669		0.665					0.113		0.117
(t)	(6.99)	(4.08)	(4.80)		(5.53)					(7.48)		(14.49)
DV--[c]			-587.995		-237.534	811.688						
(t)			(-2.83)		(-1.51)	(1.13)						
Other				144.193[d]	-0.184[e]					-12.517[f]	-0.879[g]	
(t)				(3.92)	(-2.40)					(-1.78)	(-2.08)	
Other					-84.845[h]							
(t)					(-2.35)							
R^2	0.77	0.53	0.69	0.88	0.77	0.87	0.86	0.97	0.93	0.90	0.78	0.93
D.W.	1.26	0.76	1.46	1.41	1.82	0.62	1.73	2.26	1.46	1.16	1.16	1.22

[a]Variable definitions are given in Appendix B.

[b]Animal unit variable by country as follows: FR AN, IT AN, NL AN, WG AN, ROE AN, AS AN, NA AN.

[c]Dummy variables as follows: DV68, DVUK, DV67.

[d]WG WP.

[e]UK OFU.

[f]ID WCP.

[g]AU FLP.

[h]UK CBPR.

improved feeding techniques were adopted. Therefore, trend was used to account for the improved feeding practices.

Corn feed utilization declined in the United Kingdom during the estimation period until 1974 when usage rapidly increased. Included in this equation are the competing grains fed to livestock (UK OFU) and the ratio of the United Kingdom's corn import price to barley producer price (UK DBPR). The dummy variable DVUK accounts for the country's entrance into the EEC on January 1, 1973.

Foreign Corn Human Utilization. Population was found to explain the variation in corn demanded for human purposes in most of the foreign countries (see Table XI). The French corn selling price (FR CP) was used as a proxy for the price level in West Germany and the West European region, while the United States' export corn price was included in the food demand for Japan. The dummy variable DV67 in the Netherlands' equation accounts for the effect of CAP on that country's utilization of corn for human purposes.

The estimated equation for Italy was the poorest fit. However, the population variable tracked food demand in the latter part of the study period better than the other independent variables that were tested and was therefore used in this equation.

Foreign Corn Total Utilization. Because of either a lack of data or problems in estimating the individual demand components, the total utilization of corn was estimated for the foreign countries or regions listed in Table XII. Corn consumption in Africa, the People's Republic of China, and South America was found to be a function of production. The African countries and Mainland China typically consume more corn than

TABLE XI

SELECTED REGRESSION STATISTICS FOR FOREIGN CORN HUMAN UTILIZATION EQUATIONS, 1960-1976

	Country or World Region										
Variable[a]	France	Italy	Netherlands	West Germany	United Kingdom	Rest of Western Europe	Eastern Europe	South Africa	Japan	Rest of Asia	Rest of North and Central America
Intercept	-5204.738	-2280.711	-4130.143	745.222	-11595.939	641.681	-87284.218	-191.249	-10061.713	1501.658	-4330.615
(t)	(10.09)	(-2.60)	(-4.71)	(4.76)	(-13.31)	(3.10)	(-7.70)	(-0.65)	(-13.71)	(0.91)	(-10.06)
T				70.075		96.468					
(t)				(9.34)		(9.82)					
--POP[b]	0.118	0.059	0.360		0.233		0.833	151.200	111.407	0.007	155.153
(t)	(11.43)	(3.59)	(4.92)		(14.71)		(9.10)	(10.94)	(13.79)	(8.15)	(34.45)
DV--[c]			-231.772	838.408							
(t)			(-2.19)	(7.50)							
Other				-63.286[d]		-72.024[e]			-267.265[f]		
(t)				(-2.85)		(-2.47)			(-4.00)		
R^2	0.90	0.46	0.75	0.95	0.94	0.91	0.85	0.85	0.96	0.82	0.99
D.W.	0.40	1.05	0.96	2.29	1.10	1.09	1.83	2.61	0.96	2.87	2.00

[a] Variable definitions are given in Appendix B.

[b] Population variable by country as follows: FR POP, IT POP, NL POP, UK POP, EEC POP, SAF POP, JA POP, AS POP, NA POP.

[c] Dummy variables as follows: DV67, DV71.

[d] FR CP.

[e] FR CP.

[f] US ECP.

TABLE XII

SELECTED REGRESSION STATISTICS FOR FOREIGN CORN TOTAL UTILIZATION EQUATIONS, 1960-1976

Variable[a]	Country or World Region					
	U.S.S.R.	Rest of Africa	People's Rep. of China	Thailand	Argentina	Rest of South America
Intercept	182.512	-1132.576	-130.035	-1071.111	-4082.227	348.163
(t)	(0.14)	(-1.66)	(-0.23)	(-8.09)	(-2.83)	(0.25)
--AN[b]	23.343				0.139	
(t)	(5.23)				(5.05)	
--CPROD[c]	0.954	1.097	1.013			0.961
(t)	(8.77)	(20.42)	(46.63)			(11.44)
Other	-9150.350[d]			36.956[e]	-1.154[f]	
(t)	(-7.22)			(9.68)	(-2.83)	
R^2	0.91	0.97	0.993	0.86	0.65	0.90
D.W.	1.73	1.11	1.17	0.28	2.20	2.49

[a]Variable definitions are given in Appendix B.

[b]Animal unit variable by country as follows: USSR AN, AR AN.

[c]Corn production variable by country as follows: USSR CPROD, AF CPROD, PRC CPROD.

[d]DV75.

[e]TH POP.

[f]AR PCP.

they produce, while the South American countries, particularly Brazil, export corn in the years when production exceeds domestic demand. The equation of the U.S.S.R. includes that country's corn production (RU CPROD) and animal units variable (RU AN). Until the early 1970's the Soviet Union's corn utilization depended primarily on its production, reducing grain usage in years of a production shortfall even if it meant a reduction in livestock numbers. However, after the decision to increase livestock production, the variation in the U.S.S.R.'s corn demand was found to be a function of the animal units variable. The dummy variable DV75 accounts for the production shortfall in 1975 when the Soviet Union imported over 12 million metric tons of corn to avoid excessive livestock slaughter.

Total utilization of corn in Argentina was specified as a function of animal units (AR AN) and that country's producer corn price (AR PCP) while population was found to be a good explanation of Thailand's corn demand.

Specification of Foreign Sorghum Equations

Although world sorghum production steadily increased from 30 million metric tons in 1960 to over 51 million metric tons in 1976, international trade of this feed grain exhibited a great deal of variation throughout the study period. Sorghum exports twice reached the eight million metric ton level in 1965 and 1970 only to decline to less than five million metric tons in the following years. During the mid 1970's as the west European and Communist countries increased the use of this grain in livestock production, sorghum exports increased to over 12 million metric tons in 1976 and accounted for almost 14 percent of world feed grain exports. Because of the increased activity in sorghum trade in recent years, this feed grain was also selected for separate analysis.

The foreign countries identified for balance sheet analysis are listed in Table XIII. The two major exporting countries in this grouping are Argentina and Australia, accounting for an average of 29 and 8 percent, respectively, of world sorghum trade in 1972-1976. These countries together with the United States typically supplied over 90 percent of total sorghum exports throughout the estimation period.

TABLE XIII

FOREIGN COUNTRIES AND REGIONS USED FOR SORGHUM EQUATIONS

Continent	Country or Region
Africa	Africa
North and Central America	North and Central America (less U.S.)
South America	Argentina Rest of South America
Asia	People's Republic of China Japan Rest of Asia
Europe	EEC Rest of Western Europe Eastern Europe[a]
Oceania	Australia[b]

[a]Includes U.S.S.R.

[b]Only Oceania country reporting sorghum data.

Japan, the world's largest sorghum importer, increased its imports of this feed grain at a steady rate during the study period. Imports in 1972-1976 averaged over four million metric tons, about 44 percent of world trade. Although not importing as much as Japan, the West European and Communist countries increased their sorghum imports at rapid rates between 1972 and 1976. The EEC countries, considered as one entity, tripled imports from less than 600 thousand metric tons in 1972 to over 1.7 million metric tons in 1976 and averaged 17 percent of the world trade. The other West European nations, taken together, increased imports from less than 500 thousand metric tons in 1972 to over 1.4 million metric tons in 1976 which represented nine percent of world sorghum imports. The East European countries and the U.S.S.R., averaged only five percent of world trade, but exhibited the greatest increase in sorghum imports during this period. Imports into this region rose from 50 thousand metric tons in 1972 to almost 1.3 million tons in 1976.

The People's Republic of China is the largest sorghum producing country in the world and provided almost 26 percent of the world supply in 1972-1976. However, no sorghum trade was reported for this country during the study period. The Asian, African, and South and North Central American regions together, produce over 42 percent of the world supply. Although these regions, on the average, imported 14, 1, 6, and 5 percent, respectively, of world trade in 1972-1976, individual countries within these areas do export sorghum if their domestic production exceeds consumption.

Foreign Sorghum Area Harvested. The estimated sorghum area harvested equations are listed in Table XIV. Because the area utilized

TABLE XIV

SELECTED REGRESSION STATISTICS FOR FOREIGN SORGHUM AREA HARVESTED EQUATIONS, 1960-1976

	Country or World Region							
	EEC	Rest of Western Europe	Africa	Rest of Asia	Australia	Argentina	Rest of South America	Rest of North and Central America
Intercept	12.417	16.119	10145.559	23393.719	272.027	246.353	-110.310	162.376
(t)	(2.64)	(3.58)	(31.11)	(28.96)	(5.67)	(1.63)	(-2.50)	(3.17)
T	4.618	4.133	161.637		13.109	124.314	14.429	86.369
(t)	(10.28)	(8.24)	(5.08)		(1.95)	(8.45)	(2.09)	(9.20)
US ECPL		-14.654		-129.700				
(t)		(-4.04)		(-4.30)				
DV--[b]					27.623		164.551	249.018
(t)					(6.03)		(2.84)	(2.75)
Other				-0.334[c]		39.922[d]		
(t)				(-6.59)		(1.94)		
R^2	0.88	0.85	0.63	0.74	0.942	0.83	0.92	0.97
D.W.	1.20	1.75	1.14	1.61	1.66	1.66	1.47	1.06

[a]Variable definitions are given in Appendix B.

[b]Dummy variable by country as follows: DVTAU, DV70, DV66.

[c]ID WAH.

[d]US ESPL.

for sorghum production increased in most of the foreign countries or regions during the study period, trend was found to be a significant explanatory variable in many of these equations. The United States export sorghum price, used as a proxy for the world sorghum price, was included in the equation for the South American region. The positive coefficient sign for this explanatory variable indicates that farmers in this region increased the area used for sorghum production in response to higher sorghum prices. However, in other world regions, such as Western Europe, the price of corn was found to be useful in explaining variations in the sorghum area harvested.

A number of factors affected Australia's sorghum production during the study period. In 1967 a program to stimulate sorghum production was started by a joint Australian-Japanese group. However, sorghum area harvested did not increase until 1969 when precipitation in Australia was not adequate to plant wheat. Many farmers delayed wheat production and then planted sorghum. Also during this period, the marketing of this feed grain had been improved. Thus, the combination of a drought and other pressures resulted in a doubling of output in 1969 and again in 1970 (Austin, 1977). The slope dummy variable TAU was used to account for this series of events.

Mexico typically provides over 80 percent of the sorghum produced in the North and Central American region, while India normally accounts for over 90 percent of the sorghum grown in the Asian region. Because of the dominant roles they play in these regions' sorghum production, variables specific to each country were used in the estimated equations. The dummy variable DV66 was included in the North/Central American equations to account for an increase in sorghum price supports that stimulated Mexican production. The area of wheat harvested in India was used as the independent variable in the estimated equation for Asia because increased wheat production in India resulted in a decrease in sorghum production.

Production data were not reported for Brazil until 1970, therefore the dummy variable DV70 was used in the South American equation to account for the addition of Brazil's data to the region's total in 1970.

Foreign Sorghum Yield. Sorghum yields increased in most of the foreign areas analyzed in this study due to improved technology and marketing incentives. Yields in the EEC, Western European countries and Asia were specified directly as a function of trend, used as a proxy for technology (see Table XV). Sorghum production increased in Argentina in the early 1970's due to a strong export demand, mainly to Japan. Therefore, the lagged U.S. export sorghum price was found to best explain the variations in this country's sorghum yields. Also included in this equation was the dummy variable DVAR to account for adverse weather. The estimated equations for the South and North and Central American regions contain sets of variables similar to the equation for Argentina.

Yields decreased throughout the study period in the African region. A possible explanation for this phenomenon is that the level of technology is lower in many of these countries than in other parts of the world, and yields decreased as more marginal land was planted to increase sorghum production. Sorghum yields also declines in Australia during the 1960's, but increased after the series of events discussed in the previous section. This turnabout in yields was accounted for by the dummy variable DVTAU.

TABLE XV

SELECTED REGRESSION STATISTICS FOR FOREIGN SORGHUM YIELD EQUATIONS, 1960-1976

	Country or World Region							
Variable[a]	EEC	Rest of Western Europe	Africa	Rest of Asia	Australia	Argentina	Rest of South America	Rest of North and Central America
Intercept	2.482	1.147	0.872	0.460	1.671	1.596	1.022	1.282
(t)	(13.03)	(5.23)	(71.41)	(21.44)	(9.53)	(10.45)	(4.38)	(13.17)
T	0.091	0.200	-0.008	0.010	-0.033			
(t)	(4.88)	(9.34)	(-6.34)	(4.71)	(-1.06)			
US ESPL						0.209	0.110	0.064
(t)						(4.39)	(1.14)	(1.81)
Other				-0.108[b]	0.049[c]	0.472[d]	0.627[e]	0.516[f]
(t)				(-3.84)	(2.17)	(-3.17)	(2.68)	(5.81)
R^2	0.61	0.85	0.73	0.68	0.42	0.72	0.64	0.81
D.W.	1.64	1.29	2.01	2.41	2.54	2.15	1.23	1.61

[a]Variable definitions are given in Appendix B.

[b]DVAS.

[c]TAU.

[d]DVAR.

[e]DV70.

[f]DV66.

Foreign Sorghum Total Utilization. Because sorghum is used primarily as a livestock input in many foreign countries, total domestic consumption was the only utilization category analyzed for this feed grain. The estimated equations for this balance sheet component are given in Table XVI.

Total sorghum utilization was determined to be a function of animal units for most of the countries and regions. Although these variables do not explain a large proportion of the variation in Argentina's and Western Europe's sorghum demand, they do track fluctuations in sorghum consumption in the latter part of the estimation period better than other variables that were tested. Also included in the estimated equation for the EEC was the dummy variable DVEC to account for the introduction of CAP and France's wheat selling price. The coefficient of the price variable, although not significant at the five percent level, does display a competitive relationship with sorghum utilization.

Similar to corn, Japan's sorghum demand was specified as a function of trend to account for increased sorghum usage per animal unit throughout the study period. Production was found to be a good explanation in Africa and the People's Republic of China while population explained much of the variation in sorghum demand in the Asian region. Normally not considered as a food grain in the developed countries, there is no well-defined concept of "feed grains" in developing countries because corn, barley, and sorghum are staple human foods as well as animal feeds (Szczepanik, 1976). The term feed grains may refer to the quality rather than the type of grain in these countries, and grains unfit for human consumption are fed to livestock.

TABLE XVI

SELECTED REGRESSION STATISTICS FOR FOREIGN SORGHUM TOTAL UTILIZATION EQUATIONS, 1960-1976

	Country or World Region									
Variable[a]	EEC	Rest of Western Europe	Africa	People's Rep. of China	Japan	Rest of Asia	Australia	Argentina	Rest of South America	Rest of North and Central America
Intercept	-2874.914	-3964.773	220.897	13.592	16.710	3260.372	272.446	-5277.218	-2094.825	-7211.259
(t)	(-1.26)	(-3.95)	(0.46)	(2.90)	(0.10)	(2.68)	(4.72)	(-4.21)	(-3.70)	(-10.43)
T					223.702		19.277			
(t)					(7.50)		(2.39)			
—AN[b]	0.041	0.142						0.127	0.016	0.146
(t)	(1.74)	(4.48)						(5.41)	(3.90)	(13.61)
DV—[c]	-0.013				848.867	-2335.510			611.926	
(t)	(-4.70)				(2.78)	(-7.10)			(3.63)	
Other	75.469[d]		0.960[e]	0.999[f]		0.004[g]	-5.483[h]			
(t)	(1.06)		(18.52)	(2772.91)		(6.17)	(-2.40)			
R^2	0.77	0.57	0.96	0.99	0.96	0.83	0.31	0.66	0.93	0.93
D.W.	2.39	0.98	2.74	1.42	1.90	0.90	2.16	0.78	1.01	1.05

[a]Variable definitions are given in Appendix B.

[b]Animal unit variable by country as follows: EC AN, ROE AN, AR AN, SA AN, NA AN.

[c]Dummy variable as follows: DVEC, DV66, DV AS, DV 70.

[d]FR WP.

[e]AF SPROD.

[f]EC SPROD.

[g]AS POP.

[h]AU FSP.

Because sorghum utilization in East Europe was relatively stable during the 1960's and increased at a rapid rate in the 1970's, attempts to explain this variation were unsuccessful. Therefore, a five-year average was used for the 1985 projection.

Specification of Foreign Barley and Oat Equations

Although barley exports increased from less than six million metric tons in 1960 to over 13 million metric tons in 1976, this grain's importance in international feed grain trade gradually declined from 22 percent of total world feed grain exports in 1960 to less than 15 percent in 1976. However, barley typically ranked second to corn in total volume traded throughout this period. In contrast, oats were by far the least traded feed grain. Oat exports exceeded the two million metric ton level only once during the study period and accounted for less than five percent of world feed grain exports throughout the 1970's. Because oats is the least important feed grain in international trade and exhibited little variation in exports during the study period, this feed grain was aggregated with barley into one estimation category.

The countries and regions selected for a balance sheet analysis of these feed grains are listed in Table XVII. Although Canada and Australia are the leading world exporters, they were aggregated with their respective regions because each country dominates the barley and oat markets in these areas, typically supplying between 95 and 100 percent of the total exports. The U.S.S.R. is the largest producer of these two feed grains but was either a net importer or net exporter during the study period depending on its harvest. In recent years,

TABLE XVII

FOREIGN COUNTRIES AND REGIONS USED FOR BARLEY AND OATS EQUATIONS

Continent	Country or Region
Africa	Africa
North and Central America	North and Central America (less U.S.)
South America	South America
Asia	People's Republic of China Japan Rest of Asia
Europe	EEC Rest of Western Europe Eastern Europe U.S.S.R.
Oceania	Oceania

this country's barley and oat imports have exceeded exports, accounting for nine percent of world imports. The major barley and oat importing regions are the EEC, Asia, East Europe, and the Rest of West Europe, accounting for an average of 41, 21, 14, and 8 percent, respectively, of the world total in 1974-1976. Japan is the leading importing country with an average of 12 percent of the world total during this period.

Foreign Barley and Oats Area Harvested. The estimated equations for the area of barley and oats harvested are listed in Table XVIII. Included in the equation for the EEC are trend, the ratio of France's barley price to wheat price, lagged (FR BWPL), and two dummy variables to account for the beginning of the Common Agricultural Policy in 1967. The area of barley and oats harvested in the EEC was increasing until 1967 but declined so sharply in the following years that both an intercept and slope dummy had to be used to get a good fit. Barley and oat production in the other European regions also appears to have been influenced by the policies of the EEC. Until 1967 the area of barley and oats harvested in the Rest of Western Europe was stable while area harvested in the East European countries was decreasing. After the beginning of CAP the area harvested in both of these regions increased. This probably reflects the effects of the EEC subsidy on agricultural exports to the countries outside the community. Therefore, dummy variables were also used in the equations for the Rest of Western Europe and Eastern Europe to account for the start of CAP.

The estimated equation for North and Central America contains the area of wheat harvested in Canada (CN WAH), the United States' export corn price, lagged (US ECPL), and the dummy variable DV71 to account for

TABLE XVIII

SELECTED REGRESSION STATISTICS FOR FOREIGN BARLEY AND OATS AREA HARVESTED EQUATIONS, 1960-1976

	Country or World Region				
Variable[a]	EEC	Rest of Western Europe	Eastern Europe	Oceania	Rest of North and Central America
Intercept	4348.119	4527.967	6774.857	1800.425	9374.766
(t)	(3.03)	(26.03)	(42.19)	(11.72)	(14.28)
T	202.289	72.235	-111.964	140.506	
(t)	(6.10)	(1.87)	(-3.12)	(6.72)	
FR BWPL	6527.591				
(t)	(3.77)				
DV76	1748.985		-1362.742		
(t)	(8.91)		(-4.36)		
CN WAH					-0.112
(t)					(-2.09)
US ECPL					-467.240
(t)					(-2.37)
Other	-330.736[b]	80.437[b]	184.843[b]	-46.313[c]	1560.996[d]
(t)	(-7.24)	(2.66)	(4.45)	(-3.11)	(5.09)
R^2	0.93	0.94	0.63	0.81	0.81
D.W.	2.05	0.80	2.65	1.32	2.04

[a]Variable definitions are given in Appendix B.

[b]DV67.

[c]DVT72.

[d]DV71.

a change in Canadian wheat policy. The explanatory variables specific to Canada and its wheat production proved useful in explaining the variation exhibited by the area of barley and oats harvested in this region for two reasons. First, Canada is the largest barley and oat producing country in North and Central America, typically accounting for over 90 percent of total production. Second, when faced with burdensome wheat stocks in 1971, the Canadian government encouraged farmers to plant barley in an attempt to find a viable alternative to wheat. This policy stimulated a rapid expansion in barley production.

Trend and the slope dummy variables DVT72 were used to explain the increased in the area of barley and oats harvested in the Oceania region. The dummy DVT72 reflects a structural shift that occurred in the early 1970's (Austin, 1976). Because of various estimation problems, averages were used for the 1985 predictors for the People's Republic of China, the U.S.S.R., and the Asian and African regions.

Foreign Barley and Oat Yields. Most of the estimated barley and oat yield equations were defined as a function of trend (see Table XIX). Of the seven yield relations, the equations for the Oceanic and African regions have the poorest fits. The yields in these regions did increase during the study period but the trends were more gradual than for the other foreign areas. However, the trend in increased yield was greater in the latter part of the estimation period than in earlier years. Although much of the variation was a result of weather, attempts to specify dummy variables for unfavorable years were unsuccessful. The dummy variable DV67 was again included in the equation for the Rest of Western Europe to account for the effects of the beginning of CAP.

TABLE XIX

SELECTED REGRESSION STATISTICS FOR FOREIGN BARLEY AND OATS YIELD EQUATIONS, 1960–1976

	Country or World Region						
Variable[a]	EEC	Rest of Western Europe	Eastern Europe	Africa	Rest of Asia	Oceania	Rest of North and Central America
Intercept	2.747	1.573	1.611	0.617	0.915	1.003	1.496
(t)	(24.12)	(28.53)	(19.49)	(11.11)	(22.65)	(10.84)	(16.24)
T	0.059	0.028	0.080	0.014	0.018	0.013	0.038
(t)	(5.27)	(2.91)	(9.87)	(2.59)	(4.66)	(1.43)	(4.26)
DV67		0.222					
(T)		(2.28)					
R^2	0.65	0.87	0.87	0.31	0.59	0.12	0.55
D.W.	1.32	2.32	1.64	2.34	1.47	2.51	1.92

[a]Variable definitions are given in Appendix B.

