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# Pricing in the World Feed Grain Market <sup>1</sup>

By Alex F. McCalla

CONTINUING ATTENTION is being given to possible international arrangements in the Temperate Zone for grain-livestock trade. Such arrangements may be more meaningfully derived if a knowledge of past and present pricing arrangements is available. This article reports an attempt to formulate a conceptual framework useful in exploring past feed grain price behavior and for suggesting important variables, structural and behavioral, likely to affect future price movements.<sup>2</sup> Not surprisingly, the United States emerges as the dominant pricing factor in the world market.

## The Nature of the Feed Grain Market

Taken as a group, feed grains (corn, barley, oats, millets and sorghums, and mixed grains) occupy twice as much acreage as wheat and yield more than twice the volume.<sup>3</sup> Nearly 30 percent of world wheat production enters inter-

national channels, but only about 8 percent of feed grain production enters these channels.<sup>4</sup> However, only about half of feed grain production enters any market channel (the remaining half is fed on farms where it is grown). This means that about 16 percent of marketed feed grains enter world markets. Corn constitutes 50 percent of world trade, barley 25 percent, and other grains the remainder. The volume of feed grain trade has risen rapidly in the last 15 years.

The majority of the trade in feed grains consists of exports from the Americas to Western Europe. The United States exports approximately 55 percent of the corn, 20 to 25 percent of the barley, 10 to 30 percent of the oats, and 70 to 75 percent of the millets and sorghums entering world trade. Argentina exports 12 to 18 percent of the corn, 10 to 15 percent of the oats, and 15 to 18 percent of the millets and sorghum. Canada in some years is a substantial exporter of barley and oats but an importer of corn. Australia, the U.S.S.R., and the Union of South Africa are the other major exporters. The European Economic Community (EEC) imports 40 percent of the corn, 40 percent of the barley, 60 percent of the oats, and about 40 percent of the millets and sorghums entering world channels. The European Free Trade Association (EFTA), of which the United Kingdom is the dominant importer, accounts for about 20 percent of the corn, 15 percent of the barley, 20 percent of the oats, and 15 percent of the millets and sorghums entering trade. Japan is the only other major importer of feed grain. In summary, then, the United States exports more than 50 percent of all feed grains entering world trade, while the EEC and the United

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<sup>2</sup> For a similar attempt with respect to wheat, see Alex F. McCalla, "A Duopoly Model of World Wheat Pricing," Jour. Farm Econ. Vol. 48, No. 3, part 1, August 1966, pp. 711-727.

<sup>3</sup> See Food and Agriculture Organization of the United Nations (FAO), The Stabilization of World Trade in Coarse Grains, *Commod. Policy Study 14*, Rome, 1963, table 1. Coarse grains include the feed grains listed above plus rye. The relatively minor importance of rye in production and trade makes the distinction unimportant.

<sup>4</sup> See FAO, *The Stabilization of World Trade . . .*, table 6, p. 20.

Kingdom import more than 60 percent of all feed grains.<sup>5</sup>

## The Complexity of the Feed Grain Sector

A conceptualization of the world feed grain market, which is an aggregation of surpluses and deficits from domestic feed grain sectors, is made difficult by three factors: (1) Feed grains are not a homogeneous product, though their similarities with respect to livestock feed use require joint treatment; (2) the demand for feed grains is a conglomerate of direct demand for food and industrial uses and derived demand for feed uses; and (3) in contrast with wheat and meats, large proportions of feed grain production never enter market channels.

Recent studies indicate a high degree of substitutability among the various grains classified as feed grains.<sup>6</sup> The FAO study suggests that the high interchangeability among feed grains for feeding purposes results from "the common nutrition properties and the similar content of net energy value in various grains . . ." which makes possible the compounding and feeding of grain rations of widely varying composition to the same types of livestock in different countries with generally satisfactory results.<sup>7</sup> The FAO report concludes that the major factor determining substitution is the relative price of various grains. Given this high degree of substitutability, it follows that prices of various feed grains move together over time,<sup>8</sup> though short-term variations among feed grains may occur as a result of variations

<sup>5</sup> These percentages are derived from data in the FAO Trade Yearbook, Vols. 1-18, 1947-1964.