Barley and oat production in Japan decreased throughout most of the study period and became stable in the mid 1970's. It was possible to fit this relation by using a third or fifth-degree polynomial; however, the projections were unrealistic. Therefore, a three-year average was used as Japan's 1985 projected production of barley and oats.

Foreign Barley and Oat Feed Utilization. The barley and oat feed demand equations are similar in specification to the previous feed utilization equations. The equation for the EEC includes the animal units variable for the EEC (EC AN), the West German barley selling price (WG BP) as a proxy for the barley price level in the community, and the intercept dummy variable DV67 and slope dummy variable DVECAN to reflect the effect of the beginning of CAP. All coefficients are significant and exhibit the correct hypothesized relationships. The slope dummy variable DVROEAN was used in the Rest of Western Europe equation to account for increased utilization of barley and oats for livestock feed after CAP began in the EEC.

The feed utilization of barley and oats in Japan was stable throughout the 1960's but expanded in the 1970's as corn prices increased. Therefore, the United States' export corn price was included in the estimated equation for Japan to reflect the substitutability between these feed grains and corn. Trend was used in this equation instead of Japan's animal units variable for reasons similar to those previously discussed in other feed utilization sections. The estimated equation for the Oceanic regions contains trend and the average barley feed price in that region. Of the seven relations, this equation has the poorest fit; however, it did a good job of tracking the variations in this region's feed use of barley and oats throughout the study period.

TABLE XX

SELECTED REGRESSION STATISTICS FOR FOREIGN BARLEY AND OATS FEED UTILIZATION EQUATIONS, 1960-1976

Variable[a]	Country or World Region						
	EEC	Rest of Western Europe	Eastern Europe	Japan	Rest of Asia	Oceania	Rest of North & Central America
Intercept	-21304.702	-7251.144	-9445.638	470.542	-5490.234	1340.841	345.762
(t)	(-2.18)	(-1.46)	(-6.27)	(6.07)	(-2.70)	(5.41)	(0.30)
T				24.431		88.004	
(t)				(2.67)		(3.90)	
--AN[b]	0.467	0.498	0.204		0.032		0.176
(t)	(5.17)	(3.01)	(9.89)		(4.33)		(7.72)
DV--[c]	-0.277	0.105					
(t)	(-2.18)	(5.08)					
Other	37709.593[d]				-12.858[e]	-16.663[f]	-3781.746[g]
(t)	(2.28)				(-3.39)	(-2.33)	(-4.17)
Other	-435.630[h]			163.003[i]			2007.334[j]
(t)	(-2.19)			(2.55)			(2.47)
R^2	0.95	0.88	0.87	0.82	0.57	0.53	0.87
D.W.	1.75	1.11	1.02	1.46	1.97	1.00	2.44

[a]Variable definitions are given in Appendix B.

[b]Animal unit variable by country as follows: EC AN, ROE AN, CC AN, AS AN, NA AN.

[c]Dummy variable as follows: DV ECAN, DVROEAN.

[d]DV 67. [e]IN WBP. [f]AU FOP. [g]CN WBP. [h]WG CP. [i]US ECP. [j]US ECP.

The equation for the other regions are specified similar to those previously discussed. The feed use of barley and oats in South America had such little variation that attempts to explain this variation prove unsuccessful while the 1985 projection obtained from the estimated equation for the U.S.S.R. seemed to be unrealistic. Therefore, five-year averages were used as the 1985 predictors.

Foreign Barley and Oats Human Utilization. Resembling the corn equations, the equations for barley and oats demanded for human purposes were specified as a function of population, barley price, and dummy variables (Table XXI). The dummy variable DV67 was used in the Western Europe equation to account for the beginning of CAP while the slope dummy DVOCPOP in the Oceanic equation reflects the structural change in Australia's barley sector. The wholesale price of barley in India (IN WBP) was a significant variable in explaining the variation in human utilization in the Asian region with the negative sign consistent with the hypothesized relationship between price and barley and oat consumption.

The human utilization of barley and oats in the South American region was stable during the 1960's but began to increase in the 1970's. Although population does not explain a large proportion of the variation, it was selected as the independent variable because it did track the increase in usage better than the other explanatory variables tested. Averages were used for the 1985 predictors for Japan, North and Central America, the U.S.S.R., and the Eastern European region because of estimation or projection problems.

TABLE XXI

SELECTED REGRESSION STATISTICS FOR FOREIGN BARLEY AND OATS HUMAN UTILIZATION EQUATIONS, 1960-1976

Variable[a]	Country or World Region				
	EEC	Rest of Western Europe	Rest of Asia	Oceania	Rest of South America
Intercept	-26535.777	-12413.582	1726.919	-504.986	461.084
(t)	(-6.73)	(-5.25)	(1.14)	(-1.59)	(3.85)
--POP[b]	0.140	291.550	0.004	0.070	2.135
(t)	(8.77)	(5.85)	(4.10)	(3.90)	(3.21)
Other		-327.599[c]	-13.122[d]	-0.021[e]	
(t)		(-2.11)	(-3.04)	(-6.48)	
R^2	0.84	0.81	0.57	0.77	0.41
D.W.	0.72	1.53	2.60	3.07	1.12

[a]Variable definitions are given in Appendix B.

[b]Population variable by country as follows: EC POP, ROE POP, AS POP2, OC POP, SA POP.

[c]DV67.

[d]IN WBP.

[e]DVOCPOP.

Foreign Barley and Oats Total Utilization. The total utilization of barley and oats for the People's Republic of China and Africa were specified as a function of production (see Table XXII). Both of these explanatory variables did a good job of tracking the fluctuations of the respective total utilizations throughout the study period. During the 1960's and early 1970's Mainland China did export a small percentage of its barley and oat production, but total consumption has equalled production since 1971. Total consumption of barley is typically greater than production in the African region with the deficit being made up by imports. Only two African countries, Algeria and Morocco, reported oat production which was consumed within these countries.

TABLE XXII

SELECTED REGRESSION STATISTICS FOR FOREIGN BARLEY AND OATS TOTAL UTILIZATION EQUATIONS, 1960-1976

	Country or World Region	
Variable[a]	People's Rep. of China	Africa
Intercept	1632.945	1124.747
(t)	(3.09)	(2.03)
CHBOPD	0.800	
(t)	(11.13)	
AFBOPD		0.691
(t)		(5.18)
R^2	0.89	0.64
D.W.	1.99	1.47

[a]Variable definitions are given in Appendix B.

CHAPTER IV

BALANCE SHEET PROJECTIONS FOR 1985

The primary objective in this chapter is to project the 1985 balance sheet components of corn, sorghum, and barley and oats for the specified countries and world regions using the equations presented in Chapter III. These individual projections will then be aggregated for the world excluding the United States to determine the potential for American feed grain exports.

The balance sheet projections assume the absence of major institutional changes or natural disasters that would alter the underlying factors affecting future supply and demand prospects. Therefore, the dummy variables used to account for the effects of policy changes or structural shifts were held at the same values for 1985 as they had in the last year of the study period, and the weather dummy variables were assigned a 1985 value of zero.

Foreign and domestic price variables, production requisite indices, and the area harvested of the crops competing with feed grains for available land were held constant at their 1974-1976 average levels. Assumed values for the other explanatory variables were based primarily on recent historical trends. The projected values for the animal unit variables were estimated by calculating the percentage change between the 1964-1966 and the 1974-1976 average levels and projecting these changes out to 1985. If these estimates seemed to be unrealistic based on recent

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Corn Projections

The actual 1985 balance sheet projections for corn are given in Table XXIII. The right hand column of this table shows the projected supply-demand balance for each of the countries or world regions along with the regional totals. This balance is simply the difference between projected production and total utilization; therefore, a negative value indicates a deficit or potential imports, and a positive value indicates an exportable surplus. Assuming that the four major corn exporting countries are residual suppliers, they were projected to have a potential import market of 62.7 million metric tons and an exportable surplus of 65.6 million metric tons. The Western Europe and Asian regions are expected to require most of the corn imports and the United States is projected to supply the majority of the exports.

Table XXIV shows the percentage change of the projected balance sheet variables for corn and the supply-demand balances from the 1974-1976 average levels. For the importing countries as a whole, the balance sheet projections indicate that the need to import corn will increase 46 percent by 1985. In general this results from projected domestic utilization increases which are greater than projected production increases. The two regions primarily responsible for this expansion in

TABLE XXIII

BALANCE SHEET PROJECTIONS FOR CORN,[a] 1985

Country or Region	Area Harvested	Yield	Production	Feed Use	Human Use	Total Domestic Use	Supply-Demand Balance
	mha	mt/ha	mmt	mmt	mmt	mmt	mmt
France	--	--	12.2	8.0	1.5	9.5	2.7
Germany	--	--	1.2[g]	3.4	1.8	5.2	-4.1
Italy	--	--	5.6[g]	8.8	1.1	9.9	-4.2
Netherlands	--	--	0.007[g]	3.9	0.9	4.8	-4.8
United Kingdom	--	--	0.003[g]	2.0	2.1	4.1	-4.1
Rest of Western Europe	1.2	4.97	5.9	15.9	2.3	18.2	-12.3
Western Europe Total			24.9			51.7	-26.9
Eastern Europe	7.2	4.66	33.7	10.7	27.7	38.4	-4.7
U.S.S.R.	3.5	3.90	13.7	--	--	17.9[g]	-4.2
People's Rep. of China	15.6	2.80	43.7	--	--	44.2[g]	-0.4
Communist Total			91.1			100.5	-9.3
Africa[b]	13.4	1.37	18.3	--	--	19.0[g]	-0.7
Japan	--	--	0.01[g]	9.5	2.8	12.3	-12.3
Rest of Asia[c]	16.5	1.27	20.9	8.1	20.1	28.7	-7.7
Asian Total			21.0			41.0	-20.0
Oceania	0.08	5.85	0.5	0.3	0.1	0.4	0.1
Rest of South America[d]	17.1	1.55	26.6	--	--	25.9[g]	0.7
Rest of North and Central America[e]	11.4	1.62	18.4	6.1	18.9	25.0	-6.6

TABLE XXIII (Continued)

Country or Region	Area Harvested	Yield	Production	Feed Use	Human Use	Total Domestic Use	Supply-Demand Balance
Sub-Total[f]			200.8			263.4	-62.7
Argentina	3.9	3.53	13.7	--	--	5.0[g]	8.7
South Africa	4.4	2.59	11.3	4.0	4.8	8.8	2.5
Thailand	1.9	2.70	5.0	0	0	1.1[g]	4.0
United States	27.5	6.58	181.0	116.7	13.9	130.6	50.4
Four Exporter's Total			211.0			145.5	65.6

[a]Values may not equal due to rounding error.

[b]Excludes South Africa.

[c]Excludes Thailand.

[d]Excludes Argentina.

[e]Excludes United States.

[f]World total less four major exports.

[g]Estimated as an aggregate.

TABLE XXIV

PERCENTAGE CHANGE IN 1985 CORN PROJECTIONS FROM THE AVERAGE LEVELS OF 1974/75-1976/77

Country or Region	Area Harvested	Yield	Production	Feed Use	Human Use	Total Domestic Use	Supply-Demand Balance
			Percent Change				
France	--	--	63	48	50	46	145
Germany	--	--	140	36	64	44	32
Italy	--	--	8	4	0	3	-5
Netherlands	--	--	0	77	50	71	71
United Kingdom	--	--	0	0	40	17	17
Rest of Western Europe	0	51	55	49	77	52	50
Western Europe Total			45			36	29
Eastern Europe	-9	33	20	29	26	28	114
U.S.S.R.	6	30	38	--	--	11	-32
People's Rep. of China	-6	33	26	--	--	27	300
Communist Total			25			24	11
Africa	15	8	23	--	--	23	17
Japan	--	--	0	46	87	43	56
Rest of Asia	10	5	15	76	20	34	148
Asian Total			15			40	80
Oceania	0	25	25	50	0	33	0
Rest of South America	26	0	27	--	--	29	-22
Rest of North and Central America	7	20	28	56	42	45	128

TABLE XXIV (Continued)

Country or Region	Area Harvested	Yield	Production	Feed Use	Human Use	Total Domestic Use	Supply-Demand Balance
Sub-Total			27			31	46
Argentina	39	36	88	--	--	47	123
South Africa	-2	34	30	43	30	35	14
Thailand	46	23	79	--	--	83	82
United States	0	29	28	33	18	30	24
Four Exporters Total			32			31	34

the corn import market are Asia and North and Central America. Corn production in Japan is expected to remain constant relative to the 1974-1976 level while utilization was predicted to increase by 54 percent, causing import requirements to increase 56 percent. Although production increased in the Rest of Asia and North and Central America, faster growth rates in corn usage resulted in potential imports being 148 and 120 percent higher, respectively, in 1985 than in 1974-1976. Italy and the U.S.S.R. were the only importing countries projected to need fewer corn imports while South America was the only net exporting world region projected to have less corn available for trade.

Together, the four major corn exporting countries were projected to have an increase in exportable surplus of 34 percent. Although Argentina and Thailand are shown to have the greatest increases in export supplies, the United States was projected to supply 77 percent of the 1985 exportable surplus.

Sorghum Projections

The 1985 sorghum projections are summarized in Tables XXV and XXVI. Similar to corn, an increase in exports is expected as sorghum demand was predicted to continue increasing at a rate faster than sorghum production. In fact, this was the only feed grain for which the world imports were projected to exceed the total exportable surplus estimated for the three major sorghum exporting countries. A net of 14.4 million metric tons of potential import demand but only 13 million metric tons of exportable surplus were projected. These estimated values represent increases of 58 percent in world import requirements and 29 percent in the surplus available for export over the 1974-1976 average levels.

TABLE XXV

BALANCE SHEET PROJECTIONS FOR SORGHUM, 1985

Country or Region	Area Harvested	Yield	Production	Total Domestic Use	Supply-Demand Balance
	mha	mt/ha	mmt	mmt	mmt
EEC	0.1	4.84	0.6	2.0	-1.4
Rest of Western Europe	0.08	4.22	0.3	1.9	-1.6
Western Europe Total			1.0	3.9	-3.0
Eastern Europe[b]	--	--	0.05[f]	0.7	-0.7
People's Rep. of China	--	--	14.4[f]	14.4	0.0
Communist Total			14.4	15.1	-0.7
Africa	14.3	0.68	9.8	9.6	0.2
Japan	--	--	0.0[f]	6.9	-6.9
Rest of Asia	16.7	0.73	12.2	14.0	-1.8
Asian Total			12.2	20.9	-8.7
Rest of South America[c]	0.6	2.23	1.4	2.4	-1.0
Rest of North and Central America[d]	2.5	2.14	5.4	6.6	-1.2
Sub-Total			44.2	58.5	-14.4

TABLE XXV (Continued)

Country or Region	Area Harvested	Yield	Production	Total Domestic Use	Supply-Demand Balance
	mha	mt/ha	mmt	mmt	mmt
Argentina	3.5	2.7	9.4	3.7	5.7
Australia[e]	0.9	2.06	1.9	0.4	1.5
United States	6.2	3.12	19.3	13.5	5.8
Three Exporters Total			30.6	17.6	13.0

[a]Values may not equal due to rounding error.

[b]Includes U.S.S.R.

[c]Excludes Argentina.

[d]Excludes United States.

[e]No sorghum data reported for the Rest of the Oceania Countries.

[f]Estimated as an aggregate.

TABLE XXVI

PERCENTAGE CHANGE IN 1985 SORGHUM PROJECTIONS FROM THE AVERAGE LEVEL OF 1974/75-1976/77

Country or Region	Area Harvested	Yield	Production	Total Domestic Use	Supply-Demand Balance
			Percent Changes		
EEC	25	31	100	25	-23
Rest of Western Europe	100	0	50	73	67
Western Europe Total			100	44	18
Eastern Europe	--	--	0	0	0
People's Rep. of China	--	--	-1	-1	0
Communist Total			-1	-1	0
Africa	11	10	1	0	200
Japan	0	0	0	60	60
Rest of Asia	0	11	12	17	100
Asian Total			12	30	67
Rest of South America	20	2	40	60	100
Rest of North and Central America	47	0	50	61	140
Sub-Total			10	19	58
Argentina	67	1	71	61	78
Australia	80	7	90	100	88
United States	5	4	9	15	5
Three Exporters Total			26	25	29

Japan is primarily responsible for the increased export demand. Typically producing about one thousand metric tons annually, this country was projected to need almost 48 percent or 6.9 million metric tons of the 1985 sorghum imports, an increase of 60 percent over the 1974-1976 level. Although accounting for less of the total import requirements than Japan, North and Central America, South America, and the Rest of Asia regions exhibited the most dramatic growth rates in export demand, with increases of 140,100, and 100 percent, respectively. In Western Europe, the EEC's sorghum production increased 100 percent resulting in a 23 percent decrease in imports while the Rest of Western Europe was predicted to increase import requirements by 67 percent. Export demand for the Communist countries is expected to remain at the 1974-1976 level.

On the export side of the market, Argentina's export supplies were projected to increase by 70 percent and Australia's by 88 percent. Although the United States is currently the largest world supplier of sorghum exports, greater domestic utilization relative to production resulted in an increase of only five percent in the quantity of sorghum available for trade in 1985. Should these current consumption and production trends continue in the United States, Argentina could challenge the U.S. for the dominant role in the international sorghum export market by 1985.

Barley and Oat Projections

Table XXVII gives the actual 1985 barley and oat projections and Table XXVIII gives the percentage change of each of the projected variables from the 1974-1976 average levels. For purposes of this analysis, Oceania and North and Central America were classified as major

TABLE XXVII

BALANCE SHEET PROJECTIONS FOR BARLEY AND OATS, 1985

Country or Region	Harvested	Yield	Production	Feed Use	Human Use	Total Domestic Use	Supply-Demand Balance
	mha	mt/ha	mmt	mmt	mmt	mmt	mmt
EEC	9.8	4.27	41.9	39.0	11.2	50.2	-8.3
Rest of Western Europe	8.6	2.53	21.7	17.5	3.4	20.9	0.8
Western Europe Total			63.6			71.1	-7.5
Eastern Europe	7.3	3.68	24.4	11.5	13.9	25.4	-1.0
U.S.S.R.	44.1	1.78	78.5	56.0	21.4	71.5	1.0
People's Rep. of China	7.3	1.13	8.2	--	--	8.2[c]	0
Communist Total			111.1			111.1	0
Africa	5.6	0.98	5.5	--	--	4.9[c]	0.6
Japan	--	--	0.3[c]	1.6	0.6	2.2	-1.9
Rest of Asia	1.0	1.39	13.9	3.5	11.2	14.7	-0.8
Asian Total			14.2			16.9	-2.7
South America	1.5	1.19	1.8	0.8	1.1	1.8	0
Sub-Total			196.2			205.8	-9.6
Oceania	4.3	1.34	5.7	2.3	0.8	3.1	2.6
North and Central America[b]	7.3	2.49	18.2	13.2	1.9	15.1	3.1

TABLE XXVII (Continued)

Country or Region	Area Harvested	Yield	Production	Feed Use	Human Use	Total Domestic Use	Supply-Demand Balance
	mha	mt/ha	mmt	mmt	mmt	mmt	mmt
United States	8.9	2.27	20.2	10.9	4.7	15.6	4.6
Three Exporters Total			44.2			33.8	10.3

[a]Values may not equal due to rounding error.

[b]Excludes United States.

[c]Estimated as an aggregate.

TABLE XXVIII

PERCENTAGE CHANGE IN 1985 BARLEY AND OATS PROJECTIONS FROM THE AVERAGE LEVEL OF 1974/75-1976/77

Country or Region	Area Harvested	Yield	Production	Feed Use	Human Use	Total Domestic Use	Supply-Demand Balance
				Percent Change			
EEC	-12	20	6	26	13	23	453
Rest of Western Europe	19	12	33	22	49	26	-367
Western Europe Total			14			23	316
Eastern Europe	11	25	26	49	0	28	-52
U.S.S.R.	0	0	0	2	0	2	52
People's Rep. of China	7	5	12	--	0	12	0
Communist Total			6			6	100
Africa	-2	15	12	--	--	8	20
Japan	--	--	0	14	0	0	12
Rest of Asia	0	15	15	3	26	18	100
Asian Total			15			17	29
South America	7	-2	0	0	22	6	-100
Sub-Total			9			12	174
Oceania	34	2	36	64	60	63	8
North and Central America	0	25	26	39	19	36	-3
United States	10	13	25	-7	-11	-8	a
Three Exporters Total			26			12	51

[a] Greater than 500 percent.

exporters of these two feed grains. However, it should be noted that Australia and Canada typically supply between 95 and 100 percent of the barley and oats exported from their respective regions.

For the importing countries as a whole, the 1985 supply demand balance was estimated to be a deficit of 9.6 million metric tons, an increase of 174 percent over the 1974-1976 average. The EEC is shown to require 8.3 million metric tons or 86 percent of this deficit. Although barley and oat production in these countries was estimated to increase six percent, a faster growth rate in domestic utilization resulted in a 453 percent increase in import requirements.

Japan, the Rest of Asia, and Eastern Europe were the only other regions projected to need barley and oat imports in 1985. Japan's import requirements were projected to increase by 12 percent and the Rest of Asia's by 100 percent. Eastern Europe's imports are projected to decrease by 52 percent. Africa, the U.S.S.R., and the Rest of Western Europe were predicted to have exportable supplies which, altogether, would be an increase of 2.4 million metric tons for sale on the world market. South America and the People's Republic of China were projected to have a barley and oat supply demand balance of zero.

Taken together, the three major exporting regions were projected to have an exportable surplus of 10.3 million metric tons of barley and oats, an increase of 51 percent over the 1974-1976 period. Most of this increase is expected to be supplied by the United States. Domestic utilization of barley and oats in the U.S. is projected to decrease eight percent while production increases by 25 percent. This would result in an increase of over 500 percent in the supply demand balance. In contrast, the exportable surplus in North and Central America was estimated to decline by three percent and the available export supply in the Oceanic region was projected to increase by only eight percent. These estimates imply that the United States could become the dominant country in the international barley and oat export market by 1985. However, the utilization projections for Oceania and North and Central America also account for increased demand of these feed grains in countries other than Canada and Australia. Therefore, the actual 1985 exportable surplus for these two countries could be much higher than these projections.

Aggregated Feed Grain Projections

The individual feed grain projections were aggregated for the world excluding the United States to determine the potential market for American feed grain exports in 1985. For purposes of this analysis, it was assumed that the U.S. would be a residual supplier and that the other exporting countries would be able to sell all the feed grains they have available for export. The estimates are listed in Table XXIX with the percentage changes given in Table XXX.

The projected market for U.S. feed grain exports increased 53 percent over the 1974-1976 average level as foreign utilization was predicted to continue increasing at a rate faster than foreign production. The actual 1985 estimate of total production in the foreign sector was 506.3 million metric tons while the projected domestic utilization was 564.9 million metric tons. Therefore, the potential market for United States feed grains is 58.6 million metric tons, or approximately 63

TABLE XXIX

WORLD FEED GRAIN PROJECTIONS, 1985

Country or Region	Production	Total Domestic Use	Supply-Demand Balance
EEC[a]	61.5	85.8	-24.3
Rest of Western Europe[b]	27.9	41.0	-13.1
Western Europe Total	89.4	126.8	-37.4
Eastern Europe[c]	58.2	64.5	-6.3
U.S.S.R.[d]	92.1	95.4	-3.2
People's Rep. of China	66.4	66.8	-0.4
Communist Total	216.7	226.7	-9.9
South Africa[e]	11.3	8.8	2.5
Rest of Africa[f]	33.6	33.5	0.1
African Total	44.9	42.3	2.6
Japan	0.3	21.4	-21.1
Rest of Asia	52.1	58.4	-6.3
Asian Total	52.4	79.8	-27.4
Oceania	8.1	3.8	4.2
Argentina[g]	23.1	8.7	14.4
Rest of South America[h]	29.7	30.1	-0.4
South American Total	52.8	38.8	14.0
North and Central America[i]	42.0	46.7	-4.7
Sub-Total	506.3	564.9	-58.6
United States	220.5	159.7	60.8

[a]Excludes Belgium, Denmark, Ireland, and Luxembourg corn.

[b]Includes Belgium, Denmark, Ireland, and Luxembourg corn.

[c]Includes U.S.S.R. sorghum.

[d]Excludes U.S.S.R. sorghum.

[e]Includes South Africa corn.

[f]Excludes South Africa corn.

[g]Excludes Argentina barley and oats.

[h]Includes Argentina barley and oats.

[i]Excludes the United States.

TABLE XXX

PERCENTAGE CHANGE IN 1985 WORLD FEED GRAIN PROJECTIONS FROM THE AVERAGE LEVEL OF 1974/75-1976/77

Foreign Country or Region[a]	Production	Total Domestic Use	Supply-Demand Balance
EEC	16	26	57
Rest of Western Europe	37	38	38
Western Europe Total	22	29	50
Eastern Europe	23	23	29
U.S.S.R.	4	3	-22
People's Rep. of China	18	18	300
Communist Total	13	13	9
South Africa	30	35	14
Rest of Africa	14	13	200
African Total	16	17	24
Japan	0	51	52
Rest of Asia	18	26	174
Asian Total		32	69
Oceania	45	58	31
Argentina	80	55	100
Rest of South America	30	29	-20
South American Total	48	34	109
North and Central America	30	44	0
Sub-Total	20	23	53
United States	26	24	32

[a]For footnotes, see Table XXIX.

percent[1] of the projected international feed grain export market. If these estimates and assumptions are valid, the United States would become even more dominant in the international feed grain market by 1985, increasing its projected market share over its average 1974-1976 market share of 55 percent.

These balance sheet projections indicate that Japan will continue to be the largest feed grain importing country in the world, increasing domestic utilization by 51 percent while having no appreciable changes in production. If these consumption and production trends continue, Japan is expected to require 21.1 million metric tons of feed grain imports in 1985. The EEC countries, considered as one entity, was projected to be the largest importing region. Similar to Japan, the faster rate of growth in domestic feed grain use relative to production, resulted in an estimated increase of 57 percent in import requirements.

The People's Republic of China and the Rest of Asia exhibited the most dramatic percentage increases in projected feed grain import requirements, 300 and 174, respectively. However, the 1974-1976 base quantities were small. Mainland China was estimated to require only 0.4 million metric tons of imports in 1985, producing a total of 66.4 million metric tons and consuming 66.8 million metric tons. The PRC's feed grain usage depends primarily on its total production, reducing total domestic utilization in years of a production shortfall. Although occasionally entering the international feed grain market to bolster domestic supplies after poor harvests, this country typically accounts for less than one

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[1]Actual feed grain import requirements for the foreign sector were projected to be 92.8 million metric tons.

percent of total world feed grain imports. Domestic utilization of feed grains in the Rest of Asia region was predicted to increase 26 percent, primarily as a result of a projected population increase in this region of over 25 percent. As was previously discussed, feed grains are considered a stable food grain in most of these Asian countries. Many of the farmers in this region are not as responsive to fluctuations in feed grain prices as in the more developed countries, but primarily produce these grains for food purposes and market only the residual.

The U.S.S.R. was the only importing country projected to have a decline in feed grain import requirements, decreasing 22 percent, as projected production increased at a slightly faster rate than domestic use. Although this country was estimated to account for less than four percent of the 1985 world feed grain imports, it should be noted that production shortfalls during the latter part of the study period resulted in the Soviet Union importing as much as 12 percent of the world total.

Together, South Africa, Oceania, and Argentina were projected to have a total exportable surplus of 21.1[2] million metric tons of feed grains. Although Canada is a major supplier of barley and oat exports, estimated increases in corn and sorghum import requirements resulted in North and Central America being projected as a net feed grain importer. However, total feed grain imports for this region are predicted to remain at the 1974-1976 level. Feed grain production and consumption in the United States are expected to increase by 26 and 24 percent, respectively,

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[2]This includes exportable surplusages of corn in South Africa, barley and oats in Oceania, and corn and sorghum in Argentina.

while the total exportable surplus was projected to be 60.8 million metric tons.

CHAPTER V

IMPACTS OF FEED GRAIN SUPPLY INSTABILITY

In the previous chapter, prices were held constant at their 1974-1976 levels and the 1985 supply and demand balance sheet components were projected for the individual feed grains. These projections were then aggregated to determine the 1985 production and utilization of feed grains for the United States and foreign sector, and the potential market for American feed grain exports. In this section a set of supply and demand equations will be defined for these two sectors and used to show the effects of short-run changes in world supply on the United States and world markets.

Theoretical Framework and Procedure

The theoretical framework used for this analysis was the inter-regional trade model discussed in Chapter II and illustrated in Figure 3. It was assumed that the world less the U.S. (the foreign countries taken as an aggregate entity, comprises the feed grain demand sector and the United States makes up the export sector. With the absence of trade between these two regions, the equilibrium price and the quantity of feed grain is P_F and Q_F in the foreign sector and P_{us} and Q_{us} in the United States. However, with trade feed grains will be exported from the U.S. to the foreign sector and the price in the United States will increase while that in the foreign sector will decrease. Since the supply of feed grains in each region is fixed for any given year (having been determined by the previous year's price), short run equilibrium between the U.S. and foreign sector can only be attained by changes in the quantity of feed grains demanded in both regions to equal total supply. Therefore, equilibrium with trade will be established between these two sectors when: 1) foreign import demand (ID) equals export supply (ED) in the United States and 2) import price (P_I) of feed grains is equivalent to the export price (P_E) in the U.S. plus transfer costs (t). In reality, the demand adjustments will be made in domestic utilization and carryout stocks; however, for purposes of this analysis, stocks were held constant. As a result, the total supply of feed grains available in the United States and foreign sectors in 1985 was assumed to be equal to the total production projected for each region. That is, the 1985 supply in the U.S. (S_{us}) is 220.5 million metric tons (see Table XXIX).

In the analysis that follows, the equilibrium price and quantity in each sector were determined assuming three situations: 1) the absence of trade between regions, 2) trade between the United States and foreign sectors, and 3) trade between regions with a production shortfall in one of the sectors. This was accomplished by first defining the equations for the U.S. and foreign supply and demand schedules and then using these equations to solve for the various equilibrium values. The general procedure used to calculate the equations is discussed below.

If the supply and demand schedules are written as a function of price

$$Q = a + bP \qquad (1)$$

where

Q = Quantity demanded or supplied in the U.S. or foreign sector,

P = Import or export price,

a = Intercept term, and

b = Slope coefficient,

then the slope of the function is

$$b = \frac{dQ}{dP} , \tag{2}$$

and the price elasticity at a point Q,P is

$$E_P = \frac{dQ}{dP}\left(\frac{P}{Q}\right) \tag{3}$$

where

E_P = Price elasticity of supply or demand.

Rearranging terms, the slope coefficient can be written as

$$b = \frac{dQ}{dP} = E_P\left(\frac{Q}{P}\right) \tag{4}$$

therefore, given (or assuming) the value of E_P at point Q,P such as the means $\bar{Q}$, $\bar{P}$, and calculating the slope coefficient (b'), the intercept term can be derived by substituting these value into equation (1). That is,

$$\bar{Q} = a + b'\bar{P} \tag{5}$$

$$a' = \bar{Q} - b'\bar{P} \tag{6}$$

where

$\bar{Q}$ = Mean value of Q,

$\bar{P}$ = Mean value of P,

b' = Calculated slope coefficient, and

a' = Calculated intercept term.

The equation for the supply or demand schedule is then

$$Q = a' + b'P \tag{7}$$

Thus, given the appropriate feed grain price elasticities for the U.S. and foreign sectors and assuming they are defined for 1985 by a specific point (Q,P), the supply and demand equations can be derived and used to solve for the various equilibrium points in each sector. A discussion of these values, that is E_P, Q, and P, the equations derived for each sector, and their equilibrium solution follows.

Equilibrium Prices for Baseline Projections

The elasticities used in the derivation of these equations were selected from the available literature. These elasticities and their sources are listed in Table XXXI.

TABLE XXXI

SELECTED SHORT RUN PRICE ELASTICITIES FOR FEED GRAINS

Elasticity of:	Feed Grain $Price_t$	Source
U.S. Production	0.6	Bjarnason
U.S. Demand	-0.5	Ray and Richardson
Foreign Production	0.4	Bjarnason
Foreign Demand	-0.5	G.O.L. Model

Because price elasticity estimates were limited to individual countries or regions, the values selected for the foreign sector analysis are approximations of the estimates. However, these values are reasonably similar to the price elasticity estimates reported for the major feed grain importing and exporting countries, such as Canada, South Africa, Argentina, and the EEC.

An implicit U.S. feed grain export price was computed by dividing the total value of U.S. feed grains exports by the total quantity of feed grain exports. This price was used to define the supply and demand equations for the United States and was assumed to remain constant at its 1974-1976 average level of \$112.73 per metric ton. An implicit import price for the foreign sector was calculated by dividing the total value of foreign feed grain imports by the total quantity of imports. To account for the relationship between P_i, P_e, and t, the foreign import price was regressed on the U.S. feed grain export price. This import price estimate was then used in the derivation of the foreign supply and demand equations. The results of this regression are given in equation (8) with the t statistic in parenthesis below the appropriate variable. Also included with this equation are the R^2 values and the Durbin-Watson statistic.

$$P_I = \underset{(2.24)}{19.83} + \underset{(7.50)}{1.015}\ P_E \qquad (8)$$

$$R^2 = 0.80 \qquad D.W. = 1.65$$

where

P_I = Foreign implicit feed grain import price, and

P_E = U.S. implicit feed grain export price.

The quantities used to calculate the U.S. and foreign supply and demand equations were the actual 1985 feed grain production and utilization estimates given in Table XXIX. The slope coefficients were computed as in equation (4) and the intercept term was computed as in equation (6). Substituting the appropriate values into the equations, the supply and demand relationships were defined as:

$$D_{us} = 239.5 - 0.708\ P_E \tag{9}$$

$$S_{us} = 88.2 + 1.1736\ P_E \tag{10}$$

$$D_F = 847.35 - 2.1039\ P_I \tag{11}$$

$$S_F = 303.8 + 1.5085\ P_I \tag{12}$$

Assuming the absence of trade between these two regions, short-run equilibrium is reached in each sector when the quantity demanded is equal to the quantity supplied, or $D_{us} = S_{us}$ and $D_F = S_F$. The equilibrium values for the United States are computed as P_{us} = \$80.42 per metric ton and Q_{us} = 182.6 million metric tons. The same methodology applied to the foreign supply and demand equations yields the equilibrium values summarized in Table XXXII.

The opening of trade between the U.S. and foreign sectors has the effect of bringing the combined demand of the regions to bear on the combined supply and the two sectors are in equilibrium when:

$$D_F + D_{us} = S_F + S_{us}\ . \tag{13}$$

Because the import price is used in the foreign demand and supply equations, a relationship between the import price and the U.S. export price was necessary to be able to aggregate the foreign domestic demands

TABLE XXXII

EQUILIBRIUM PRICES AND QUANTITIES FOR BASELINE PROJECTIONS

	No Trade	Trade: Projected Production	Trade: Production Shortfall of 30 mmt	
	Equilibrium Values	Equilibrium Values	Equilibrium Values	Percent Change From Projected
	Dollars per Metric Ton			Percent
United States:				
P_E[a]	80.40	111.96	122.48	9.4
Q_{us}[b]	182.6	160.2	152.75	-4.7
Q_E[c]	0	60.2	67.7	12.5
Foreign:				
P_I[d]	150.47	133.47	144.15	8.0
Q_F[e]	530.8	566.5	544.07	-4.0
Q_I[f]	0	60.2	67.6	12.5

[a]P_E = Export price in U.S.

[b]Q_{us} = Quantity in U.S. with no trade.

[c]Q_E = Quantity exported from U.S.

[d]P_I = Import price in Foreign sector.

[e]Q_F = Quantity in Foreign sector with no trade.

[f]Q_I = Quantity imported by Foreign sector.

to determine the equilibrium price. Given equation (8), foreign demand can be expressed in terms of the U.S. export price as follows:

$$D_F = 805.63 - 2.1355\ P_E\ . \qquad (14)$$

The world demand (D_W) for feed grain, then, is the aggregate of the foreign and domestic demand with the following equation:

$$D_W = 1045.18 - 2.8438\ P_E\ . \qquad (15)$$

Setting D_W equal to S_W, the world supply, the equilibrium value of P_E can be determined. In the short run, the total supply of feed grains is fixed and the 1985 world supply is the projected quantity 726.8 million metric tons (506.3 for the foreign sector and 220.5 for the U.S. sector). With this supply, the equilibrium price (P_E) is \$111.96 per metric ton and P_I = \$133.74 per metric ton. The quantity of feed grains exported (Q_E) from the United States is:

$$Q_E = S'_{us} - D_{us} = 60.2 \text{ mmt}$$

which is equal to the total volume imported (Q_I) by the foreign sector ($D_F - S'_F$).

The estimated quantity of feed grains traded between regions is slightly higher than the original baseline projection of 58.6 million metric tons. Consumption in the foreign sector was higher by 1.6 million tons.

Although the baseline projections represent a reasonable expectation of the international feed grain market for an average year in 1985, unforeseen disruptions due to weather or policy changes can cause variations in the actual state of the market. Therefore, to look at the impact of a short term decrease in world supply on the United States and world markets, a production shortfall of 30 million metric tons was postulated to occur in the foreign sector. The new equilibrium values under this assumption are P_E = \$122.48 per metric ton and P_I = \$144.15 per metric ton, with the quantity traded equal to 67.7 million metric tons.

The effect of this decrease in world supply is to increase the absolute level of the import market potential from 60.2 to 67.7 million tons, 12.4 percent greater than the previous estimate. The United States will consume 152.7 million metric tons of feed grains with 544.1 million tons demanded in the foreign sector. It is apparent from this analysis that under the present assumptions there is not a high degree of variability present in the world feed grain market as compared with wheat. A decrease in world feed grain supply of 4.2 percent resulted in increases of only 9.6 percent in the export price and eight percent in the import price.

Equilibrium Prices for Modified Baseline Projections

The second situation analyzed in this study postulates that the Rest of Asia and the People's Republic of China do not respond systematically to price changes in the international feed grain market. Thus, the price elasticity of supply and demand for these regions was assumed to equal zero. Although these areas were chosen for illustrative purposes, there is some justification for their selection.

In general, the countries in the Rest of Asia region are underdeveloped and have standards of living lower than in some other areas of the world. This area contains almost half of the world's population and some of the countries do not produce enough food for their own needs. As indicated by the balance sheep projections in Tables XXIX and XXX, the gap between feed grain consumption and production will continue to widen by 1985, with domestic demand estimated to increase by 26 percent and production by only 18 percent. Hence, it was hypothesized that future purchases of feed grains by the governments of these countries might be motivated more by pressures to feed the population than by the particular price level that might prevail in the short run situation.

The People's Republic of China, on the other hand, has seldom entered the international feed grain market and was estimated to require only 0.4 million tons of imports in 1985, less than one percent of the world total. Because Mainland China does not have an open market economy and their trading behavior is administratively determined, this country's price elasticity of supply and demand was postulated to equal zero for the following short run analysis.

With the assumption of zero price elasticities for the PRC and the Rest of Asia, the slope coefficients are different because of different quantities. The slope for the demand equation becomes -1.6376 and for the supply equation becomes 1.1555.

The final equations after adjusting the intercept terms to account for projected consumption and production and changing the slopes are specified as:

$$S_F = 351.7 + 1.1555\ P_I \qquad (16)$$

$$D_F = 784.75 - 1.6376\ P_I\ . \qquad (17)$$

The equivalent demand schedule in terms of the U.S. export price is:

$$D_F = 752.28 - 1.6622\ P_E\ . \tag{18}$$

The world demand for feed grains is now defined as:

$$D_W = 991.83 - 2.3705\ P_E\ .$$

Using these equations, the equilibrium values were again computed for the three interregional trade situations. These values are summarized in Table XXXIII. With no trade between regions, the equilibrium price in the foreign sector is higher than the original estimate of $150.47 per metric ton while there is little difference in the quantity. With trade under normal weather conditions, there was also little change from the previous estimates in the import and export prices and quantity traded. Assuming a production shortfall of 30 million tons again resulted in little variation in the international market. The export price increased 11.3 percent, the import price 8.6 percent, and American feed grain exports 14.9 percent. The additional feed grain exports came from a decrease in U.S. domestic utilization of 9.7 million tons because of the higher price.

Modified Baseline Projections in the Very Short Run

Although simple static theory assumes instantaneous adjustments to price changes, in reality producers may take time to adjust to changing price situations. In a short run situation, such as a year, producers may vary output by moving along the present marginal cost curves. However, in a very short run period, such as three to six months,

TABLE XXXIII

EQUILIBRIUM PRICES AND QUANTITIES FOR MODIFIED BASELINE PROJECTIONS

	No Trade	Trade: Projected Production	Trade: Production Shortfall of 30 mmt	
	Equilibrium Values	Equilibrium Values	Equilibrium Values	Percent Change From Projected
	Dollars per Metric Ton			Percent
United States:				
P_E	80.40	111.96	124.46	11.3
Q_{us}	182.6	160.2	151.34	-5.6
Q_E	0	60.14	69.1	14.9
Foreign:				
P_I	155.04	133.31	146.16	9.64
Q_F	530.5	566.44	545.4	-3.7
Q_I	0	60.14	69.1	14.9

Note: For definitions of variables, see footnotes in Table XXXII.

producers often have fixed inputs (including feed) and are not able to change production. For example, due to the nature of production, livestock producers cannot appreciably alter the number of animals over the period of a feeding period--120 to 150 days. In this situation, animal numbers are often fixed, having been determined in the previous quarter, and producers cannot completely adjust to either a change in the price of livestock or the price of feed inputs. Although an increase in the price of feed grains would result in some substitution of other inputs, a large part of the feed ration would still be composed of these grains. Therefore, livestock producers' demand for feed grains may be assumed to be more inelastic in the very short run of up to six months than in a longer period of time. Thus, the final situation examined was for the very short run--three to six months--and the demand elasticities for the U.S. and foreign sectors were assumed to be -0.2.

The demand equations for each sector are now:

$$D_{us} = 191.64 - 0.2833\ P_E$$

$$D_F = 652.83 - 0.6549\ P_I$$

or,

$$D_F = 639.83 - 0.6647\ P_E$$

and

$$D_W = 831.47 - 0.948\ P_E\ .$$

The new equilibrium values resulting from these equations are listed in Table XXXIV. Notice that in the absence of trade between regions, the price and quantity values are now lower in the U.S. and higher in the foreign sector as the slopes of the demand schedules

TABLE XXXIV

EQUILIBRIUM PRICES AND QUANTITIES FOR MODIFIED BASELINE PROJECTIONS IN THE VERY SHORT RUN

	No Trade	Trade: Projected Production	Trade: Production Shortfall of 30 mmt	
	Equilibrium Values	Equilibrium Values	Equilibrium Values	Percent Change From Projected
	Dollars per Metric Ton			Percent
United States:				
P_E	71.00	110.41	126.23	14.3
Q_{us}	171.5	160.34	155.88	-2.8
Q_E	0	60.14	49.62[a]	-17.5
Foreign:				
P_I	166.63	131.89	147.95	12.2
Q_F	543.7	566.45	555.94	-1.8
Q_I	0	60.14	49.62[a]	-17.5

Note: For definitions of variables, see footnotes in Table XXXII.

[a]A shortfall in Foreign production rather than U.S. production would result in the same prices but exports and imports of 64.62 million metric tons.

become greater. With trade under normal conditions, however, the import and export prices are essentially unchanged relative to their previous levels.

In this situation, a production shortfall of 15 million metric tons was assumed to occur in the United States. This 2.1 percent reduction in the world feed grain supply resulted in an 18.5 percent decline in exports and decreases in feed grain demand of over four million metric tons in the U.S. and over 10 million tons in the foreign sector. The export price increased 14.34 percent and the import price 12.2 percent. Thus, only under these rigid assumptions did the international feed grain market exhibit very much price variation.

CHAPTER VI

SUMMARY AND CONCLUSIONS

Projections

The purpose of this study was to analyze the supply and demand relationships of the world feed grain market and develop a model (or models) which would use annual data to project feed grain prices and permit analysis of the impact of certain variables on the feed grain economy. This was accomplished by disaggregating the four major feed grains, corn, sorghum, barley, and oats, into their supply and demand balance sheet components and dividing the world into major importing and exporting regions. The balance sheet categories of these four grains were then estimated for the United States. To estimate the foreign countries' feed grain supplies and demands, corn and sorghum balance sheet components were estimated separately while the barley and oat components were aggregated into a single balance sheet. The major importing and exporting countries for each feed grain or feed grain grouping were then identified for an individual balance sheet analysis. Foreign countries of lesser importance in international feed grain trade were aggregated by feed grain grouping into seven geographical regions for balance sheet estimates.

World prices were held constant at the 1974-1976 averages to obtain the 1985 balance sheet projections for the individual feed grains. The

1985 values of some explanatory variables, such as population and animal units, were based on recent historical trends, while other variables, such as the area harvested of competing crops, were assumed to remain at their 1974-1976 levels.

Balance sheet projections for the individual feed grains were aggregated for the specified countries and regions to determine projected production and domestic utilization. The difference between the projected quantities supplied and demanded served as an estimate of a country's or region's 1985 import requirements or export supply. These individual projections were then aggregated for the world, excluding the United States, to determine the potential market for American feed grain exports in 1985.

Through the use of the balance sheet projections, a number of significant trends and relationships were revealed and quantified. In general, foreign import requirements for all the feed grains were projected to increase because the projected increases in domestic utilization were greater than the projected increases in production. The faster growth rate in utilization was primarily due to projected increases in population and animal numbers.

For corn, the two importing regions responsible for most of the expansion in the foreign import market were Asia and North and Central America (less U.S.). Corn production in Japan was projected to remain constant relative to the 1974-1976 level while utilization was projected to increase by 54 percent, causing import requirements to increase 56 percent. Although production increased in the Rest of Asia and North and Central America, faster growth rates in corn usage resulted in potential imports being 148 and 120 percent, respectively, higher in 1985 than in 1974-1976.

The western European countries, taken together, were projected to increase corn imports 29 percent and require 42 percent of world imports by 1985. Most of the other corn importing countries or regions are also expected to have expanded corn import markets; however, the U.S.S.R. was projected to decrease its import requirements by 32 percent. This decline was primarily due to a 36 percent increase in production and a projected increase in domestic utilization of 11 percent.