<sup>6</sup> See FAO, *The Stabilization of World Trade . . .*, p. 6; also the study of the British feed industry in appendix B, *Ibid.*, pp. 1-24; and R. J. Foote, J. W. Klein, and M. Clough, *The Demand and Price Structure for Corn and Total Feed Concentrate*, U.S. Dept. Agr., Tech. Bul. 1061, Oct. 1952, p. 21.

<sup>7</sup> Depending on relative prices, soft wheat may become substitutable as a feed grain. However, nearly all wheat entering international trade is for human consumption. For this reason, feed-wheat relationships are disregarded in this analysis.

<sup>8</sup> Foot, Klein, and Clough, *loc. cit.*

in the supplies of individual feed grains.<sup>9</sup> In the following analysis, secular movements in prices of corn--the dominant traded feed grain--are assumed to be representative of feed grain prices.

The final demand for feed grains is a composite of direct demand for food, industrial and export uses, and derived demand for feed grains. During 1958-61, 66 percent of the total world feed grain production was used for livestock feed, 24 percent for food, and 4 percent for industrial purposes; while 6 percent went for seed, wastes, and losses.<sup>10</sup> It is likely, however, that the proportion of feed grain production utilized in livestock feeding is substantially higher in the developed nations under study here. Table 1 shows the allocations of U.S. feed grain output to various uses. The combined feed and export use in 1965 was 94.1 percent, an increase over the 1959-63 average of 91.0 percent. These data also suggest an increase over time in the proportion of feed grains used for livestock purposes. Foote, Klein, and Clough<sup>11</sup> found that the nonfeed uses of corn from 1921 to 1942 were nonresponsive to price changes. These two factors--the high and rising proportion of production utilized for feeding purposes and the nonresponsiveness of nonfeed uses to price changes--tend to justify the assumption that the domestic and international demand for feed grains is predominantly a demand derived from the demand for meat.

The demand-supply situation with respect to feed grains is further complicated by the fact that only about half of feed grain production enters market channels, while the other half is fed on the farm where it is raised.<sup>12</sup> The pro-

<sup>9</sup> See Kenneth W. Meinken, *The Demand and Price Structure for Oats, Barley, and Sorghum Grains*, U.S. Dept. Agr., Tech. Bul. 1080, Sept. 1953, pp. 65-74.

<sup>10</sup> FAO, *The Stabilization of World Trade . . .*, p. 4; also see FAO, "Grains: Recent Trends in Utilization," *Monthly Bul. Agr. Econ. and Statis.*, Vol. 11, May 1962, pp. 6-9.

<sup>11</sup> Foote, Klein, and Clough, *op. cit.*, pp. 19-20.

<sup>12</sup> FAO, *The Stabilization of World Trade . . .*, table 7, p. 22, for proportions marketed in selected countries. In 1965, the U.S. proportions used on farms were: corn, 25 percent; oats, 68 percent; barley, 26 percent; and sorghum grain 24 percent (U.S. Dept. Agr., *Feed Situation*, ERS, June 1966, p. 13).

Table 1.--U.S. feed grain production and utilization, average 1959-63 and 1965

Commodity and years	Production	Utilization as percent of production		
		Livestock feed	Food and industrial	Exports
Corn:	<i>Mil. bu.</i>	<i>Percent</i>	<i>Percent</i>	<i>Percent</i>
Average 1959-63.....	3,818	82.0	7.6	9.8
1965.....	4,171	77.2	8.0	17.4
Oats:				
Average 1959-63.....	1,044	87.5	3.9	2.4
1965.....	959	79.8	4.6	3.6
Barley:				
Average 1959-63.....	418	58.4	22.2	20.3
1965.....	412	56.1	<sup>1</sup> 24.8	17.0
Sorghum grain:				
Average 1959-63.....	550	74.9	2.0	17.8
1965.....	666	75.8	1.7	<sup>2</sup> 35.5
Total	<i>Mil. tons</i>			
Average 1959-63.....	149.0	80.5	7.6	10.5
1965.....	160.7	76.0	7.9	18.1

<sup>1</sup> Reflects rising use as malt.

<sup>2</sup> Reflects reduction of stocks.

Source: U.S. Dept. Agr., Feed Situation, ERS, June 1966, p. 9.

portion marketed varies from region to region, country to country, and grain to grain. Since most of the feed grains used for food, industrial, and export purposes pass through market channels, the relative importance of these uses in commercial sales of feed grains is greater than the disposition data would suggest. In some areas, feed uses of certain grains predominate, for example, corn in rural Argentina; in other areas, industrial uses may predominate, as malting barley does in certain areas of the United States and Canada. It is, therefore, most difficult to arrive at a global statement with respect to the proportion of feed grains marketed. An early study by Phillips<sup>13</sup> has shown that a high percentage of the variation in corn marketed from the North Central region of the United States from 1926 to 1945 was associated with variations in livestock numbers. This

<sup>13</sup> Quoted in Foot, Klein, and Clough, op. cit., p. 31.

result is sometimes projected to argue that marketed feed grains are a residual and that such marketing is not responsive to price. These two characteristics, it is further argued, imply a market which is inherently unstable. If farmers are rational maximizers, however, there is an economic choice as to whether to market corn or feed it. Clearly, the corn-hog cycle is an exemplification of the adjustments farmers make to changing price relationships. Further, since it has been argued that the demand for feed grains is derived from the demand for meat, the choice of the grower-feeder to feed corn is based on the same demand relation as that of a feeder to buy corn.<sup>14</sup> Although it is recognized that the

<sup>14</sup> See FAO, The Stabilization of World Trade . . . , ch. 17, for the parallel relationship between animal units, feed grain production, and feed utilization in the United States.

nonmarketed proportion of production contributes to increased instability, for the remainder of this study it is assumed that total feed utilization is a derived function from the demand for livestock products.

## The Model

Simplifying assumptions which abstract from detailed reality are made so that a working theoretical model may be developed. These assumptions are examined in the next section of the paper as to their general validity and as to the importance of some exceptions which arise. The following structural assumptions are made:

1. The U.S. market for feed grains is essentially competitive in the sense that trading is conducted by many firms. It is clear, however, that the stocks of feed grains held by the Commodity Credit Corporation (CCC) have constant potential influence on prices in the U.S. market, as does land held out of production by farm programs. But this influence is indirect with respect to export pricing whereas the influence of wheat export subsidies is direct.

2. Given the volume and stock dominance of the United States, the price-setting market for world trade in feed grains is assumed to be the U.S. market. The validity of this assumption will be investigated in detail as the argument proceeds. Net export supplies and net import demands, as determined by world prices and national policies, influence world trade by direct interaction with U.S. domestic supply and demand.

The following behavioral assumptions are made:

1. Nations participating in the international market for feed grains act in a fashion consistent with domestic agricultural programs. In pursuance of domestic objectives, the U.S. Department of Agriculture does, by acquisition or disposal of stocks and the alteration of acreage diversions, attempt to maintain price within a range generally from the loan rate to some policy-determined maximum price which is at least 105 percent of loan rate. The United States can be considered the residual supplier in the world market. This behavioral assumption is based on the fact that the United States

has been willing to store current production or dispose of it in other fashions rather than attempt, through price cutting, to sell current production in the commercial export market. Therefore, the United States can be considered as filling the market remaining after other suppliers have dissipated their current production.<sup>15</sup>

2. The international supply of feed grains is a product of competitive agricultural sectors composed of rational profit-maximizing farmers, as modified by domestic agricultural programs.

3. National governments exercise market power as market units only to the extent of their willingness and ability to influence world price behavior.

4. Private traders operating in both domestic and international markets are rational profit maximizers.

Given the assumption that the U.S. market is competitive, and that it is the world price-setting market, the conceptualization of a world demand function, a world supply function, and a world pricing mechanism is outlined.