Together, the four major corn export countries--Argentina, Thailand, South Africa, and the United States--were projected to have an increase in export supply of 34 percent. Argentina's export supply was estimated to increase by 123 percent over the 1974-1976 average and Thailand's by 83 percent, primarily due to increases in production resulting from new technology being introduced in both countries. Increases in corn feed use limited expansion of the United States' export supply to 24 percent and South Africa's to 14 percent. However, the U.S. was projected to supply 77 percent of the 1985 exportable surplus.

Sorghum was the only feed grain for which the potential world import requirements were projected to exceed the total exportable surplus. A net of 14.4 million metric tons of potential import demand, but only a 13 million metric tons of exportable surplus, were projected. These values represent increases over the 1974-1976 average levels of 58 percent in world import requirements and 29 percent in the surplus available for export. Japan was primarily responsible for the increased export demand. This country was projected to require almost 48 percent or 6.9 million metric tons of the 1985 sorghum imports, an increase of 60 percent over the 1974-1976 level. North and Central America, South America, the Rest of Asia, and the Rest of Western Europe are also expected to be expanding markets for sorghum imports. The EEC was the only importing region projected to decrease its import requirements while the Communist countries were projected to have no change in their sorghum imports between the 1974-1976 period and 1985.

On the export side of the market, Argentina's export supplies were projected to increase by 70 percent, Australia's by 88 percent, and the United States' by 5 percent. Although the U.S. is expected to supply the majority of the world sorghum exports, Argentina could increase its market share about 13 percent by 1985.

The 1985 barley and oat supply demand balance was estimated to be a deficit of 9.6 million metric tons, an increase of 174 percent over the 1974-1976 average. The EEC was projected to require 86 percent of this deficit as a result of a 23 percent increase in domestic utilization and an increase in production of only six percent. Japan and the Rest of Asia were the only other regions projected to increase their barley and oat import requirements.

Taken together the major barley and oat exporting regions, the United States, North and Central America, and Oceania, were projected to increase their exportable surplus 51 percent over the 1974-1976 period. The U.S. is expected to have the largest increase in export supplies while North and Central America's exportable surplus was projected to have a slight decrease. Oceania's export supplies were estimated to increase.

Assuming that the United States is a residual supplier of all feed grains, the potential market for American feed grain exports was projected to be 58.6 million metric tons in 1985, approximately 63 percent of the world total. Japan is expected to be the largest feed grain importing country while the EEC countries are expected to be the largest importing region. Most of the developing countries were also projected to be expanding markets for feed grain exports, primarily due to increasing populations and livestock numbers. The U.S.S.R. was the only importing country projected to have a decrease in feed grain imports.

Excluding the U.S., the other major feed grain exporting countries--Argentina, South Africa, Australia, Thailand, and Canada--were also projected to increase their feed grain export supply. However, as a rule, their projected market shares decreased relative to that of the United States.

Price Variability

A set of equations were defined for the United States and foreign feed grain economies based on the 1985 projections and specified price elasticities. These equations revealed that the world market is not sensitive to small changes in world supplies except under strict assumptions. Assuming price elasticities of demand for the U.S. and foreign sector to be -0.5, a production shortfall of 4.2 percent of total world production caused the price of feed grains on a corn equivalent basis to increase 9 percent from $2.84 to $3.11 per bushel in 1974-1976 prices. The decrease in U.S. consumption represented about 30 percent of the total adjustment. A second situation hypothesized that the People's Republic of China and the Rest of Asia region would not be responsive to price changes, that is their price elasticities of demand were equal to zero. Under this assumption the 4.2 percent decrease in world feed grain supply was demonstrated to increase prices by 11.3 percent to an equivalent of $3.16 per bushel for corn.

The final situation analyzed was for the very short run with demand elasticities for the U.S. and foreign sectors assumed to be -0.2. In this situation, a 2.1 percent production shortfall resulted in feed grain price increases of 14.3 percent from $2.80 to $3.21 per bushel on a corn equivalent basis.

Limitations and Need for Further Study

The research reported in this study is one of the first attempts to analyze the individual feed grain quantities supplied and demanded by the major importing and exporting foreign regions. In the course of completing this project, several discoveries were made which might aid other persons attempting similar research work.

This study does not estimate or predict trade flows of the individual feed grains. Although the United States is currently the major supplier of corn and sorghum exports, many foreign importers such as Japan are attempting to develop alternate sources of imports in the other major exporting countries and in the developing nations. This model does not analyze the ability of the U.S. to compete with these countries. An analysis of future trade flows of the individual feed grains would be helpful in this area.

One shortcoming of the model is the application of the same price elasticity of demand to all foreign countries and regions. Although one objective of this study was to estimate equations for demand and supply, separate price elasticities could not be estimated because many of the price variables were not statistically significant during the time of the study period. Elasticity estimates for each of the importing or exporting countries and regions would have allowed for separate supply and demand equations to be defined for each geographic area based on their 1985 balance sheet projections. Such equations would have been very useful in analyzing the effects of a production shortfall in one or more geographic areas on the world feed grain market.

The methodology used in this study to analyze the effect of short run changes in world supplies in the U.S. and foreign feed grain economies ignores the lagged supply response. Therefore it is felt that the construction of a simultaneous equation model, which combines the supply and demand balance sheet projections, would be useful in determining the joint response of supply and demand to short term alternatives. Such a model would allow the price movements and adjustments in the quantities supplied and demanded to interact to bring the system back into equilibrium. The stability of the system could also be determined from the expanded model.

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APPENDIXES

APPENDIX A

DEFINITIONS OF VARIABLE NAMES USED IN REPORTED RESULTS FOR UNITED STATES

Variable Name	Description	Units
ANUNFD	Grain consuming animal units FED	Thous. Units
BAPROD	Annual U.S. barley production	Bil. Lbs.
BMP	Average barley market price; Minneapolis, #3	$/cwt.
BRPD	Annual U.S. beer production	
CDDVP	Corn effective diversion payment (deflacted)	$/cwt.
CDEPS	Corn effective support rate (deflated)	$/cwt.
CCFED	Number of cattle and calves on feed	Thous. Head
CFP	Average corn price received by farmers	$/cwt.
CFPL	CFP_{t-1}	$/cwt.
CPRM	Average corn price for corn; Chicago, #2 yellow	$/bu.
CNAPLT	Annual U.S. cotton area planted	Thous. Acres
CP	Spliced corn price series (= CDEPS in 1948 to 1971; = CFPL, deflated, in 1972 to 1976)	$/cwt.
DV58	Dummy variable to reflect structural change in the U.S. feed industry (= 1 in 1959-1976; = 0, otherwise)	
DV66	Dummy variable to reflect the change in calculation of effective support rate (= 1 1966-1976; = 0 otherwise)	
DV70	Dummy variable to account for the corn blight (= 1 in 1970; = otherwise)	
FBP	Average price of choice slaughter steers; Omaha, 900-1100 lb.	$/cwt.
GSCPR	GSFP ÷ CMP	
GSDDVP	Sorghum effective diversion payment (deflated)	$/cwt.
GSDEPS	Sorghum effective support rate (deflated)	$/cwt.
GSFP	Average sorghum price received by farmers	$/cwt.
GSFPL	$GSFP_{t-1}$	
GSP	Split sorghum price series (= GSDCPS from 1948 to 1971; = GSFPL, deflated, from 1972 to 1976)	$/cwt.
HCR	Hog - corn ratio, Omaha ratio	
IRRTX	Irrigated land in the Texas and Oklahoma Panhandles	Thous. Acres

Variable Name	Description	Units
JULPRC	Weighted index of July precipitation for five major states (Illinois, Indiana, Ohio, Iowa, and Nebraska). July precipitation for a state is weighted by its planted acreage (1964-1967 = 100).	
MALTP	Malt barley price	\$/bu.
MCN	Number of milk producing cows	Thous. Head
OATCOM	Barley, corn, soybean, and wheat area planted in six major oat producing states (Iowa, Illinois, Minnesota, North Dakota, South Dakota, and Wisconsin).	
OFP	Average oats price received by farmers	\$/cwt.
OFPL	OFP_{t-1}	
OP	Spliced oats price series (= ODEPS from 1948 to 1971; = OFPL, deflated, from 1972 to 1976).	\$/cwt.
OMP	Average market price for oats; Minneapolis, #2 white	\$/cwt.
OWPR	OP ÷ WFP	
PCEGG	Per capita consumption of eggs (civilian consumption)	
PFNO	Weighted average price of corn, barley, and sorghum = (CFD • CAPROD + BFP • BAPROD + GSFP • GSAPROD)/(CAPROD + BAPROD + GSAPROD)	
PPFCPR	PPFER ÷ CP	
PPFBPR	PPFED ÷ BFPL, deflated	
PPFER	Prices paid by farmers for fertilizer, index (1967 = 100)	
PPFOPR	PPFER ÷ OFPL, deflated	
SAPLT	Annual soybean area planted	Thous. Acres
T	Annual linear time trend variable (= 1 in 1948; = 29 in 1976)	
TOTDA	Total acreage diverted from feed grain production under government programs	Mil. Acres
WFP	Average wheat price received by farmers (deflated)	\$/cwt.

Variable Name	Description	Units
WMPL	Average wheat market price; Kansas City, #2, Hard (deflated)	$/cwt.
WWIN	Acreage of wheat planted in eight major sorghum producing states (California, Colorado, Kansas, Missouri, Nebraska, New Mexico, Oklahoma, and Texas).	

APPENDIX B

DEFINITIONS OF VARIABLE NAMES USED IN REPORTED RESULTS FOR FOREIGN COUNTRIES

Variable Name	Description	Units
AF BOPD	Africa - Annual barley and oats production	Thous. MT
AF CPROD	Africa - Annual corn production (excluding South Africa corn production)	Thous. MT
AF SPROD	Africa - Annual sorghum production	Thous. MT
AR AN	Argentina - Animal units variable	Thous. Units
AR SOY	Argentina - Annual soybean area harvested	Thous. Hect.
AR PCP	Argentina - Producer corn price	New Pesos /100 kg.
AR PCPL	$ARPCP_{t-1}$	New Pesos /100 kg/
AS AN1	Asia - Animal units variable (excluding Japan, the People's Republic of China, and Thailand)	Thous. Units
AS AN2	Asia - Animal units variable (excluding Japan and the People's Republic of China)	Thous. Units
AS POP1	Asia - Total population (excluding Japan, the People's Republic of China, and Thailand)	Thous. Persons
AS POP2	Asia - Total population (excluding Japan and the People's Republic of China)	Thous. Persons
AU FBP	Australia - Average barley feed price	$/MT
AU FCP	Australia - Average corn feed price	$/MT
AU FSP	Australia - Average sorghum feed price	$/MT
BZ WCPL	Brazil - Average corn wholesale price, lagged	New Cruzeiros /60 kg.
CH BOPD	PRC - Annual barley and oats production	Thous. MT
CH CPROD	PRC - Annual corn production	Thous. MT
CH SPROD	People's Republic of China - Annual sorghum production	Thous. MT
CN WAH	Canada - Annual wheat area harvested	Thous. Hect.
CN WBP	Canada - Wholesale barley price	$/bu.
DVAF	Dummy variable to reflect the years of adverse weather in Africa; excluding South Africa (= 1 in 1961, 1967, and 1972; = 0 otherwise)	
DVAR	Dummy variable to reflect the years of adverse weather in Argentina (= 1 in 1964, 1967, 1971, 1974 and 1975; = 0 otherwise)	

Variable Name	Description	Units
DVAS	Dummy variable to reflect the years of adverse weather in Asia; excluding Japan, People's Republic of China, and Thailand (= 1 in 1960, 1965, 1966, 1968, 1972, and 1975; = 0 otherwise)	
DVAU	Dummy variable to reflect a structural change in Australia's sorghum production (= 1 in 1969 to present; = 0 otherwise)	
DVCC	Dummy variable to reflect years of adverse weather in the East European countries (= 1 in 1961, 1965, 1970, and 1974; = 0 otherwise)	
DVCH	Dummy variable to reflect years of adverse weather in the People's Republic of China (= 1 in 1960, 1972, and 1976; = 0 otherwise)	
DVECAN	DV67 * EC-AN	
DVNA	Dummy variable to reflect years of adverse weather in the North-Central American countries (= 1 in 1960, 1962, 1969, 1972, and 1974; = 0 otherwise)	
DVOCPOP	DV72 * OC-POP	
DVROEAN	DV67 * ROEAN	
DVRU	Dummy variable to reflect years of adverse weather in the U.S.S.R. (= 1 in 1963, 1965, and 1972; = 0 otherwise)	
DVSAF	Dummy variable to reflect years of adverse weather in South Africa (= 1 in 1960, 1963, 1964, 1967, 1968, 1972, and 1975; = 0 otherwise)	
DVTAU	DVAU * T	
DVTH	Dummy variable to reflect years of adverse weather in Thailand (= 1 in 1972 and 1976; = 0 otherwise)	
DVT67	DV67 * T	
DVT72	DV67 * T	
DVUK	Dummy variable to account for the United Kingdom entering the EEC (= 1 in 1973 to present; = 0 otherwise)	
DV65	Dummy variable to reflect the change in the U.S.S.R.'s corn production policy (= 1 in 1965 to present; = 0 otherwise)	

Variable Name	Description	Units
DV66	Dummy variable accounting for an increase in Mexican price supports for sorghum production (= 1 in 1966 to present; = 0 otherwise)	
DV67	Dummy variable accounting for the start of the Common Agricultural Policy in the EEC (= 1 in 1967 to present; = 0 otherwise)	
DV68	Dummy variable accounting for a structural change in the Netherlands' mixed food industry (= 1 from 1968 to present; = 0 otherwise)	
DV70	Dummy variable to reflect the addition of Brazil's sorghum data to the South American total (= 1 in 1970 to present; = 0 otherwise)	
DV71	Dummy variable to account for an unexplained increase in West Germany's corn utilization for human purposes (= 1 in 1971; = 0 otherwise)	
DV72	Dummy variable accounting for a structural change in the Australian barley production (= 1 in 1972 to present; = 0 otherwise)	
DV75	Dummy variable to reflect the policy change in the U.S.S.R.'s livestock industry (= 1 in 1975; = 0 otherwise)	
DV76	Dummy variable to account for decrease in yield due to adverse weather in the West European countries (= 1 in 1976; = 0 otherwise)	
EC AN	EEC - Animal units variable	Thous. Units
EC POP	EEC - Total population	Thous. Persons
EE AN	East Europe - Animal units variable	Thous. Units
EE POP	East Europe - Total population	Thous. Persons
EG LCP	Egypt - Producer corn price, lagged	Piastres/140 kg
FR AN	France - Animal units variable	Thous. Units
FR BP	France - Barley selling price	$/bu.
FR BWPL	FR $BP_{t-1} \div$ FR WP_{t-1}	
FR PDRI	France - Prices paid for all production requisites, index (1960 = 100)	
FR POP	France - Total population	Thous. Persons
FR WP	France - Wheat selling price	$/bu.

Variable Name	Description	Units
ID WAH	India - Annual wheat area harvested	Thous. Hect.
ID WBP	India - Wholesale barley price	Rupees/100 kg
ID WCP	India - Wholesale corn price	Rupees/100 kg
ID WCPL	ID WCP_{t-1}	Rupees/100 kg
IT AN	Italy - Animal units variable	Thous. Units
IT POP	Italy - Total population	Thous. Persons
IT LCP	Italy - Corn selling price, lagged	1,000 lira / 100 kg
JP POP	Japan - Total population	Mil. Persons
NA AN	North-Central America - Animal units variable; excludes United States	Thous. Units
NA POP	North-Central America - Total population	Mil. Persons
NL AN	Netherlands - Animal units variable	Thous. Units
NL POP	Netherlands - Total population	Thous. Persons
OC POP	Oceania - Total population	Thous. Persons
ROE AN1	Rest of Western Europe - Animal units variable (includes Belgium, Denmark, Ireland, and Luxembourg)	Thous. Units
ROE AN2	Rest of Western Europe - Animal units variable (excludes EEC countries)	Thous. Units
ROE POP	Rest of Western Europe - Total population (excludes EEC countries)	Mil. Persons
RU AN	U.S.S.R. - Animal units variable	Mil. Units
RU CPROD	U.S.S.R. - Annual corn production	Thous. MT
SA CPROD	South America - Annual corn production (excludes Argentina)	Thous. MT.
SA SOY	South America - Annual soybean area harvested (excludes Argentina)	Thous. Hect.
SA POP	South America - Total population (includes Argentina)	Mil. Persons
SAF POP	South Africa - Total population	Mil. Persons
T	Annual linear time trend variable (= 1 in 1960; = 17 in 1976)	
TH POP	Thailand - Total population	Mil. Persons
TLOG	Log (T)	
UK BP	United Kingdom - Barley producer price	£/112 lbs.

Variable Name	Description	Units
UK CBPR	UK CP ÷ UK BP	
UK CP	United Kingdom - Corm import price	£/2,240 lbs.
UK OFU	United Kingdom - Total annual grain utilized for feed, excluding corn (includes barley, oats, rye, sorghu, and wheat)	Thous. MT
UK POP	United Kingdom - Total annual population	Thous. Persons
US ECP	United States - Export corn price	$/bu.
UC ECPL	US ECP_{t-1}	$/bu.
US ESP	United States - Export sorghum price	$/100 lbs.
US ESPL	US ESP_{t-1}	$/bu.
WG AN	West Germany - Animal units variable	Thous. Units
WG BP	West Germany - Barley selling price	$/bu.
WG PDRI	West Germany - Prices paid for production requisites, index (1970 = 100)	
WG WP	West Germany - Wheat selling prices	$/bu.
YU CP	Yugoslavia - Producer corn price	New Dinars/100 kg
YU LCP	YU CP_{t-1}	New Dinars/100 kg

APPENDIX C

DEFINITION OF BALANCE SHEET VARIABLES

Country[1]	Feed Grain	Variable Name
Argentina--AR	Corn--C	Area Harvested--AH
Australia--AU	Sorhum--S	(1000 Hect.)
East Europe--EE	Barley--B	Yield--Y
France--FR	Oats--O	(mt/Hect.)
Italy--IT	Barley and Oats--BO	Beginning Stocks--BS
Japan--JP		(1000 mt.)
Netherlands--NL		Production--PD
North/Central America--NA		(1000 mt.)
Oceania--OC		Import--I
People's Republic of China--CH		(1000 mt.)
Rest of Africa--AF		Exports--E
Rest of Asia--AS		(1000 mt.)
Rest of South America--SA		Feed Use--FU
Rest of West Europe--RWE		(1000 mt.)
South Africa--SAF		Human Use--HU
Thailand--TH		(1000 mt.)
United Kingdom--UK		Seed Use--SU
United States--US		(1000 mt.)
U.S.S.R.--RU		Total Domestic Use--TU
West Germany--WG		(1000 mt.)
		Imports from U.S.--USI
		(1000 mt.)

[1]Variables names are constructed by reading from left to right, for example FR OI = French oat imports.

APPENDIX D

UNITED STATES FEED GRAIN BALANCE SHEETS

CORN BALANCE SHEET : UNITED STATES

OBS	YR	US CAH	US CY	US CBS	US CPD	US CI	US CE	US CHUM	US CSD	US CFU	US CTU
1	48	31096.7	2.69696	3124.4	84003	25.402	2997.4	5918.6	304.819	57281	63504
2	49	31204.4	2.39590	20651.5	74833	25.402	2845.0	6299.6	279.418	64647	71226
3	50	29299.1	2.39590	21439.0	70210	25.402	2972.0	6553.6	304.819	63047	69505
4	51	28810.6	2.31437	18797.2	66781	25.402	2082.9	5944.0	304.819	64901	71150
5	52	28876.2	2.62170	12370.6	75722	25.402	3683.2	5842.4	304.819	58754	64901
6	53	28627.3	2.55270	19533.8	73207	25.402	2641.8	5791.6	330.221	60634	66755
7	54	27789.6	2.47117	23369.5	68788	25.402	2616.4	6020.2	304.819	56953	63275
8	55	27706.2	2.63424	26290.7	72979	25.402	3048.2	6248.8	304.819	60100	66654
9	56	26255.4	2.97293	29592.9	78110	25.402	4673.9	6350.4	279.418	60380	67010
10	57	25522.1	3.02938	36044.9	77348	50.803	5080.3	6375.8	279.418	64393	71048
11	58	25717.9	3.31162	37315.0	85248	25.402	5842.4	7036.2	330.221	70667	78034
12	59	29174.8	3.33043	38712.0	97161	25.402	5842.4	7061.6	304.819	77297	84664
13	60	28904.1	3.43078	45392.7	99244	25.402	7417.3	7214.1	279.418	78542	86035
14	61	23324.2	3.91373	51209.6	91395	25.402	11049.7	7722.1	279.418	81590	89591
15	62	22552.0	4.05798	41988.8	91598	25.402	10567.1	7899.9	279.418	80193	88372
16	63	23968.8	4.25869	34673.2	102089	25.402	12700.8	8331.7	279.418	76433	85045
17	64	22407.5	3.94509	39042.3	88499	25.402	14478.9	8560.3	279.418	75113	83952
18	65	22416.8	4.64755	29135.6	104223	25.402	17450.9	8839.8	330.221	85375	94545
19	66	23068.4	4.58483	21388.1	105874	25.402	12370.6	9017.6	355.622	84562	93935
20	67	24562.5	5.02387	20981.7	123452	25.402	16079.2	9297.0	304.819	89083	98685
21	68	22654.8	4.98624	29694.5	113037	25.402	13615.3	9500.2	304.819	90938	100743
22	69	22085.8	5.38765	28399.0	119057	25.402	15545.8	9652.6	330.221	96424	106407
23	70	23212.5	4.54093	25528.6	105467	101.606	13132.6	9627.2	431.827	90963	96501
24	71	25919.5	5.52563	16942.9	143290	25.402	20219.7	10008.2	381.024	101048	111437
25	72	23229.5	6.08384	28602.2	141563	25.402	31955.2	10338.5	406.426	109481	120226
26	73	25050.6	5.72634	18009.7	144052	25.402	31574.2	10922.7	457.229	106814	118194
27	74	26467.0	4.50957	12294.4	119413	50.803	29186.4	10973.5	482.630	81946	93402
28	75	27316.9	5.41285	9170.0	148066	50.803	43462.1	11938.8	508.032	91243	103689
29	76	28854.7	5.51309	10135.2	159166	76.205	42776.3	12523.0	508.032	91116	104147

BARLEY BALANCE SHEET : UNITED STATES

OBS	YR	US BAH	US BY	US BBS	US BPD	US BI	US BE	US BHUM	US BSD	US BFU	US BTU
1	48	4857.20	1.55184	1132.19	6880.2	261.274	609.64	2111.95	391.910	2961.10	5464.97
2	49	4027.74	1.40544	2199.05	5160.2	391.910	479.00	2024.87	457.229	3048.19	5530.29
3	50	4551.20	1.59283	1741.82	6618.9	304.819	870.91	2199.05	391.910	3157.06	5748.02
4	51	3844.96	1.59869	2046.64	5595.6	283.046	674.96	2024.87	326.592	3309.47	5660.93
5	52	3360.26	1.62211	1589.41	4964.2	544.320	805.59	1916.01	348.365	2917.56	5181.93
6	53	3541.41	1.66310	1110.41	5377.9	827.366	413.68	2003.10	522.547	2830.46	5356.11
7	54	5454.92	1.66310	1545.87	8251.9	522.547	936.23	1937.78	566.093	4027.97	6531.84
8	55	5925.34	1.62797	2852.24	8774.4	609.638	2242.60	1981.32	522.547	4942.43	7446.30
9	56	5243.57	1.71581	2547.42	8208.3	587.866	1349.91	1959.55	566.093	4702.92	7228.57
10	57	6067.73	1.74509	2765.15	9645.4	522.547	2003.10	1916.01	566.093	4768.24	7250.34
11	58	6034.68	1.89149	3679.60	10385.6	394.619	2547.42	1959.55	566.093	5029.52	7555.16
12	59	6066.50	1.65725	4267.47	9144.6	391.910	2569.19	2024.87	522.547	5051.29	7598.71
13	60	5653.20	1.81536	3636.06	9340.5	326.592	1872.46	1981.32	544.320	5595.61	8121.25
14	61	5224.81	1.79194	3309.47	8534.9	435.456	1828.92	2024.87	500.774	5247.24	7772.89
15	62	4983.27	2.04960	2678.05	9318.8	108.864	1458.78	2003.10	457.229	5007.74	7468.07
16	63	4594.25	2.04960	3178.83	8556.7	283.046	1545.87	2111.96	391.910	5094.84	7598.71
17	64	4192.98	2.20088	2874.01	8404.3	261.274	1328.14	2220.83	348.365	5464.97	8034.16
18	65	3739.70	2.51222	2177.28	8556.7	174.182	1676.51	2286.14	370.138	4289.24	6945.52
19	66	4181.97	2.24285	2286.14	8534.9	152.410	979.78	2416.78	348.365	4594.06	7359.21
20	67	3765.81	2.37168	2634.51	8143.0	174.182	674.96	2438.55	370.138	4485.20	7293.89
21	68	3970.62	2.56493	2982.87	9275.2	217.728	283.05	2525.64	348.365	4942.43	7816.44
22	69	3899.22	2.61763	4376.33	9297.0	283.046	370.14	2721.60	348.365	5377.88	8447.85
23	70	3967.77	2.50637	5138.38	9057.5	195.955	1698.28	2634.51	391.910	6292.34	9318.76
24	71	4141.57	2.67607	4006.20	10102.6	261.274	892.68	2699.83	370.138	5878.66	8948.62
25	72	3957.57	2.55322	4528.74	9209.9	370.138	1524.10	2721.60	391.910	5290.79	8404.30
26	73	4283.97	2.35997	4180.38	9079.3	195.955	2024.87	2895.78	304.819	5051.29	8251.89
27	74	3223.17	2.20771	3178.83	6510.1	435.456	914.46	2939.33	348.365	3919.10	7206.80
28	75	3467.97	2.57078	2024.87	8143.0	326.592	522.55	2895.78	348.365	3962.65	7206.80
29	76	3386.37	2.62934	2786.92	8099.5	239.501	1437.00	3048.19	391.910	3505.42	6945.52

OATS BALANCE SHEET : UNITED STATES

OBS	YR	US QAH	US QY	US QBS	US QPD	US QI	US QE	US QHUM	US QSD	US CFU	US QTU
1	48	16026.1	1.32250	2641.77	21047.0	275.79	362.880	479.002	1509.58	17403.7	19392.3
2	49	15419.8	1.15763	4209.41	17708.5	290.30	232.243	479.002	1582.16	16855.7	18956.9
3	50	16036.7	1.24723	3019.16	19871.3	435.46	101.606	464.486	1451.52	17157.0	19073.0
4	51	14374.9	1.30099	4151.35	18550.4	899.94	72.576	479.002	1524.10	17505.3	19508.4
5	52	15100.8	1.17914	4020.71	17665.0	1001.55	58.061	479.002	1567.64	16968.3	19014.9
6	53	15314.6	1.10029	3614.28	16736.0	1161.22	43.546	479.002	1712.79	15981.2	18173.0
7	54	16544.7	1.24723.	3294.95	20466.4	290.30	217.728	508.032	1727.31	17200.5	19435.9
8	55	15922.9	1.37267	4398.11	21714.7	43.55	420.941	508.032	1611.19	18594.0	20713.2
9	56	13599.8	1.23648	5022.26	16707.0	246.76	391.910	537.062	1524.10	16039.3	18100.5
10	57	13899.4	1.35834	3483.65	18724.6	362.88	406.426	551.578	1378.94	15531.3	17461.8
11	58	12746.7	1.60563	4702.92	20335.8	43.55	464.486	580.608	1277.34	17447.3	19305.2
12	59	11325.2	1.35475	5312.56	15241.0	29.03	653.184	609.638	1146.70	14297.5	16053.8
13	60	10847.8	1.55546	3875.56	16736.0	14.52	417.312	624.154	1190.25	13687.8	15502.2
14	[illegible]	9745.4	1.51603	4702.92	14660.4	14.52	304.819	638.669	1088.64	13339.5	15066.8
15	62	9129.7	1.61997	4006.20	14689.4	58.06	348.365	667.699	1030.58	12744.3	14442.6
16	63	8693.6	1.62355	3962.65	14021.7	58.06	87.091	667.699	943.49	11815.4	13426.6
17	64	8061.6	1.54470	4528.74	12367.0	58.06	72.576	667.699	885.43	11307.3	12860.5
18	65	7556.9	1.79917	4020.71	13499.1	43.55	537.062	638.669	870.91	10915.4	12425.0
19	66	7293.8	1.60922	4601.32	11655.7	58.06	290.304	624.154	769.31	10697.7	12091.2
20	67	6572.6	1.76691	3933.62	11525.1	43.55	145.152	624.154	870.91	9884.9	11379.9
21	68	7224.8	1.92461	3977.16	13804.0	29.03	116.122	653.184	870.91	10668.7	12192.8
22	69	7332.1	1.92461	5501.26	14021.7	29.03	72.576	653.184	899.94	10683.2	12236.3
23	70	7604.2	1.76333	7243.08	13310.4	29.03	261.274	653.184	827.37	11336.4	12816.9
24	71	6434.9	2.00346	8288.18	12787.9	43.55	304.819	624.154	754.79	10770.3	12149.2
25	72	5508.0	1.83501	8665.57	10044.5	43.55	275.789	595.123	711.24	10480.0	11786.3
26	73	5630.4	1.71674	6691.51	9681.6	0.00	827.366	566.093	711.24	9797.8	11075.1
27	74	5140.6	1.70598	4470.68	8709.1	0.00	275.789	566.093	609.64	8491.4	9667.1
28	75	5344.6	1.75616	3382.04	9318.8	14.52	203.213	609.638	624.15	8157.5	9391.3
29	76	4855.2	1.63789	2975.62	7925.3	43.55	130.637	624.154	667.70	7112.4	8404.3

SORGHUM BALANCE SHEET : UNITED STATES

OBS	YR	US SAH	US SY	US SBS	US SPD	US SE	US STU
1	48	2961.15	1.12950	177.8	3327.4	1016.0	2006.6
2	49	2671.79	1.41187	482.6	3759.2	812.8	1905.0
3	50	4186.97	1.41815	1524.0	5943.6	1905.0	4597.4
4	51	3457.71	1.19852	965.2	4140.2	1574.8	3276.6
5	52	2155.40	1.06675	254.0	2311.4	254.0	2133.6
6	53	2547.55	1.15460	177.8	2946.4	381.0	2184.4
7	54	4742.21	1.26127	558.8	5994.4	1219.2	3429.0
8	55	5216.92	1.17970	1905.0	6172.2	1676.4	4343.4
9	56	3726.83	1.39305	2057.4	5207.0	558.8	4699.0
10	57	7965.20	1.80720	2006.6	14427.2	1447.8	7137.4
11	58	6687.17	2.20880	7848.6	14757.4	2540.0	7112.0
12	59	6234.72	2.26527	12954.0	14097.0	2489.2	9804.4
13	60	6313.64	2.49117	14757.4	15748.0	1803.4	10871.2
14	61	4445.57	2.74217	17830.8	12192.0	2514.6	10718.8
15	62	4682.72	2.76727	16789.4	12954.0	2870.2	10236.2
16	63	5392.96	2.75472	16637.0	14859.0	2717.8	12293.6
17	64	4751.92	2.61667	16484.6	12446.0	3759.2	10795.0
18	65	5272.76	3.23790	14376.4	17094.2	6756.4	14782.8
19	66	5185.35	3.50145	9931.4	18161.0	6299.2	15595.6
20	67	6065.56	3.16260	6197.6	19177.0	4216.4	13843.0
21	68	5621.21	3.30065	7315.2	18567.4	2692.4	15900.4
22	69	5437.88	3.40732	7289.8	18542.0	3200.4	16433.8
23	70	5490.89	3.16260	6197.6	17373.6	3657.6	17627.6
24	71	6596.92	3.36967	2286.0	22250.4	3124.2	17805.4
25	72	5409.96	3.79637	3606.8	20548.6	5384.8	16916.4
26	73	6353.70	3.68970	1854.2	23444.2	5943.6	17805.4
27	74	5584.78	2.83002	1549.4	15824.2	5384.8	11099.8
28	75	6232.29	3.07475	889.0	19126.2	5816.6	12903.2
29	76	5949.01	3.06847	1295.4	18288.0	6248.4	11023.6

APPENDIX E

CORN BALANCE SHEETS FOR THE REST OF THE WORLD

CORN BALANCE SHEET : SOUTH AFRICA

OBS	YR	SAF CAH	SAF CY	SAF CBS	SAF CPROD	SAF CIMP	SAF CEXP	SAF CFU	SAF CTC	SAF CUSI
1	60	4118	1.28	675	5275	0	1617	1030	3220	0
2	61	4341	1.38	1113	6002	2	2586	1101	3439	0
3	62	4339	1.41	1092	6100	1	2765	1143	3566	0
4	63	4433	0.97	862	4279	0	1101	1297	3457	0
5	64	4290	1.07	583	4583	160	480	1569	4576	160
6	65	4241	1.21	270	5118	136	482	1688	4363	5
7	66	4539	2.13	679	9762	3	2899	1578	4471	0
8	67	4728	1.12	3074	5316	0	2671	1859	4885	0
9	68	4387	1.22	834	5340	503	796	2071	5008	0
10	69	4217	1.45	873	6132	9	1104	2355	5159	0
11	70	4402	1.95	751	8600	2	2555	2007	5173	0
12	71	4578	2.07	1625	9483	0	3562	2308	5540	0
13	72	3611	1.15	2006	4160	0	157	2308	5544	0
14	73	4463	2.49	465	11105	0	3227	2650	6325	0
15	74	4488	2.04	2018	9140	0	3206	2740	6388	0
16	75	4548	1.61	1564	7312	0	1487	2810	6553	0
17	76	4453	2.16	836	9622	0	2900	2860	6658	0

CORN BALANCE SHEET : REST OF AFRICA

OBS	YR	AF CAH	AF CY	AF CBS	AF CPROD	AF CIMP	AF CEXP	AF CFU	AF CTC	AF CUSI
1	60	5263	0.93198	0	4905	101	0	0	6351	42
2	61	5334	0.70472	0	3759	711	0	0	6644	418
3	62	5383	0.79695	0	4290	352	0	0	6858	248
4	63	6055	1.10041	0	6663	592	0	0	7744	472
5	64	6141	1.04315	0	6406	213	0	0	6459	98
6	65	5998	1.10003	0	6598	476	0	0	7559	255
7	66	6516	0.51397	0	3349	304	0	0	8394	58
8	67	5496	1.09868	0	7137	365	0	0	7169	7
9	68	6186	1.24588	0	7707	0	0	0	7527	44
10	69	6918	0.96531	0	6678	413	0	0	7853	123
11	70	6315	0.70521	0	4806	401	0	0	8288	130
12	71	7151	0.56048	0	4008	368	0	0	7942	161
13	72	7615	1.12751	0	8586	480	845	0	7045	236
14	73	7137	0.39274	285	2803	974	0	0	7946	665
15	74	6925	0.75596	0	5235	1165	0	0	8649	773
16	75	7290	1.08834	0	7934	967	0	0	9208	672
17	76	7476	0.72004	0	5383	1136	0	0	9050	787

CORN BALANCE SHEET : NORTH / CENTRAL AMERICA

OBS	YR	NA CAH	NA CY	NA CBS	NA CPROD	NA CIMP	NA CEXP	NA CFU	NA CTC	NA CUSI
1	60	7467	1.04366	538	7793	675	110	991	8364	593
2	61	8417	0.94547	532	7958	925	33	1178	8670	819
3	62	8494	0.95367	712	8075	1389	46	1506	9301	1114
4	63	8870	1.06009	829	9403	957	109	1292	9507	918
5	64	9431	1.13116	1573	10668	776	1250	1522	10266	462
6	65	9792	1.16023	1501	11361	941	1187	1785	11207	611
7	66	9854	1.19708	1409	11796	866	1095	2012	11748	565
8	67	9952	1.18680	1228	11811	1094	975	2463	12403	928
9	68	10074	1.25432	755	12636	1113	994	2659	13033	911
10	69	9778	1.07435	477	10505	1703	82	2262	12309	1169
11	70	10468	1.30369	294	13647	774	361	2628	13649	599
12	71	10679	1.33655	705	14273	661	540	2549	14695	461
13	72	10222	1.22471	404	12519	2642	137	3362	15064	1449
14	73	10641	1.31228	373	13964	3178	10	4056	16614	3166
15	74	10530	1.18528	856	12481	3778	16	3765	16492	2776
16	75	10909	1.40645	545	15343	2769	246	3839	17323	2014
17	76	10674	1.44585	1013	15433	2697	210	4146	18024	2372

CORN BALANCE SHEET : ARGENTINA

OBS	YR	AR CAH	AR CY	AR CBS	AR CPROD	AR CIMP	AR CEXP	AR CFU	AR CTC	AR CUSI
1	60	2744	1.77	24	4850	0	1817	2711	3042	0
2	61	2747	1.89	15	5220	0	2865	2035	2349	0
3	62	2645	1.65	21	4368	0	2542	1422	1774	0
4	63	2970	1.80	65	5350	0	3348	1570	2043	0
5	64	3062	1.68	24	5140	0	2707	1931	2432	0
6	65	3274	2.15	25	7040	1	4010	2559	3042	0
7	66	3450	2.32	14	8000	0	4153	3270	3828	0
8	67	3378	1.94	33	6560	1	3448	2466	3134	0
9	68	3556	1.93	12	6860	0	3740	2381	3124	1
10	69	4017	2.33	8	9360	0	5510	2957	3840	0
11	70	4066	2.44	18	9930	1	6436	2285	2817	0
12	71	3147	1.86	696	5860	1	2040	3594	3981	1
13	72	3565	2.52	536	9000	0	5066	2781	3852	0
14	73	3486	2.84	578	9900	0	5399	2954	4615	0
15	74	3070	2.51	464	7700	0	3517	2477	3897	0
16	75	2766	2.12	750	5855	0	3238	2172	3262	0
17	76	2700	3.15	105	8500	0	4500	2800	4000	0

CORN BALANCE SHEET : REST OF SOUTH AMERICA

OBS	YR	SA CAH	SA CY	SA CBS	SA CPROD	SA CIMP	SA CEXP	SA CFU	SA CTC	SA CUSI
1	60	9126	1.27175	0	11606	66	15	5756	11538	95
2	61	9627	1.25470	0	12079	121	15	5985	12208	156
3	62	10309	1.26967	0	13089	104	708	6077	12622	134
4	63	10394	1.15826	0	12039	162	72	5912	12095	126
5	64	11205	1.33432	0	14951	182	569	7045	12998	75
6	65	11245	1.28039	0	14398	117	628	6818	14819	85
7	66	11846	1.34729	0	15960	225	440	7767	14272	34
8	67	12205	1.30447	0	15921	246	1258	7349	14754	193
9	68	12203	1.28468	0	15677	619	652	7555	17395	83
10	69	12544	1.39764	132	17532	340	1842	7820	16215	188
11	70	13132	1.32470	186	17396	400	1015	10388	16963	63
12	71	13040	1.38113	0	18010	520	180	13669	19967	122
13	72	12186	1.39463	0	16995	559	62	10658	17072	454
14	73	13455	1.43776	0	19345	725	1341	13564	19017	413
15	74	12961	1.49826	0	19419	674	1003	13040	19316	380
16	75	13565	1.57140	0	21316	533	1550	13323	20101	300
17	76	14172	1.58037	0	22397	895	2030	14342	20987	497

CORN BALANCE SHEET : PEOPLES REPUBLIC OF CHINA

OBS	YR	CH CAH	CH CY	CH CBS	CH CPROD	CH CIMP	CH CEXP	CH CFU	CH CTC	CH CUSI
1	60	11845	1.10	0	13000	33	14	0	13019	0
2	61	11990	1.33	0	15980	212	0	0	16192	0
3	62	12135	1.57	0	19090	264	19	0	19335	0
4	63	12280	1.64	0	20170	212	98	0	20284	0
5	64	12425	1.72	0	21340	101	285	0	21156	0
6	65	12570	1.83	0	22960	31	232	0	22759	0
7	66	12715	1.89	0	24070	63	123	0	24010	0
8	67	12860	2.09	0	26930	113	25	0	27018	0
9	68	13005	1.90	0	24680	1	35	0	24646	0
10	69	13150	1.90	0	24980	0	0	0	24980	0
11	70	13295	2.12	0	28200	0	31	0	28169	0
12	71	13440	2.06	0	27700	0	99	0	27601	0
13	72	13000	1.89	0	24570	887	59	0	25398	828
14	73	13500	2.07	0	27970	2058	61	0	29967	1806
15	74	14000	2.19	0	30700	500	72	0	31128	23
16	75	14500	2.21	0	32000	0	115	0	31865	0
17	76	14500	2.17	0	31400	0	50	0	31350	0

CORN BALANCE SHEET : JAPAN

CBS	YR	JP CAH	JP CY	JP CBS	JP CPROD	JP CIMP	JP CEXP	JP CFU	JP CTC	JP CUSI
1	60	44	2.57	185	113	1708	0	1721	1821	416
2	61	43	2.70	185	116	2109	0	2119	2220	976
3	62	42	2.48	190	104	2396	0	2345	2495	735
4	63	39	2.67	195	104	3076	0	2842	3132	1431
5	64	36	2.33	243	84	3223	0	2895	3287	1710
6	65	30	2.50	263	75	2887	0	2414	2956	1946
7	66	26	2.42	269	63	3837	0	3289	3989	2096
8	67	21	2.90	180	61	4582	0	3502	4450	2096
9	68	18	2.83	373	51	5287	6	4295	5375	2558
10	69	15	2.67	330	40	5975	3	4742	5927	4536
11	70	12	2.75	415	33	5173	0	4130	5282	3402
12	71	12	2.75	339	33	5416	0	4157	5460	2303
13	72	9	2.67	328	24	6881	0	5470	6795	5191
14	73	7	2.71	438	19	8210	0	6400	7825	6978
15	74	5	2.80	842	14	7388	0	6090	7415	5439
16	75	4	2.75	829	11	7879	0	6400	7925	5397
17	76	4	2.75	794	11	8850	0	6930	8515	7000

CORN BALANCE SHEET : THAILAND

CBS	YR	TH CAH	TH CY	TH CBS	TH CPROD	TH CIMP	TH CEXP	TH CFU	TH CTC	TH CUSI
1	60	285	1.91	375	544	0	519	2	10	0
2	61	298	2.01	390	598	0	589	4	15	0
3	62	321	2.07	384	665	0	722	4	15	0
4	63	388	2.21	312	858	0	923	6	20	0
5	64	541	1.73	227	935	0	896	10	25	0
6	65	562	1.82	241	1021	0	1132	10	29	0
7	66	590	1.90	101	1122	0	1180	15	35	0
8	67	598	2.20	8	1315	0	1214	25	55	0
9	68	606	2.49	54	1507	0	1289	45	104	0
10	69	690	2.46	168	1700	0	1502	85	176	0
11	70	829	2.34	190	1938	0	1663	105	220	0
12	71	1019	2.26	245	2300	0	2111	135	280	0
13	72	997	1.32	154	1315	0	1039	140	295	0
14	73	1044	2.25	135	2350	0	2131	160	341	0
15	74	1082	2.26	13	2450	0	1979	250	450	0
16	75	1336	2.25	34	3000	0	2386	350	560	0
17	76	1400	1.93	88	2700	0	2000	450	700	0

CORN BALANCE SHEET : REST OF ASIA

OBS	YR	AS CAH	AS CY	AS CBS	AS CPROD	AS CIMP	AS CEXP	AS CFU	AS CTC	AS CUSI
1	60	12361	1.02508	1191	12671	500	187	723	13016	249
2	61	12285	1.06895	1159	13132	585	146	804	13440	314
3	62	13122	1.08589	1290	14249	840	224	949	14801	367
4	63	12331	1.07801	1354	13293	666	157	862	13733	420
5	64	13476	1.09855	1423	14804	593	182	841	15132	362
6	65	12724	1.05997	1506	13487	667	191	909	13948	156
7	66	14376	1.05711	1521	15197	875	277	996	15688	537
8	67	13759	1.13162	1627	15570	1160	284	1224	15933	644
9	68	14539	1.08267	2140	15741	1186	253	1558	16984	246
10	69	14124	1.09140	1830	15415	1470	368	1678	16442	476
11	70	14548	1.22161	1415	17772	1630	310	1929	19012	568
12	71	14041	1.08019	1498	15167	2421	186	2362	17386	1084
13	72	13742	1.13491	1532	15596	3319	87	3343	19200	1403
14	73	15376	1.07993	1210	16605	3143	258	3077	18908	1421
15	74	14984	1.15477	1792	17303	3107	467	3563	19560	1159
16	75	15062	1.26869	2171	19109	4339	359	4815	22039	1836
17	76	14977	1.21259	3205	18161	4800	307	5348	22363	2371

CORN BALANCE SHEET : WEST GERMANY

OBS	YR	WG AHAR	WG YLD	WG BSTK	WG PROD	WG IMP	WG EXP	WG FEED	WG DCON	WG USIMF
1	60	6	3.33	235	20	872	6	554	914	500
2	61	8	2.88	207	23	1527	8	815	1223	727
3	62	13	3.23	526	42	1083	57	765	1177	650
4	63	13	3.62	417	47	1746	88	1015	1696	770
5	64	18	3.39	426	61	2067	293	1352	1871	1100
6	65	27	3.44	390	93	2430	332	1569	2154	1293
7	66	31	3.97	427	123	2570	116	1737	2419	1109
8	67	42	4.52	585	190	2453	28	1921	2632	1539
9	68	58	4.79	554	278	2157	48	1866	2628	1333
10	69	81	4.79	313	388	2132	60	1678	2536	1312
11	70	99	5.12	237	507	2842	265	1894	3094	1867
12	71	116	5.12	227	594	3600	181	1975	3904	2119
13	72	118	4.78	336	564	2880	163	2073	3212	1900
14	73	106	5.41	405	573	3533	344	2264	3474	2450
15	74	108	4.82	693	521	3001	181	2110	3292	2235
16	75	96	5.53	742	531	2973	323	2222	3281	2186
17	76	103	4.66	642	480	3900	250	3200	4240	3500