Consider first the demand side. The major importers of feed grains are the EEC--considered as a unit because of the Common Agricultural Policy (CAP), the United Kingdom, and Japan. Each must be considered separately. Given the nature of the EEC's agricultural policy, the demand for imports is completely inelastic with respect to world price so long as the world price is below the EEC threshold price. This is demonstrated in figure 1(a), where Deec-Deec is the domestic demand as a function of internal prices and Seec-Seec is domestic supply as a function of internal prices.  $P_0$  is equilibrium price in the absence of trade. However, since the EEC is deficient in feed grains at present CAP prices,  $P_1$  is introduced as the threshold and target price (assume these

<sup>15</sup> Argentine corn normally commands a premium over U.S. corn in European markets. This premium reflects quality. The EEC has administratively quantified this premium. When calculating variable levies on corn imports, it deducts a quality premium of \$1.25 per metric ton of Plata (Argentine) corn before determining the "standardized" c.i.f. price for corn. The "standardized" c.i.f. price is the subtrahend to be deducted from the threshold price in calculating the variable import levy; see *Journal Officiel des Communautés Européennes*, no. 66, p. 1867/62, July 28, 1962.

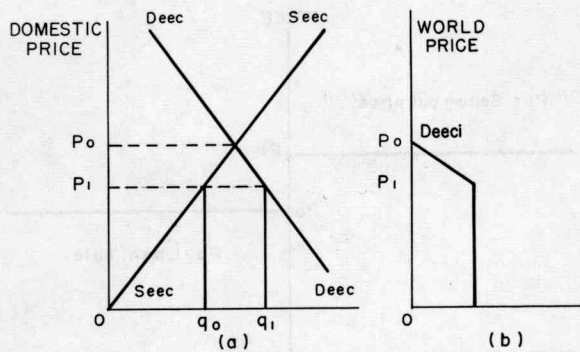


Figure 1.--Derivation of EEC net demand.

prices are the same for this analysis). At  $P_1$ ,  $Oq_0$  is produced and  $Oq_1$  is demanded; the difference  $Oq_1 - Oq_0$  is made up by imports. For world prices below  $P_1$ , a variable levy is applied equal to the difference between world price and target price. Thus, for prices below  $P_1$ , the import demand for feed grains as a function of world prices is totally inelastic (as shown in figure 1(b)). That is, regardless of the level of world price below  $P_1$ , the EEC will purchase only  $Oq_1 - Oq_0$ . At prices above  $P_1$  but below  $P_0$ , import demand is equal to the difference between domestic supply and demand. Thus,  $Deeci$  in figure 1(b) represents the demand for imports by the EEC as a function of world price.

In the United Kingdom, where a system of deficiency payments plus minimum threshold prices constitutes feed grain policy, a similar derivation can be made. Given domestic supply and demand functions  $S_{uk} - S_{uk}$  and  $D_{uk} - D_{uk}$  in figure 2(a),  $P_0$  would be the equilibrium price without trade. If  $P_1$  is the announced support price, then  $q_1$  is produced. The difference

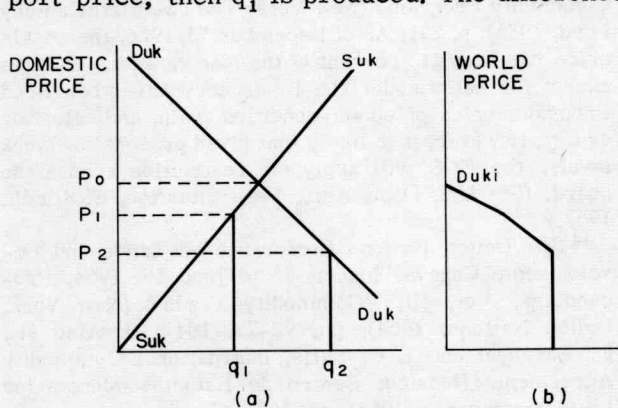


Figure 2.--Derivation of U.K. net demand.

between  $P_1$  and market price is made up by the deficiency payment. If minimum threshold price is  $P_2$ , world prices below  $P_2$  have no influence on British price or quantity, thus yielding a perfectly inelastic demand function, as was the case in the EEC (figure 2(b)).