CORN BALANCE SHEET : ITALY

OBS	YR	IT AHAR	IT YLD	IT BSTK	IT PROD	IT IMP	IT EXP	IT FEED	IT DCON	IT USIMF
1	60	1188	3.21	635	3813	1564	1	4761	5511	100
2	61	1197	3.29	500	3936	2035	1	5065	5870	410
3	62	1120	2.91	600	3263	3017	47	5520	6333	709
4	63	1121	3.29	500	3692	4252	116	7110	7828	1058
5	64	1072	3.68	500	3950	3930	468	6886	7612	1451
6	65	1028	3.23	300	3317	5467	506	7303	8078	2624
7	66	988	3.55	500	3510	5002	76	7560	8336	1267
8	67	1017	3.80	600	3860	4911	4	7947	8767	1667
9	68	967	4.13	600	3991	4722	5	7992	8858	1648
10	69	999	4.52	450	4519	4348	6	8040	8661	1263
11	70	1026	4.61	650	4729	4294	10	8250	8813	1073
12	71	936	4.77	850	4469	4756	7	8609	9628	1385
13	72	891	5.37	440	4789	4988	32	8675	9705	2465
14	73	891	5.71	480	5088	4852	40	8770	9820	2266
15	74	890	5.67	560	5043	4121	1	8200	9250	2240
16	75	897	5.94	473	5326	4344	3	8510	9600	2374
17	76	890	6.00	540	5337	4600	0	8707	9947	2600

CORN BALANCE SHEET : NETHERLANDS

OBS	YR	NL AHAR	NL YLD	NL BSTK	NL PROD	NL IMP	NL EXP	NL FEED	NL DCON	NL USIMF
1	60	1	1.00	164	1	1428	2	1389	1515	950
2	61	1	1.00	76	1	1520	8	1247	1428	1153
3	62	0	0.00	161	0	1693	180	1241	1419	1383
4	63	0	0.00	255	0	1899	42	1637	1842	1567
5	64	0	0.00	270	0	1694	65	1613	1746	1473
6	65	0	0.00	153	0	2000	74	1761	1928	1779
7	66	0	0.00	151	0	2203	8	2012	2240	1851
8	67	0	0.00	106	0	2485	192	2107	2264	1948
9	68	0	0.00	65	0	1911	257	1540	1656	1290
10	69	0	0.00	63	0	2331	457	1742	1873	1670
11	70	0	0.00	64	0	2514	488	1654	2026	1735
12	71	2	5.50	64	11	2221	305	1648	1941	1082
13	72	3	3.33	50	10	3292	1006	1776	2246	2086
14	73	2	5.50	100	11	4412	1631	2223	2742	3252
15	74	2	5.00	150	10	5323	2335	2516	3028	4543
16	75	1	6.00	120	6	4370	1906	1948	2500	3565
17	76	1	5.00	90	5	5410	2450	2154	2955	5200

CORN BALANCE SHEET : UNITED KINGDOM

OBS	YR	UK AHAR	UK YLD	UK BSTK	UK PROD	UK IMP	UK EXP	UK FEED	UK DCON	UK USIMP
1	60	0	0	275	0	3093	6	2377	3166	234
2	61	0	0	196	0	4002	83	3055	3818	206
3	62	0	0	297	0	3897	21	3156	3973	2381
4	63	0	0	200	0	3487	118	2329	3316	1920
5	64	0	0	253	0	3191	5	2298	3299	1909
6	65	0	0	140	0	3550	19	2356	3468	2321
7	66	0	0	203	0	3384	0	2240	3370	1814
8	67	0	0	217	0	3801	0	2653	3800	1820
9	68	0	0	218	0	3465	0	2281	3485	1740
10	69	0	0	198	0	3107	0	1768	3102	1838
11	70	0	0	203	0	2870	15	1561	2920	1506
12	71	1	4	138	4	3121	20	1590	3050	1419
13	72	2	3	201	6	3555	9	1942	3508	1827
14	73	1	6	245	6	3295	20	1761	3360	1403
15	74	1	3	166	3	3159	33	1539	3042	1746
16	75	1	3	253	3	3310	69	1793	3222	2005
17	76	1	3	275	3	4260	35	2725	4228	3000

CORN BALANCE SHEET : FRANCE

OBS	YR	FR AHAR	FR YLD	FR BSTK	FR PROD	FR IMP	FR EXP	FR FEED	FR DCON	FR USIMP
1	60	824	3.41	539	2813	195	670	1977	2343	154
2	61	975	2.53	534	2470	300	343	2100	2466	229
3	62	866	2.15	495	1664	470	111	2042	2402	232
4	63	952	4.07	316	3871	434	848	2879	3289	294
5	64	893	2.36	484	2105	726	551	2018	2433	443
6	65	869	3.94	331	3420	605	879	2681	3097	413
7	66	964	4.50	380	4340	538	1836	2172	2612	319
8	67	1013	4.11	810	4162	522	1262	2770	3341	346
9	68	1022	5.26	647	5379	451	2319	2884	3520	318
10	69	1184	4.83	638	5723	451	2222	2908	3678	375
11	70	1483	5.11	912	7581	478	3579	3837	4634	405
12	71	1685	5.25	758	8840	302	3737	4300	5162	195
13	72	1877	4.36	1001	8177	285	2911	4249	5178	300
14	73	1952	5.47	1374	10671	316	4717	5012	6080	345
15	74	1907	4.56	1564	8699	564	2751	5078	6164	520
16	75	1965	4.03	1912	8194	336	2795	5677	6769	290
17	76	1375	4.03	878	5544	1600	300	5390	6422	1500

CORN BALANCE SHEET : REST OF WEST EUROPE

OBS	YR	RWE CAH	RWE CY	RWE CBS	RWE CPD	RWE CI	RWE CE	RWE CFU	RWE CTU	RWE CUSI
1	60	1157	1.69494	295	1978	879	91	3304	3653	771
2	61	1191	1.82788	335	2177	1039	39	3709	4077	1134
3	62	1164	1.70533	260	1985	1259	216	4257	4680	1766
4	63	1223	1.81112	270	2215	1218	132	4914	5370	1761
5	64	1220	1.91230	252	2333	1232	134	4785	5281	2041
6	65	1164	1.81959	219	2118	1387	148	6018	6552	3578
7	66	1157	2.01815	330	2335	1586	222	6345	6902	2242
8	67	1111	2.20612	224	2451	1506	274	6306	6943	2151
9	68	1173	2.40580	218	2822	1612	409	6467	7152	1228
10	69	1193	2.70914	224	3232	1895	485	6822	7794	2218
11	70	1110	3.23604	325	3592	2062	511	6751	8007	1326
12	71	1241	3.21193	253	3986	2312	480	7407	8805	1765
13	72	1242	3.09420	420	3843	2296	397	8504	9847	3873
14	73	1233	3.51014	380	4328	2472	235	10593	12076	5081
15	74	1174	3.43015	635	4027	2133	188	10954	12298	5582
16	75	1164	3.39089	688	3947	2148	254	10037	11202	5195
17	76	1112	3.17896	592	3535	2865	503	11094	12494	7708

CORN BALANCE SHEET : EAST EUROPE

OBS	YR	CC CAH	CC CY	CC CBS	CC CPROD	CC CIMP	CC CEXP	CC CFU	CC CTC	CC CUSI
1	60	6543	2.04261	50	17450	562	1212	4921	16800	60
2	61	8271	1.82324	50	15080	1241	1329	3449	14442	62
3	62	7874	1.98298	400	15614	921	1397	4426	15316	61
4	63	8111	2.15423	522	17473	1377	1405	5079	17667	432
5	64	7954	2.50038	300	19888	1248	1181	6474	19682	71
6	65	7947	2.16144	573	17177	1184	927	5850	17841	422
7	66	7917	2.88379	167	22831	687	1243	6561	21954	410
8	67	7857	2.57694	487	20247	1161	1524	6107	19819	465
9	68	7925	2.54069	463	20135	1210	1058	5654	19925	596
10	69	7818	2.99501	825	23415	734	1010	6476	22802	542
11	70	7560	2.72963	1162	20636	1532	856	6735	21552	721
12	71	7841	2.97590	922	23334	1483	277	6930	24256	847
13	72	7987	3.40603	1196	27204	2889	927	7248	29130	1625
14	73	7762	3.23280	1192	25093	1888	1920	7747	25423	888
15	74	7541	3.20475	830	24167	3801	832	7635	27243	2355
16	75	8084	3.70077	723	29917	3966	2682	8450	30021	3556
17	76	8219	3.63536	1903	29879	4760	1400	8700	33152	4105

CORN BALANCE SHEET : U.S.S.R.

OBS	YR	RU CAH	RU CY	RU CBS	RU CPROD	RU CIMP	RU CEXP	RU CFU	RU CTC	RU CUSI
1	60	5086	1.93	0	9823	133	390	0	9566	0
2	61	7145	2.40	0	17113	24	1129	0	16008	0
3	62	7005	2.21	0	15474	5	832	0	14647	0
4	63	6995	1.59	0	11143	127	712	0	10558	0
5	64	5114	2.71	0	13849	2	533	0	13318	0
6	65	3177	2.53	0	8030	23	227	0	7826	0
7	66	3229	2.61	0	8416	186	177	0	8425	0
8	67	3485	2.63	0	9163	361	201	0	9323	0
9	68	3350	2.64	0	8628	432	254	0	9006	0
10	69	4167	2.87	0	11954	110	129	0	11935	0
11	70	3353	2.81	0	9428	271	281	6555	9418	0
12	71	3332	2.58	0	8597	2106	128	8206	10575	1979
13	72	4012	2.45	0	9830	4101	249	11053	13682	3731
14	73	4029	3.28	0	13216	4797	365	13544	17648	4518
15	74	3955	3.07	0	12142	2200	450	10654	13892	1261
16	75	2652	2.76	0	7328	12300	0	17122	19628	10450
17	76	3303	3.11	0	10260	4500	0	12000	14760	4000

CORN BALANCE SHEET : OCEANIA

OBS	YR	OC CAH	OC CY	OC CBS	OC CPROD	OC CIMP	OC CEXP	OC CFU	OC CTC	OC CUSI
1	60	78	2.16667	35	169	0	0	112	169	0
2	61	88	2.27273	35	200	0	10	124	184	0
3	62	88	2.31818	40	204	0	0	137	204	0
4	63	91	2.08791	40	190	2	1	134	196	0
5	64	90	2.21111	35	199	3	0	139	202	0
6	65	83	1.73494	35	144	1	2	108	158	2
7	66	85	2.44706	20	208	6	3	126	191	0
8	67	87	2.49425	40	217	3	0	155	220	0
9	68	73	2.73973	40	200	3	1	151	207	0
10	69	88	2.85227	35	251	0	22	161	219	0
11	70	98	3.19388	45	313	2	41	222	269	0
12	71	93	3.54839	50	330	1	9	272	337	0
13	72	72	3.56944	35	257	1	3	216	272	0
14	73	64	3.68750	18	236	1	1	182	240	1
15	74	76	4.44737	14	338	1	38	213	274	1
16	75	83	4.45783	41	370	1	83	230	297	0
17	76	93	4.31183	32	401	1	35	236	339	0

APPENDIX F

SORGHUM BALANCE SHEETS FOR THE REST OF THE WORLD

SORGHUM BALANCE SHEET : AFRICA

OBS	YR	AF SAH	AF SY	AF SBS	AF SPD	AF SI	AF SE	AF SFU	AF STC	AF SUSI
1	60	9572	0.848099	0	8118	260	314	215	8064	195
2	61	10034	0.852900	0	8558	280	127	247	8703	218
3	62	10561	0.884461	0	9341	219	182	203	9340	133
4	63	11022	0.867810	76	9565	273	251	247	9637	183
5	64	11818	0.848536	26	10028	256	305	264	9889	192
6	65	12241	0.786619	116	9629	286	231	265	9694	268
7	66	11390	0.805707	106	9177	491	174	372	9096	438
8	67	11469	0.826227	428	9476	491	414	398	9901	390
9	68	10623	0.760990	254	8084	460	149	422	8431	411
10	69	12399	0.825228	62	10232	623	182	520	10565	567
11	70	12562	0.812530	115	10207	618	550	484	10373	561
12	71	11930	0.799665	190	9540	657	266	614	9942	620
13	72	11475	0.751285	166	8621	694	108	679	9249	662
14	73	11625	0.762323	51	8862	855	291	775	9249	771
15	74	12237	0.754678	228	9235	821	264	1306	9871	757
16	75	13105	0.763220	249	10002	659	300	1240	10426	615
17	76	13332	0.743849	209	9917	778	68	1354	10616	696

SORGHUM BALANCE SHEET : NORTH / CENTRAL AMERICA

OBS	YR	NA SAH	NA SY	NA SBS	NA SPD	NA SI	NA SE	NA SFU	NA STC	NA SUSI
1	60	361	1.23269	10	445	29	2	384	473	27
2	61	363	1.36639	9	496	46	4	455	540	43
3	62	377	1.41114	7	532	176	1	596	688	174
4	63	449	1.39421	26	626	18	6	564	652	15
5	64	542	1.39852	12	758	59	3	691	787	56
6	65	591	1.69205	39	1000	61	5	994	1078	56
7	66	853	1.95897	17	1671	31	22	1297	1385	25
8	67	913	2.04600	312	1868	92	178	1704	1804	85
9	68	1119	2.16175	290	2419	34	177	2092	2194	28
10	69	1390	1.94101	372	2698	35	256	2307	2602	27
11	70	1431	2.00699	248	2872	35	207	2411	2724	27
12	71	1408	1.94389	224	2737	101	10	2533	2951	84
13	72	1434	1.60739	101	2305	199	1	2079	2388	185
14	73	1667	2.00180	217	3337	210	1	3204	3451	189
15	74	1648	1.94721	312	3209	604	11	3318	3578	575
16	75	1747	2.25415	536	3938	301	22	3939	4167	246
17	76	1656	2.20592	590	3653	882	2	4234	4473	402

SORGHUM BALANCE SHEET : ARGENTINA

OBS	YR	AR SAH	AR SY	AR SBS	AR SPD	AR SI	AR SE	AR SFU	AR STC	AR SUSI
1	60	553	2.26	7	1252	3	467	668	781	1
2	61	646	2.16	14	1394	5	487	804	920	2
3	62	574	1.56	6	952	4	680	151	255	2
4	63	724	1.75	27	1267	5	842	324	448	5
5	64	588	1.46	9	857	6	216	488	643	4
6	65	844	2.52	13	2130	3	1277	689	856	1
7	66	764	1.81	13	1380	2	404	646	980	1
8	67	1083	1.75	11	1897	3	809	786	1088	1
9	68	1302	1.91	14	2484	1	1354	846	1136	5
10	69	1872	2.04	9	3820	1	1603	1896	2212	1
11	70	2235	2.09	15	4660	1	2215	1941	2249	1
12	71	1419	1.66	212	2360	1	474	1485	1810	1
13	72	2131	2.16	289	4600	0	2420	1916	2243	0
14	73	2324	2.54	226	5900	0	2838	2493	2773	0
15	74	1938	2.49	515	4830	0	2370	2015	2375	0
16	75	1834	2.76	600	5060	0	3539	1861	2061	0
17	76	2377	2.78	60	6600	0	4261	2100	2339	0

SORGHUM BALANCE SHEET : REST OF SOUTH AMERICA

OBS	YR	SA SAH	SA SY	SA SBS	SA SPD	SA SI	SA SE	SA SFU	SA STC	SA SUSI
1	60	3	0.33333	0	1	6	0	6	7	0
2	61	6	1.16667	0	7	20	1	23	26	10
3	62	8	1.50000	0	12	20	10	19	22	0
4	63	37	0.83784	0	31	26	8	46	49	12
5	64	63	1.19048	0	75	14	7	78	85	1
6	65	66	1.42424	0	94	17	4	108	107	4
7	66	74	1.20270	0	89	19	3	100	105	28
8	67	87	1.60920	0	140	31	18	148	153	9
9	68	97	1.83505	0	178	19	12	177	185	2
10	69	103	1.47573	0	152	101	0	228	253	63
11	70	197	1.98985	10	392	339	8	700	713	274
12	71	261	1.90421	20	497	231	23	737	694	291
13	72	435	2.01379	31	876	475	10	1302	1351	419
14	73	543	2.02947	21	1102	531	76	1463	1515	474
15	74	437	2.08238	63	910	520	0	1384	1409	404
16	75	487	2.39014	84	1164	507	39	1552	1571	490
17	76	502	2.08367	145	1046	671	157	1593	1610	508

SORGHUM BALANCE SHEET : PEOPLES REPUBLIC OF CHINA

OBS	YR	CH SAH	CH SY	CH CPD	CH STC
1	60	8970	0.71	6359	6379
2	61	9352	0.84	7878	7878
3	62	9302	1.04	9643	9643
4	63	9250	1.11	10267	10267
5	64	9190	1.18	10881	10881
6	65	9140	1.18	10768	10768
7	66	9083	1.38	12556	12556
8	67	9017	1.68	15139	15139
9	68	8970	1.59	14289	14289
10	69	8916	1.59	14179	14179
11	70	8860	1.74	15398	15398
12	71	8801	1.73	15199	15199
13	72	8669	1.71	14845	14845
14	73	8283	1.80	14950	14950
15	74	7903	1.88	14835	14835
16	75	7322	1.99	14542	14542
17	76	7006	2.02	14150	14150

SORGHUM BALANCE SHEET : JAPAN

OBS	YR	JP SBS	JP SI	JP SFU	JP STC	JP SUSI
1	60	75	114	114	114	114
2	61	75	254	254	254	254
3	62	75	542	543	543	542
4	63	74	984	966	977	910
5	64	81	1308	1186	1299	993
6	65	90	1704	1596	1611	1555
7	66	183	2651	2633	2651	2309
8	67	183	2478	2508	2526	1986
9	68	135	2500	2453	2473	1800
10	69	162	3228	3125	3140	1948
11	70	250	4159	4099	4109	2553
12	71	300	3553	3630	3640	1149
13	72	213	3612	3366	3376	2665
14	73	449	4345	4273	4283	3199
15	74	511	4015	4040	4050	2176
16	75	476	3771	3930	3940	2316
17	76	307	4948	4852	4862	2684

SORGHUM BALANCE SHEET : REST OF ASIA

OBS	YR	AS SAH	AS SY	AS SBS	AS SPD	AS SI	AS SE	AS SFU	AS STC	AS SUSI
1	60	18933	0.532615	3000	10084	90	0	323	9674	53
2	61	18814	0.442702	3500	8329	23	0	321	8853	0
3	62	18952	0.530287	3000	10050	28	0	327	9078	0
4	63	18950	0.500686	4000	9488	52	0	316	9540	25
5	64	18696	0.536960	4000	10039	60	0	360	10096	54
6	65	18334	0.432639	4003	7932	104	61	335	9959	0
7	66	18692	0.515301	3009	9632	2133	54	365	10194	2172
8	67	19115	0.550039	4526	10514	1259	108	400	11158	923
9	68	19303	0.528156	5033	10195	58	99	377	11181	57
10	69	19183	0.529062	4006	10149	282	59	390	10861	169
11	70	18024	0.475255	510	8566	2	65	337	8482	8
12	71	17540	0.474971	531	8331	2	90	333	8235	8
13	72	16175	0.469923	540	7601	858	131	340	8331	468
14	73	17463	0.559869	552	9777	981	97	429	10273	576
15	74	16507	0.669595	840	11053	305	188	411	10986	9
16	75	16934	0.608185	1024	10299	920	207	616	10948	0
17	76	16630	0.680277	1088	11313	597	170	990	11615	180

SORGHUM BALANCE SHEET : EUROPEAN ECONOMIC COMMUNITY

OBS	YR	EC SAH	EC SY	EC SBS	EC SPD	EC SI	EC SE	EC SFU	EC STC	EC SUSI
1	60	21	2.47619	103	52	1854	45	1871	1893	923
2	61	12	2.58333	71	31	2023	41	1910	1938	762
3	62	16	2.75000	143	44	2143	187	1901	1929	986
4	63	26	3.34615	214	87	2152	104	2102	2125	762
5	64	30	2.90000	224	87	2251	110	2270	2295	976
6	65	39	2.84615	167	111	2534	142	2499	2526	1780
7	66	57	2.89474	144	165	2456	230	2348	2362	1252
8	67	70	2.45714	173	172	1418	208	1369	1382	729
9	68	62	3.59677	136	223	971	224	1022	1032	169
10	69	61	3.63934	74	222	738	157	820	830	232
11	70	60	3.25000	43	195	1559	160	1583	1584	607
12	71	59	4.08475	48	241	730	191	785	790	185
13	72	82	3.82927	38	314	538	181	633	663	100
14	73	71	4.32394	45	307	1660	499	1396	1408	142
15	74	73	3.93151	69	287	1653	464	1426	1436	613
16	75	88	3.69318	111	325	2540	977	1912	1926	1729
17	76	86	3.46512	79	298	1703	649	1366	1378	766

SORGHUM BALANCE SHEET : REST OF WEST EUROPE

OBS	YR	RWF SAH	RWE SY	RWE SBS	RWE SPD	RWE SI	RWE SFU	RWE STC	RWE SUSI
1	60	4	1.75000	30	7	103	109	110	73
2	61	4	1.75000	30	7	120	131	132	71
3	62	4	1.75000	25	7	157	153	154	118
4	63	10	1.60000	35	16	43	92	93	5
5	64	22	2.31818	1	51	128	158	159	43
6	65	20	2.15000	21	43	336	382	383	229
7	66	26	1.53846	17	40	588	635	637	154
8	67	17	2.58824	8	44	410	438	440	185
9	68	31	2.93548	22	91	152	261	263	21
10	69	55	2.85455	1	157	120	276	278	0
11	70	47	4.02128	0	189	465	653	654	24
12	71	40	4.32500	0	173	513	578	686	51
13	72	44	4.02273	0	177	492	613	633	198
14	73	43	3.81395	36	164	736	889	916	138
15	74	37	4.24324	20	157	572	730	732	275
16	75	35	4.11429	220	144	993	1071	1075	307
17	76	37	4.29730	282	159	1360	1471	1474	833

SORGHUM BALANCE SHEET : EAST EUROPE

OBS	YR	CC SAH	CC SBS	CC SPD	CC SI	CC SE	CC SFU	CC STC	CC SUSI
1	60	0	0	0	97	0	97	97	97
2	61	0	0	0	113	0	108	111	0
3	62	0	0	0	492	0	491	492	378
4	63	0	0	0	155	0	151	155	110
5	64	0	0	0	99	0	96	99	85
6	65	0	0	0	526	4	47	522	470
7	66	0	0	0	516	3	131	513	506
8	67	0	0	0	155	3	61	152	119
9	68	0	0	0	162	6	47	156	143
10	69	0	0	0	57	2	25	55	0
11	70	0	0	0	79	7	38	72	61
12	71	0	0	0	25	7	1	18	0
13	72	0	0	0	53	2	0	51	1
14	73	0	0	0	148	1	26	147	38
15	74	1	0	2	376	1	300	360	147
16	75	15	17	36	398	1	284	440	307
17	76	69	10	112	1279	0	500	1178	839

SORGHUM BALANCE SHEET : AUSTRALIA

OBS	YR	AU SAH	AU SY	AU SBS	AU SPD	AU SI	AU SE	AU SFU	AU STC
1	60	103	1.58	0	163	0	39	106	124
2	61	147	1.73	0	255	0	61	173	194
3	62	158	1.77	0	279	0	8	249	271
4	63	148	1.45	0	215	0	19	180	196
5	64	140	1.39	0	195	0	2	176	193
6	65	175	1.11	0	195	0	72	103	123
7	66	203	1.57	0	319	0	22	277	297
8	67	187	1.54	0	285	0	80	188	208
9	68	210	1.40	0	294	0	17	223	243
10	69	359	1.52	34	547	0	278	243	268
11	70	552	2.35	35	1298	0	1087	216	222
12	71	638	1.92	24	1228	0	692	448	500
13	72	697	1.46	60	1018	0	633	293	299
14	73	540	1.96	146	1061	0	984	110	115
15	74	511	1.76	108	901	0	897	83	89
16	75	504	2.23	23	1124	0	972	110	116
17	76	532	1.80	59	956	0	490	367	372

APPENDIX G

BARLEY AND OATS BALANCE SHEETS FOR THE REST OF THE WORLD

BARLEY AND OATS BALANCE SHEET : AFRICA

OBS	YR	AF BOAH	AF BOY	AF BOBS	AF BOPD	AF BOI	AF BOE	AF BOTC	AF BOUSI
1	60	5379	0.69734	0	3751	176	122	3805	26
2	61	4619	0.69474	0	3209	544	41	2712	287
3	62	4576	0.78977	0	3614	124	193	3545	13
4	63	5221	0.75388	0	3936	22	338	3520	0
5	64	4672	0.67509	100	3154	48	141	3051	20
6	65	4628	0.71672	110	3317	44	45	3266	8
7	66	4302	0.68038	160	2927	160	51	3088	80
8	67	4519	0.78535	115	3549	111	6	3660	14
9	68	4853	1.18710	109	5761	59	105	5306	15
10	69	4549	0.77880	318	3542	69	276	3410	0
11	70	4717	0.82404	243	3887	37	124	3973	0
12	71	4516	0.86537	70	3908	76	3	4016	0
13	72	4722	0.93753	35	4427	167	11	4518	0
14	73	5233	0.70438	0	3686	141	11	3717	3
15	74	4910	0.92770	119	4555	256	9	4751	49
16	75	5168	0.84423	175	4363	79	9	4483	4
17	76	5224	1.05283	125	5500	187	0	3787	57

BARLEY AND OATS BALANCE SHEET : REST OF ASIA

OBS	YR	AS BOAH	AS BOY	AS BOBS	AS BOPD	AS BI	AS BOE	AS BOFU	AS BOTC	AS BUSI
1	60	11428	0.86253	612	9857	379	22	2946	10250	333
2	61	10785	0.94984	776	10244	397	394	2832	10182	16
3	62	10945	1.03618	841	11341	400	461	2947	11009	74
4	63	10896	1.00000	1112	10896	297	488	3564	10923	212
5	64	10356	0.92478	894	9577	281	274	2670	9363	79
6	65	10381	1.04460	1115	10844	186	330	3050	10614	146
7	66	9883	1.07174	1201	10592	240	78	3122	10447	46
8	67	10356	1.08459	1508	11232	405	112	3375	11152	171
9	68	11238	1.11372	1883	12516	345	258	3421	13052	149
10	69	10263	1.14080	1432	11708	325	438	3483	11811	29
11	70	9642	1.11377	1216	10739	745	9	3470	11986	170
12	71	9032	1.20660	705	10898	1355	7	3594	11891	248
13	72	9393	1.21772	1060	11438	1153	350	3580	12444	534
14	73	9334	0.97664	857	9116	251	55	2799	10382	84
15	74	9594	1.06087	787	10178	1127	0	2934	11517	296
16	75	10141	1.23134	575	12487	882	112	3740	12517	258
17	76	10329	1.32462	1290	13682	851	383	4155	13553	297

BARLEY AND OATS BALANCE SHEET : EAST EUROPE

OBS	YR	CC BOAH	CC BOY	CC BOBS	CC BOPD	CC BOI	CC BOE	CC BOFU	CC BOTC	CC BOUSI
1	60	6700	1.90448	304	12760	785	146	4053	13363	272
2	61	6601	1.86714	340	12325	627	205	4441	12867	96
3	62	6332	1.94046	220	12287	684	135	3935	12826	119
4	63	6365	1.85609	230	11814	1327	131	4271	12890	186
5	64	6208	1.75677	350	10906	1878	122	3626	12707	55
6	65	5958	2.02534	305	12067	831	185	4376	12898	75
7	66	6125	2.05453	170	12584	588	260	4058	12932	42
8	67	6085	2.25127	150	13699	980	314	4103	14049	23
9	68	5955	2.28463	466	13605	1067	254	4487	14453	0
10	69	6181	2.39961	431	14832	2442	406	5080	16218	202
11	70	6303	2.24338	1081	14140	1529	509	5911	16074	522
12	71	6199	2.65704	289	16471	3520	473	6577	19349	87
13	72	6295	2.68546	424	16905	1503	360	6155	18133	16
14	73	6298	2.84027	265	17888	1898	397	6654	19203	226
15	74	6433	3.17535	483	20427	2302	185	7984	22540	238
16	75	7102	2.72853	488	19378	2361	468	7626	21519	325
17	76	6380	2.90392	250	18527	2509	578	7430	20677	189

BARLEY AND OATS BALANCE SHEET : EUROPEAN ECONOMIC COMMUNITY

OBS	YR	EEC BOAH	EC BOY	EC BOBS	EC BOPD	EC BOI	EC BOE	EC BOFU	EC BOTC	EC BOUSI
1	60	5480	2.95639	1358	16201	3865	417	14923	19697	1182
2	61	5816	2.85540	1395	16607	4600	990	14945	19919	1097
3	62	5781	3.29614	1649	19055	3502	806	16213	21293	1228
4	63	6094	3.17296	2122	19336	3473	579	17191	22403	877
5	64	6133	3.39459	2131	20819	3535	822	17728	23462	647
6	65	6353	3.31623	2100	21068	4740	1527	17889	23968	1210
7	66	6800	3.23632	2494	22007	3950	1836	18569	24479	713
8	67	6860	3.54665	2073	24330	4022	1497	20402	26568	421
9	68	6804	3.49045	1977	23749	4169	823	20496	26229	80
10	69	6995	3.55728	3001	24563	4738	1552	22394	28329	21
11	70	6828	3.30419	2252	22561	6713	1186	21149	27525	687
12	71	6858	3.71129	2449	25452	5384	1623	22165	29129	126
13	72	6830	3.83265	2446	26177	4823	1171	22028	29784	219
14	73	6918	3.78520	2368	26186	5846	1284	22880	30606	542
15	74	6783	4.02197	2346	27281	4668	2138	21478	29494	101
16	75	7003	3.61816	2688	25338	5283	2396	21051	29072	129
17	76	6839	3.40678	1972	23299	6956	1806	20986	28534	875

BARLEY AND OATS BALANCE SHEET : JAPAN

OBS	YR	JP BOAH	JP BOY	JP BOBS	JP BOPD	JP BOI	JP BOE	JP BOFU	JP BOTC	JP BOUSI
1	60	917	2.68484	217	2462	4	0	787	2466	0
2	61	774	2.77003	217	2144	2	0	897	2118	0
3	62	697	2.69154	245	1876	5	0	883	1901	2
4	63	640	1.41719	225	907	501	0	635	1441	281
5	64	547	2.42048	192	1324	549	0	762	1861	205
6	65	484	2.83264	204	1371	544	0	798	1939	244
7	66	442	• 2.73077	180	1207	576	0	789	1791	236
8	67	398	2.84673	172	1133	604	2	802	1723	100
9	68	357	3.12045	184	1114	683	1	830	1685	9
10	69	317	2.77287	295	879	804	1	907	1641	7
11	70	252	2.51587	336	634	1040	0	934	1613	2
12	71	193	2.91710	397	563	1123	0	1146	2014	4
13	72	145	2.61644	69	382	1386	0	1175	1584	153
14	73	100	2.57000	253	257	1468	0	1150	1560	35
15	74	95	2.84211	418	270	1680	0	1372	1807	89
16	75	91	2.73626	561	249	1802	0	1503	2187	41
17	76	90	2.57778	425	232	1893	0	1355	1938	105

BARLEY AND OATS BALANCE SHEET : NORTH / CENTRAL AMERICA

OBS	YR	NA BOAH	NA BOY	NA BOBS	NA BOPD	NA BOI	NA BOE	NA BOFU	NA BOTC	NA BOUSI
1	60	3997	1.59970	1553	6394	51	949	5450	6183	54
2	61	3775	1.22411	1776	4621	143	880	4520	5267	119
3	62	4565	1.71698	1219	7838	65	631	5776	6470	27
4	63	4102	1.74086	2317	7141	107	1182	5883	6521	18
5	64	3534	1.58546	2766	5603	167	942	5683	6301	86
6	65	3647	• 1.74993	2006	6382	117	968	5835	6310	73
7	66	3526	1.71894	1961	6061	94	1085	5670	6364	40
8	67	3278	1.49634	1693	4905	57	898	4767	5408	4
9	68	3301	1.75613	1187	5797	67	483	4343	5031	6
10	69	3236	1.76576	2044	5714	62	1592	4863	5377	5
11	70	3063	1.86941	2348	5726	63	3985	5293	5901	8
12	71	3045	1.92282	2053	5855	77	4629	5284	5906	11
13	72	2825	1.73982	1898	4915	92	3705	4858	5505	27
14	73	2958	1.81711	1293	5375	349	2596	5089	5743	284
15	74	2724	1.55653	1261	4240	318	3035	3911	4579	253
16	75	2779	1.78517	1218	4961	107	4336	3967	4663	42
17	76	2819	1.92302	1343	5421	69	4094	4136	4818	4

BARLEY AND OATS BALANCE SHEET : PEOPLES REPUBLIC OF CHINA

OBS	YR	CH BOAH	CH BOY	CH BOPD	CH BOTC
1	60	7048	0.72361	5100	5743
2	61	7255	0.82564	5990	6963
3	62	7249	0.97034	7034	7109
4	63	7193	1.01404	7294	7872
5	64	7136	1.05185	7506	7730
6	65	7075	1.03025	7289	7319
7	66	7013	1.13161	7936	7937
8	67	6988	1.26660	8851	8850
9	68	6887	1.16306	8010	8009
10	69	6824	1.11474	7607	7607
11	70	6756	1.16400	7864	7864
12	71	6689	1.18358	7917	8330
13	72	6589	1.05858	6975	6975
14	73	6419	1.06387	6829	6829
15	74	6249	1.05153	6571	6571
16	75	6844	1.07642	7367	7367
17	76	7172	1.10569	7930	7930

BARLEY AND OATS BALANCE SHEET : OCEANIA

OBS	YR	OC BOAH	OC BOY	OC BOBS	OC BOPD	OC BOI	OC BOE	OC BOFU	OC BOTC	OC BOUSI
1	60	2262	1.34571	0	3044	0	1305	1067	1739	0
2	61	2263	0.90853	0	2056	0	703	821	1353	0
3	62	2196	1.02914	0	2260	0	608	1021	1652	0
4	63	2237	1.06437	0	2381	0	588	1081	1793	0
5	64	2301	1.10387	0	2540	2	656	1137	1886	0
6	65	2505	0.88184	0	2209	0	655	950	1554	0
7	66	2780	1.25971	0	3502	1	677	1450	2326	2
8	67	2502	0.72622	500	1817	16	383	966	1623	0
9	68	2988	1.21854	1087	3641	33	922	1096	1879	0
10	69	2969	1.07208	1250	3183	25	908	1295	2194	0
11	70	3656	1.17123	1551	4282	23	1788	1520	2279	0
12	71	3888	1.21553	1087	4726	13	2102	2332	3202	0
13	72	3224	0.85763	484	2765	14	736	2211	2647	0
14	73	3175	1.21417	470	3855	13	1479	1715	2194	0
15	74	2864	1.32263	465	3788	0	1988	1338	1836	0
16	75	3417	1.37782	535	4708	0	2647	1273	1791	0
17	76	3410	1.25836	799	4291	0	2295	1438	2029	0

BARLEY AND OATS BALANCE SHEET : REST OF WEST EUROPE

OBS	YR	RWE BOAH	RWE BOU	RWE BOBS	RWE BOPD	RWE BOI	RWE BOE	RWE BOFU	RWE BOTC	RWE BOUSI
1	60	4919	1.56333	649	7690	818	72	6824	8212	246
2	61	4894	1.62526	873	7954	726	399	6946	8424	194
3	62	4841	1.59967	730	7744	1034	127	7028	8504	208
4	63	4983	1.66968	877	8320	1366	241	8006	9360	191
5	64	4809	1.75255	962	8428	1371	259	8298	9667	58
6	65	4862	1.79761	834	8740	1552	213	8159	9941	314
7	66	4991	1.80164	972	8992	1537	273	8908	10367	56
8	67	5186	2.04898	860	10626	1040	394	9572	11054	27
9	68	5735	2.08317	1079	11947	991	597	10951	12186	39
10	69	5899	2.00136	1233	11806	832	364	10957	12579	36
11	70	6150	2.03008	1040	12485	1334	714	11262	12964	313
12	71	6325	2.40364	1181	15203	958	1057	12780	14654	81
13	72	6488	2.16492	1531	14046	960	853	12522	14518	18
14	73	6763	2.00059	1266	13530	1359	152	12657	14811	210
15	74	7030	2.31053	1182	16243	999	540	14045	16221	59
16	75	7365	2.27196	2762	16733	801	372	13804	16239	18
17	76	7301	2.19573	3685	16031	761	385	15169	17526	92

BARLEY AND OATS BALANCE SHEET : U.S.S.R.

OBS	YR	RU BOAH	RU BOY	RU BOBS	RU BOPD	RU BOI	RU BOE	RU BOFU	RU BOTC	RU BOUSI
1	60	24968	1.12224	2000	28020	20	669	19436	27281	0
2	61	24908	0.89281	2000	22238	0	906	14286	21332	0
3	62	23200	1.08793	2000	25240	0	444	16962	24796	0
4	63	26189	0.90759	2000	23769	0	569	15473	22200	0
5	64	27408	1.24475	3000	34116	0	865	17064	26251	0
6	65	26365	1.00474	10000	26490	0	1985	21796	30505	0
7	66	26558	1.39611	4000	37078	0	328	27475	36750	0
8	67	27813	1.30310	4000	36243	0	492	26383	35751	0
9	68	28351	1.43004	4000	40543	98	630	28882	40011	0
10	69	31784	1.43852	4000	45722	0	753	31622	44969	0
11	70	30547	1.71457	4000	52375	0	628	37735	51747	0
12	71	31198	1.57770	4000	49221	2163	545	38125	50839	956
13	72	38627	1.31794	4000	50908	2227	120	38536	53015	223
14	73	41274	1.75801	4000	72560	690	517	50718	71733	91
15	74	42646	1.62993	5000	69510	500	550	50466	69460	0
16	75	44655	1.08169	5000	48303	3250	0	37813	53553	50
17	76	45530	1.92515	3000	87652	700	2000	59606	83352	0

BARLEY AND OATS BALANCE SHEET : SOUTH AMERICA

OBS	YR	SA BOAH	SA BOY	SA BOBS	SA BOPD	SA BOI	SA BOE	SA BOFU	SA BOTC	SA BOUSI
1	60	1385	1.06570	290	1476	64	113	763	1488	6
2	61	1357	1.06190	229	1441	70	197	771	1453	9
3	62	959	1.04484	90	1002	73	40	381	1038	3
4	63	1314	1.26865	87	1667	98	488	588	1266	10
5	64	1153	1.31483	98	1516	90	321	607	1324	4
6	65	1007	1.10328	58	1111	83	125	458	1093	22
7	66	1048	1.09542	35	1148	101	57	514	1175	3
8	67	1152	1.17014	52	1348	116	155	676	1266	21
9	68	1152	1.04601	95	1205	125	236	458	1117	50
10	69	1059	1.15958	72	1228	160	81	563	1290	53
11	70	992	1.12601	89	1117	161	88	445	1193	33
12	71	1136	1.10827	86	1259	107	120	507	1240	9
13	72	1195	1.26862	94	1516	145	181	703	1481	25
14	73	1153	1.27927	93	1475	182	134	651	1516	76
15	74	1022	1.15264	100	1178	131	69	474	1225	21
16	75	1121	1.10972	105	1244	142	76	571	1304	7
17	76	1159	1.33046	121	1542	228	148	785	1619	50

APPENDIX H

EXPLANATORY VARIABLES USED IN THE UNITED STATES FEED GRAIN EQUATIONS

VARIABLES USED IN UNITED STATES REGRESSION EQUATIONS

OBS	YR	ANUNFD	BAPROD	BMP	BRPD	CDDVP	CDEPS	CCFED	CFD	CFPL	CNAPLT	CP	CPRM	DV58	DV66	DV70
1	48	71980	6880.2	3.18506	91291	0.000000	2.95571	3821	2.62759	.	23576	2.95571	2.83218	0	0	0
2	49	74161	5160.2	3.68120	89736	0.000000	3.32518	4540	2.94493	2.62759	28283	3.32518	3.06464	0	0	0
3	50	75615	6618.9	3.91065	88807	0.000000	2.67268	4390	3.53201	2.94493	18866	2.67268	4.02004	0	0	0
4	51	74888	5595.6	3.24861	88976	0.000000	3.59196	4534	3.79757	3.53201	29353	3.59196	4.18706	0	0	0
5	52	72707	4964.2	3.72560	89601	0.000000	3.47661	4961	3.30251	3.79757	28065	3.47661	3.45461	0	0	0
6	53	71973	5377.9	3.77772	96434	0.000000	3.82875	5762	3.54195	3.30251	26872	3.82875	3.66122	0	0	0
7	54	73684	8251.9	3.66777	92561	0.000000	3.17464	5370	3.49289	3.54195	20052	3.17464	3.61461	0	0	0
8	55	74494	8774.4	3.29076	89791	0.000000	3.38946	5795	3.44084	3.49289	17991	3.38946	3.15970	0	0	0
9	56	72852	8208.3	3.43359	90698	0.000000	2.83571	5929	3.29614	3.44084	17377	2.83571	3.34621	0	0	0
10	57	71392	9645.4	3.24299	89882	0.111964	2.49893	6122	2.88921	3.29614	14310	2.49893	3.15015	0	0	0
11	58	73897	10385.6	3.22826	89011	0.141607	2.34304	5898	3.05157	2.88921	12379	2.34304	3.29722	1	0	0
12	59	73211	9144.6	3.18510	90974	0.000000	3.25536	6601	3.05176	3.05157	15833	3.25536	3.40007	1	0	0
13	60	73844	9340.5	3.03341	94548	0.000000	3.23411	7574	3.05143	3.05176	16080	3.23411	3.35554	1	0	0
14	61	76759	8534.9	3.90773	93496	0.603214	2.63893	8048	3.45531	3.05143	16588	2.63893	3.48698	1	0	0
15	62	76701	9318.8	3.15483	96418	0.632500	2.76696	8520	3.68936	3.45531	16293	2.76696	3.91994	1	0	0
16	63	76021	8556.7	3.26153	97961	0.390179	3.06554	9702	3.86656	3.68936	14843	3.06554	4.18065	1	0	0
17	64	74306	8404.3	3.71187	103018	0.679643	3.05875	9845	4.41742	3.86656	14836	3.05875	4.75788	1	0	0
18	65	74387	8556.7	3.96134	108015	0.667679	3.00411	9979	4.30114	4.41742	14152	3.00411	4.89512	1	0	0
19	66	77196	8534.9	4.15390	109736	0.934286	2.44893	10582	4.67089	4.30114	10394	2.44893	5.12236	1	1	0
20	67	77125	8143.0	3.98490	116564	0.573393	3.21107	11268	3.93706	4.67089	9450	3.21107	4.35881	1	1	0
21	68	78443	9275.2	3.54866	117524	0.978036	2.75964	11417	4.38182	3.93706	10913	2.75964	4.95000	1	1	0
22	69	78458	9297.0	3.33878	122657	0.963393	2.71857	12534	4.59816	4.38182	11883	2.71857	5.23618	1	1	0
23	70	79990	9057.5	3.82972	124654	0.938036	2.76143	13190	5.40141	4.59816	11945	2.76143	5.96998	1	1	1
24	71	80188	10102.6	3.49742	134000	0.602500	3.95393	12770	4.06580	5.40141	12355	3.95393	4.63096	0	1	0
25	72	79443	9209.9	3.75944	140000	0.856250	3.27071	13912	5.77073	4.06580	14001	4.06580	7.01996	0	1	0
26	73	78447	9079.3	5.55278	143000	0.389286	3.46464	14432	8.41463	5.77073	12480	5.77073	9.73392	0	1	0
27	74	69766	6510.1	6.11143	153000	0.000000	3.43625	13642	9.46641	8.41463	13699	8.41463	9.74633	0	1	0
28	75	73339	8143.0	4.80706	158000	0.000000	2.94232	10167	6.79449	9.46641	9493	9.46641	7.35620	0	1	0
29	76	74745	8099.5	4.46102	161000	0.000000	3.62518	12943	5.60698	6.79449	11656	6.79449	5.55826	0	1	0

VARIABLES USED IN UNITED STATES REGRESSION EQUATIONS.CONT.

OBS	YR	FBP	GSCPR	GSDDVP	GSDEPS	GSFP	GSFPL	GSP	HCR	IRRTX	JULPRC	MALTP	MCN	OATCOM	OFP	OFPL
1	48	26.79	0.929383	0.00000	2.64786	2.6322	.	2.6479	13.0	1160	130.2	1.40	22336	59872	2.57586	.
2	49	24.62	0.676736	0.00000	2.67446	2.5858	2.6322	2.6745	15.7	1711	107.9	1.50	22024	60492	2.48091	2.57586
3	50	28.88	0.698611	0.00000	2.61625	2.6231	2.5858	2.6162	13.7	1967	135.5	1.54	21944	57095	2.81243	2.48091
4	51	34.92	0.722154	0.00000	3.00982	3.2606	2.6231	3.0098	12.4	2231	125.9	1.50	21505	60030	2.75247	2.81243
5	52	32.37	0.993308	0.00000	3.34375	3.9702	3.2606	3.3437	11.0	2465	99.0	1.53	21338	58623	2.63405	2.75247
6	53	22.77	0.863836	0.00000	3.34268	3.2485	3.9702	3.3427	15.0	3064	104.1	1.50	21691	59228	2.65940	2.63405
7	54	23.45	0.851305	0.00000	2.92143	2.8758	3.2485	2.9214	15.0	3627	71.9	1.41	21581	58662	2.45516	2.65940
8	55	22.95	0.785908	0.00000	2.37321	2.3126	2.8758	2.3732	11.8	4018	101.0	1.26	21044	59713	2.07917	2.45516
9	56	21.93	0.876443	0.00000	2.69518	2.8128	2.3126	2.6952	11.2	4339	125.3	1.26	20501	59211	2.50790	2.07917
10	57	23.16	0.805183	0.00000	2.63089	2.4649	2.8128	2.6309	15.5	4569	113.6	1.24	19774	58008	2.21844	2.50790
11	58	27.07	0.823693	0.00000	2.88304	2.8173	2.4649	2.8830	18.6	4753	231.3	1.19	18711	59549	2.13047	2.21844
12	59	27.67	0.732408	0.00000	2.92750	2.9508	2.8173	2.9275	13.2	4778	90.3	1.16	17901	63987	2.49660	2.13047
13	60	25.90	0.758656	0.00000	3.44411	3.3810	2.9508	3.4441	15.1	4887	87.8	1.16	17515	63041	2.40586	2.49660
14	61	24.43	0.908174	0.76821	3.37464	4.4754	3.3810	3.3746	16.5	4889	153.0	1.41	17243	58576	2.66436	2.40586
15	62	26.92	0.856471	0.81750	3.59143	4.8161	4.4754	3.5914	16.0	4974	165.7	1.18	16842	55006	2.51386	2.66436
16	63	23.58	0.811946	0.50429	3.89446	4.8658	4.8161	3.8945	13.4	5135	145.4	1.18	16260	58773	2.62419	2.51386
17	64	22.41	0.831111	0.64446	3.80500	5.4583	4.8658	3.8050	13.1	5372	105.0	1.27	15677	59213	2.73357	2.62419
18	65	24.99	0.746712	0.81357	3.66625	4.9494	5.4583	3.6662	17.7	5262	106.9	1.32	14953	60852	2.65031	2.73357
19	66	25.71	0.749538	1.20554	2.83357	5.2510	4.9494	2.8336	18.5	4968	92.0	1.35	14071	62212	2.85205	2.65031
20	67	25.26	0.869352	0.82089	3.99375	5.4986	5.2510	3.9937	16.3	5273	96.1	1.24	13415	60075	2.79186	2.85205
21	68	26.87	0.780533	1.32375	3.39571	5.4786	5.4986	3.3957	17.9	5564	110.4	1.15	12832	61361	2.59223	2.79186
22	69	29.45	0.816588	1.27554	3.28625	5.9576	5.4786	3.2862	19.8	5442	176.7	1.08	12307	60776	2.47880	2.59223
23	70	29.36	0.777143	1.16964	3.13679	6.0732	5.9576	3.1368	19.1	5516	102.2	1.23	12000	61208	2.70482	2.47880
24	71	32.39	0.851548	0.73732	4.93286	5.3261	6.0732	4.9329	14.0	5793	124.5	1.16	11842	69165	2.50334	2.70482
25	72	35.78	0.718264	1.19786	4.10571	6.6270	5.3261	5.3261	22.1	5664	133.9	1.43	11698	65255	2.88994	2.50334
26	73	44.54	0.725133	0.72500	4.31500	9.2315	6.6270	6.6270	21.7	5941	144.5	2.67	11409	74791	3.97971	2.88994
27	74	41.89	0.890325	0.00000	4.19982	11.1111	9.2315	9.2315	12.2	6016	52.9	4.16	11219	77840	4.51549	3.97971
28	75	44.61	0.861332	0.00000	3.62821	8.1850	11.1111	11.1111	17.1	5907	68.5	3.52	11140	78134	3.70683	4.51549
29	76	39.11	0.881422	0.00000	4.32946	6.1377	8.1850	8.1850	17.5	6369	94.6	3.13	11049	80476	3.67619	3.70683

VARIABLES USED IN UNITED STATES REGRESSION EQUATIONS,CONT.

OBS	YR	OP	OMP	OWPR	PCEGG	PFNO	PPFCPR	PPFBPR	PPFER	PPFOPR	SAPLT	T	TOTDA	WFP	WMPL	WWIK
1	48	2.47844	2.64713	.	388	2.29573	33.4944	.	99	.	12617	1	0	3.79310	.	39669
2	49	2.68906	2.70755	0.708935	383	2.20582	30.6750	36.7149	102	39.5984	12456	2	0	3.83987	4.1954	42742
3	50	2.57000	3.00548	0.669294	389	2.64117	36.6673	34.9169	98	39.5016	15640	3	0	3.74322	4.4118	35586
4	51	2.61875	2.90718	0.699599	393	2.90971	28.6751	33.2018	103	36.6232	15655	4	0	3.44805	4.2673	38344
5	52	2.67031	2.80389	0.774441	390	2.72504	30.4895	34.9538	106	38.5109	16374	5	0	3.28958	3.9710	38065
6	53	2.68750	2.74885	0.816974	379	2.62026	27.9465	32.0813	107	40.6218	16719	6	0	3.71096	3.6516	37939
7	54	2.09781	2.53109	0.565299	376	2.50591	33.7046	33.6449	107	40.2346	18872	7	0	3.90208	4.1294	31255
8	55	2.25250	2.13462	0.577256	371	2.31895	30.9783	34.9306	105	42.7671	19981	8	0	3.87961	4.3622	29331
9	56	2.22969	2.69037	0.574719	369	2.26918	36.3224	39.1207	103	49.5389	21998	9	0	3.96825	4.2715	28444
10	57	2.23656	2.38268	0.553614	362	1.93582	41.6178	36.7228	104	41.4690	22186	10	0	3.96190	4.4517	22291
11	58	1.84312	2.27439	0.465212	354	1.96143	44.3869	42.4254	104	46.8797	25350	11	0	3.73166	4.4135	28085
12	59	1.93219	2.70558	0.517782	352	1.83209	31.6402	41.1286	103	48.3461	23349	12	0	4.18152	4.1368	28816
13	60	2.49000	2.49068	0.595478	334	1.74932	31.8480	41.3609	103	41.2561	24440	13	0	4.25095	4.7517	29614
14	61	2.57344	2.81047	0.605379	328	1.95374	39.7889	43.2780	105	43.6434	27787	14	25200	4.70389	4.7396	28739
15	62	2.61844	2.71110	0.556654	326	1.97370	37.5863	36.6855	104	39.0337	28418	15	28200	4.93971	5.2694	24800
16	63	2.74187	2.74568	0.555068	318	1.94829	33.5993	39.9625	103	40.9729	29462	16	24500	4.63659	5.4482	27243
17	64	2.59906	2.85833	0.560555	318	2.05744	33.6739	38.3729	103	39.2502	31721	17	32400	3.42843	4.8622	27596
18	65	2.55625	2.85481	0.745604	314	2.03754	34.2864	34.5700	103	37.6796	35227	18	34765	3.38855	3.9289	29135
19	66	2.70219	3.08811	0.797446	313	2.16339	41.6509	30.2928	102	38.4861	37294	19	34703	4.04567	4.0412	28444
20	67	2.66937	3.00881	0.659811	320	1.84442	31.1423	27.7377	100	35.0626	40819	20	22900	3.46858	4.5917	34752
21	68	2.73062	2.81692	0.787245	316	1.89678	34.0624	26.8958	94	33.6693	42265	21	32400	3.03342	3.9677	31577
22	69	2.69312	2.73598	0.887819	310	2.02337	32.0021	27.1772	87	33.5618	42534	22	39100	3.00973	3.5716	28158
23	70	2.35531	3.00907	0.782567	311	2.31038	31.8676	29.3621	88	35.5011	43082	23	37400	3.25885	3.4913	25229
24	71	2.25281	2.75300	0.691292	314	1.92916	23.0151	27.1829	91	33.6437	43472	24	18200	3.32936	3.8714	24885
25	72	2.50334	3.26744	0.751898	308	2.75018	23.1197	28.2456	94	37.5499	46885	25	36600	4.36898	3.9754	27246
26	73	2.86994	4.38330	0.661467	294	4.45968	17.6754	26.2384	102	35.2949	56675	26	9400	8.61017	5.6102	28715
27	74	3.97971	4.95844	0.462211	238	5.38512	19.8464	28.6587	167	41.9628	53507	27	0	7.93558	10.5284	33095
28	75	4.51549	4.21549	0.569018	279	4.52962	22.9232	32.7193	217	48.0568	54732	28	0	5.84478	8.3236	35833
29	76	3.70683	4.10075	0.634213	276	4.12053	27.2280	37.8439	185	49.9078	50327	29	0	4.31700	6.7174	36844

APPENDIX I

EXPLANATORY VARIABLES USED IN THE FOREIGN FEED GRAIN EQUATIONS

VARIABLES USED IN FOREIGN REGRESSION EQUATIONS

OBS	AF BOPD	AF CPROD	AF SPROD	AR AN	AR SOY	AR PCP	AR PCPL	AS AN1	AS AN2	AS POP1	AS POP2	AU FBP	AU FCP	AU FSP
1	3410	10160	8562	47524.4	1	2.3	2.2	91855.6	99999	1003325	1003351	32.06	76.51	31.27
2	1913	9761	8673	47198.7	1	3.0	2.3	88402.1	96664	1021187	1021214	42.36	58.27	31.45
3	3359	10390	9137	43947.6	10	3.4	3.0	87423.2	95424	1044780	1044808	39.96	60.42	21.70
4	3606	10942	8874	45932.7	19	4.8	3.4	85658.9	94013	1069332	1069360	40.17	67.53	27.88
5	3058	10989	8951	50427.3	12	6.0	4.8	85338.0	93370	1087269	1087299	40.78	66.89	29.18
6	2993	11716	8836	50619.7	16	6.0	6.0	85485.8	93674	1114082	1114113	44.63	83.30	28.01
7	1967	13111	7637	54482.7	16	7.5	6.0	83516.1	91241	1140994	1141026	42.83	62.60	27.28
8	3680	12453	9599	54945.6	17	11.7	7.5	81952.1	89861	1168716	1168749	43.11	61.22	31.91
9	6140	13047	7168	52194.6	20	12.4	11.7	83694.1	91774	1197192	1197226	34.53	69.13	27.40
10	4720	12810	9090	52229.2	28	14.6	12.4	81230.1	89214	1226334	1226369	29.54	54.43	36.75
11	4590	13406	9406	53382.4	26	13.5	14.6	83892.9	91995	1256045	1256082	42.15	52.06	28.87
12	4959	13491	9435	53575.8	36	14.0	13.5	84654.5	93046	1286944	1286981	35.01	50.98	43.19
13	5449	12746	8906	55730.6	68	20.4	14.0	85511.1	93115	1317981	1318020	52.60	58.46	40.38
14	34[illegible]	13908	8502	58303.8	157	47.0	20.4	89773.1	98186	1349645	1349684	59.39	86.52	63.69
15	4280	14375	9714	58859.0	334	67.0	47.0	92258.7	100240	1382347	1382388	75.05	87.29	70.65
16	4134	15246	9789	61525.4	356	316.0	67.0	91184.0	98410	1410324	1410365	77.80	98.54	78.53
17	5176	15005	9714	61038.8	434	1433.0	316.0	90655.4	97809	1445629	1445672	80.69	108.88	65.93

OBS	BZ WCPL	CH BOPD	CH CPROD	CH SPROD	CN WAH	CN WBP	DVAF	DVAR	DVAS	DVAU	DVCC	DVCH	DVECAN	DVNA
1	0.49	5100	13000	6359	9930	0.97	0	0	1	0	0	1	0	1
2	0.43	5990	15360	7878	10245	1.10	1	0	0	0	1	0	0	0
3	0.76	7034	19090	9643	10652	1.28	0	0	0	0	0	0	0	1
4	1.24	7294	20170	10267	11157	1.15	0	0	0	0	0	0	0	0
5	1.40	7506	21340	10881	12018	1.16	0	1	0	0	0	0	0	0
6	3.26	7289	22960	10768	11453	1.26	0	0	1	0	1	0	0	0
7	4.55	7936	24070	12556	12016	1.31	0	0	1	0	0	0	0	0
8	6.35	8851	26930	15139	12190	1.25	1	1	0	0	0	0	116716	0
9	8.54	8010	24680	14289	11908	1.15	0	0	1	0	1	0	118483	0
10	8.72	7607	24980	14179	10102	1.00	0	0	0	1	0	0	122627	1
11	13.23	7864	28290	15398	5052	1.10	0	0	0	1	1	0	123691	0
12	15.10	7917	27700	15199	7854	1.12	0	1	0	1	0	0	123528	0
13	17.98	6975	24570	14845	8640	1.50	1	0	1	1	0	1	122850	1
14	24.16	6829	27970	14950	9575	2.48	0	0	0	1	0	0	126916	0
15	31.62	6571	30700	14835	8935	2.73	0	1	0	1	1	0	129937	1
16	36.49	7367	32000	14542	9479	2.66	0	1	1	1	0	0	129431	0
17	40.68	7930	31400	14150	11252	2.32	0	0	0	1	0	1	128800	0

VARIABLES USED IN FOREIGN REGRESSION EQUATIONS ,CONT.

OBS	DVOCPOP	DVROEAN	DVRU	DVSAF	DVTAU	DVTH	DVT67	DVT72	DVUK	DV65	DV66	DV67	DV68	DV70
1	0	0.0	0	1	0	0	0	0	0	0	0	0	0	0
2	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0
3	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0
4	0	0.0	1	1	0	0	0	0	0	0	0	0	0	0
5	0	0.0	0	1	0	0	0	0	0	0	0	0	0	0
6	0	0.0	1	0	0	0	0	0	0	1	0	0	0	0
7	0	0.0	0	0	0	0	0	0	0	1	1	0	0	0
8	0	30287.1	0	1	0	0	8	0	0	1	1	1	0	0
9	0	30644.8	0	1	0	0	9	0	0	1	1	1	1	0
10	0	30495.4	0	0	10	0	10	0	0	1	1	1	1	0
11	0	30274.8	0	0	11	0	11	0	0	1	1	1	1	1
12	0	33095.0	0	0	12	0	12	0	0	1	1	1	1	1
13	20013	32799.8	1	1	13	1	13	13	0	1	1	1	1	1
14	20345	34529.5	0	0	14	0	14	14	1	1	1	1	1	1
15	20726	35126.2	0	0	15	0	15	15	1	1	1	1	1	1
16	20999	34366.7	1	1	16	0	16	16	1	1	1	1	1	1
17	21275	34642.1	0	0	17	1	17	17	1	1	1	1	1	1

OBS	DV71	DV72	DV75	DV76	EC AN	EC POP	EE AN	EE POP	EG LCP	FR AN	FR BP	FR BWPL	FR PDRI	FR POP
1	0	0	0	0	104709	231671	65621.4	116717	381	26166.5	6.63	.	100.0	45678
2	0	0	0	0	107333	233837	66896.5	116963	407	27328.9	6.43	0.836066	101.0	46158
3	0	0	0	0	106684	236373	63811.1	118349	402	27194.9	6.84	0.798758	104.0	46998
4	0	0	0	0	106337	238836	66642.5	119604	365	26797.6	6.64	0.825090	107.8	47853
5	0	0	0	0	109679	241747	67153.8	120470	365	26754.2	6.31	0.779343	109.3	48310
6	0	0	0	0	.111197	243956	68463.7	121392	416	27213.4	6.56	0.759747	110.5	48758
7	0	0	0	0	116055	245774	70255.6	122135	376	31107.6	7.14	0.824121	111.9	49164
8	0	0	0	0	116716	247324	71314.9	122859	416	30658.8	7.55	0.838028	112.7	49548
9	0	0	0	0	118483	248687	69590.8	123874	488	30686.1	7.62	0.821545	116.4	49914
10	0	0	0	0	122627	250067	69664.7	124889	414	31311.5	7.20	0.848552	121.7	50315
11	0	0	0	0	123691	251502	71856.0	125482	435	31722.2	7.48	0.867470	129.2	50770
12	1	0	0	0	123528	253062	73256.2	126478	446	31764.9	7.87	0.885207	138.3	51245
13	0	1	0	0	122850	254551	76202.1	127369	438	31038.4	8.29	0.891280	145.0	51703
14	0	1	0	0	126916	255999	79027.1	128259	468	32825.6	8.34	0.923163	159.6	52131
15	0	1	0	0	129937	257474	82831.9	129224	566	34165.6	9.97	0.873298	204.7	52510
16	0	1	1	0	129431	258424	85292.6	130004	685	34864.2	11.19	0.966085	225.3	52790
17	0	1	0	1	128800	259051	83835.3	130909	641	35049.7	12.80	0.935619	240.4	52920

VARIABLES USED IN FOREIGN REGRESSION EQUATIONS ,CONT.

OBS	FR WP	ID WAH	ID WBP	ID WCP	ID WCPL	IT AN	IT POP	IT LCP	JP POP	NA AN	NA POP	NL AN	NL POP	OC POP
1	7.93	13380	28.8	30.5	35.7	14338.9	49571	.	94.10	50533.6	20.975	6253.0	11477	16000
2	8.05	12927	28.0	33.6	30.5	14171.8	49830	6.66	94.95	50486.8	21.528	6309.8	11637	16123
3	8.29	13570	25.6	30.9	33.6	14072.8	50170	6.68	95.83	52123.4	22.141	6212.2	11797	16459
4	8.52	13590	32.9	30.8	30.9	13824.3	50457	7.66	96.61	54390.1	22.770	6272.7	11967	16802
5	7.89	13459	53.9	49.0	30.8	14693.3	51600	7.68	97.93	56949.7	23.410	6600.2	12124	17158
6	7.96	13422	59.8	64.2	49.0	14973.3	51944	7.57	98.88	59546.3	24.024	6961.9	12292	17508
7	8.52	12572	62.3	62.2	64.2	14949.8	52332	7.94	99.79	61778.6	24.633	7190.1	12455	17853
8	9.19	12838	72.9	103.6	62.2	15374.7	52667	7.44	100.83	63206.7	25.350	7484.1	12597	18193
9	8.58	14998	47.0	60.4	103.6	16299.8	52987	8.14	101.96	64617.7	26.021	7766.2	12725	18518
10	8.30	15958	57.3	64.3	60.4	16952.2	53330	8.95	103.17	65548.3	26.715	8353.4	12873	18893
11	8.45	16626	44.3	66.8	64.3	15948.6	53660	9.32	104.34	67839.9	27.410	8589.8	13032	19281
12	8.53	18241	45.5	62.4	66.8	15948.0	54010	9.60	105.69	70038.2	28.024	8633.9	13154	19658
13	8.98	19139	71.5	80.0	62.4	15450.3	54410	9.26	107.18	71439.4	28.735	8724.4	13330	20013
14	9.55	19463	107.3	132.3	80.0	15473.0	54900	9.52	108.70	71877.1	29.455	9226.6	13438	20345
15	10.32	18583	136.0	123.9	132.3	15299.1	55360	10.52	110.16	73680.1	30.246	9719.7	13540	20726
16	11.96	18010	76.5	116.0	123.9	15401.4	55810	12.78	111.57	75415.4	31.040	10110.9	13653	20995
17	13.45	20112	75.0	83.0	116.0	15775.7	56190	13.85	112.77	75947.8	31.845	10242.8	13770	21278

OBS	ROE AN1	ROE AN2	ROE POP	RU AN	RU CPROD	SA CPROD	SA SOY	SA POP	T	TH POP	TLOG	UK BP	UK CBPR
1	49337.8	31433.2	46.647	112.549	9823	16456	214	143.040	1	26.39	0.00000	1.44	14.4444
2	48355.5	30241.4	46.982	115.623	17113	17299	255	147.155	2	27.10	0.69315	1.38	14.4928
3	48595.1	30673.4	47.368	125.388	15474	17457	331	151.289	3	27.83	1.09861	1.38	14.2029
4	49575.1	30442.1	47.661	132.338	11143	17389	365	155.604	4	28.50	1.38629	1.34	16.4179
5	47868.5	28980.8	47.978	115.111	13849	20091	392	159.837	5	30.08	1.60944	1.31	17.0229
6	47772.0	28935.5	48.232	121.962	8030	21438	473	164.872	6	31.03	1.79176	1.24	18.8710
7	48914.6	29839.9	48.526	130.494	8416	23960	540	168.748	7	32.00	1.94591	1.23	19.2683
8	49105.6	30287.1	48.859	134.954	9163	22481	674	173.010	8	33.00	2.07944	1.22	18.8525
9	49723.5	30644.8	49.161	133.401	8828	22537	781	177.455	9	34.04	2.19722	1.26	18.7302
10	50494.5	30495.4	49.483	131.894	11954	26892	976	181.990	10	35.11	2.30259	1.30	19.7692
11	50599.9	30274.8	49.635	134.934	9428	27326	1395	186.680	11	36.37	2.39790	1.39	21.5827
12	53163.8	33095.0	49.867	144.779	8597	23870	1695	191.763	12	37.49	2.48491	1.45	19.5862
13	5351[illegible].3	32799.8	50.220	151.029	9830	25995	2426	196.545	13	38.59	2.56495	1.56	17.3077
14	55514.7	34529.5	50.443	151.697	13216	29245	3755	201.694	14	39.69	2.63906	2.65	17.8868
15	56366.7	35126.2	50.957	156.653	12142	27119	5331	206.910	15	40.78	2.70805	2.95	22.6780
16	55144.7	34366.7	51.721	161.550	7328	27171	6092	212.495	16	41.87	2.77259	3.24	17.6852
17	55143.7	34642.1	51.958	156.027	10260	30897	6674	217.894	17	42.96	2.83321	4.19	13.0549

VARIABLES USED IN FOREIGN REGRESSION EQUATIONS ,CONT.

OBS	UK CP	UK OFU	UK POP	US ECP	US ECPL	US ESP	US ESPL	WG AN	WG BP	WG PDR1	WG WP	YU CP	YU LCP
1	20.8	5978	52518	1.27	1.36	1.88	1.89	21991.7	8.98	84.9	10.61	24.9	24.1
2	20.0	5740	52980	1.29	1.27	2.12	1.88	23195.8	9.19	87.3	10.90	28.0	24.9
3	19.6	6483	53441	1.38	1.29	2.20	2.12	23074.6	9.41	90.3	11.02	33.2	28.0
4	22.0	7128	53812	1.39	1.38	2.20	2.20	22771.2	9.75	92.8	11.00	36.4	33.2
5	22.3	7454	54156	1.42	1.39	2.18	2.20	23622.5	9.75	94.2	10.99	50.0	36.4
6	23.4	7386	54520	1.43	1.42	2.17	2.18	24116.7	9.88	97.2	11.13	60.0	50.0
7	23.7	7591	54789	1.45	1.43	2.36	2.17	24540.3	9.74	99.2	11.13	61.0	60.0
8	23.0	7787	54957	1.22	1.45	2.20	2.36	25176.1	9.10	95.6	10.50	59.0	61.0
9	23.6	8084	55164	1.30	1.22	2.18	2.20	25114.4	8.55	96.7	9.76	60.0	59.0
10	25.7	8801	55318	1.42	1.30	2.30	2.18	25795.9	8.60	96.9	9.83	59.0	60.0
11	30.0	7753	55480	1.56	1.42	2.59	2.30	26397.4	9.12	100.0	10.02	73.0	59.0
12	28.4	9035	55712	1.34	1.56	2.39	2.59	26398.0	8.96	105.0	10.09	111.0	73.0
13	27.0	8388	55882	2.18	1.34	3.73	2.39	25572.7	9.48	109.9	10.56	117.0	111.0
14	47.4	8694	56021	3.12	2.18	5.07	3.73	25854.4	10.44	122.2	11.70	108.0	117.0
15	66.9	7735	56226	3.26	3.12	5.63	5.07	26462.3	11.96	131.1	12.85	177.1	108.1
16	57.3	7135	56146	2.98	3.26	5.05	5.63	26241.3	12.88	138.7	14.03	231.0	177.1
17	54.7	7063	55970	2.59	2.98	4.24	5.05	26085.8	15.19	147.8	16.61	237.0	231.0

VITA

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