If the world price is between  $P_1$  and  $P_2$ , then the segment of the demand curve  $D_{uk} - D_{uk}$  between its intersections with price lines  $P_1$  and  $P_2$  is the locus for the intersection with any price line within that range. The perpendicular through such an intersection indicates the total quantity demanded in the United Kingdom. The horizontal difference between such a perpendicular and the perpendicular through  $q_1$  indicates the demand for imports. The import demand function shown in figure 2(b) has three distinct segments resulting from the nature of the United Kingdom's agricultural policy.

In other importing countries such as Japan, which has state trading in small grains and relatively free entry of corn, similar constructions for the derivation of net import demand can be accomplished. Given the assumption that the U.S. feed grain market is the price-setting market for the world, these individual net import demand functions can be added to the U.S. domestic demand to yield a "world demand function."

A symmetrical construction is possible on the supply side. Given domestic supply and demand functions  $S_d - S_d$  and  $D_d - D_d$  in figure 3(a), in each country equilibrium price without trade is  $P_0$ . If world price is above  $P_0$ , then export availability is the difference between  $S_d - S_d$ , and  $D_d - D_d$  is depicted in  $S_e - S_e$  in figure 3(b). In complete symmetry, and in the absence of

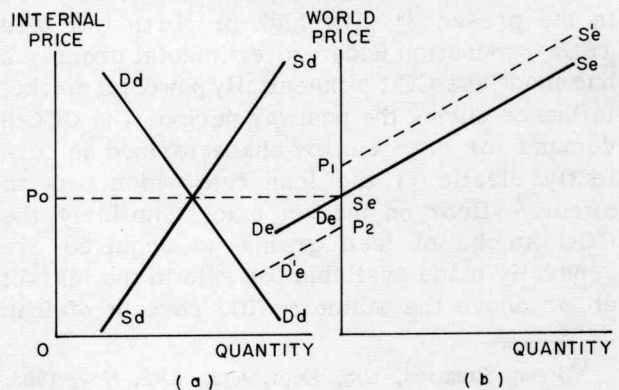


Figure 3.--Derivation of net export supply.

transfer costs or import restrictions,  $D_e - D_e$  is a net export demand for world prices below  $P_0$ . In reality, the spatial separation of exporters and importers, which results in transport costs, creates a certain price range over which a country is neither an exporter nor an importer. This is shown by the curves  $P_1 - S_e'$  and  $D_e' - P_2$  where, in figure 3(b), for example, the Argentine market would be isolated from the world market for world prices between  $P_1$  and  $P_2$ . Domestic programs, tariffs, and quantitative restrictions also have a tendency to isolate domestic markets. The implication of this discontinuity is that surpluses available for export would be highly variable, given year-to-year variations in domestic supply. Evidence presented later will tend to substantiate this point. The net export supply functions constructed as above can then be added to the U.S. domestic supply function to make a world supply function.

The world supply and demand functions, derived in the above fashion, would interact in the U.S. market to determine a world equilibrium price. But the nature of U.S. domestic farm policy introduces an additional price-influencing factor into the market. Given the first behavioral assumption above, the Commodity Credit Corporation has potential market power through acquisition and disposal of stocks of feed grains and, in the longer run, by alterations in diversion programs. Clearly, the CCC is committed to purchase unlimited stocks of feed grains at the loan rate. This commitment has varied. It was made to all producers from 1948 to 1955 and from 1959 to 1960, to compliers and noncompliers at differential rates from 1956 to 1958, and to compliers only from 1961 to the present.<sup>16</sup> The high proportion of feed grain production under governmental programs has made the CCC a potentially powerful market influence during the postwar period. The CCC's demand for corn can be characterized as perfectly elastic at the loan rate which sets an effective floor on market price. Similarly, the CCC stocks of feed grains so acquired are generally made available for sale in the market at or above the statutory 105 percent of loan

<sup>16</sup> Feed Situation, U.S. Dept. Agr., ERS, Nov. 1965, p. 41.

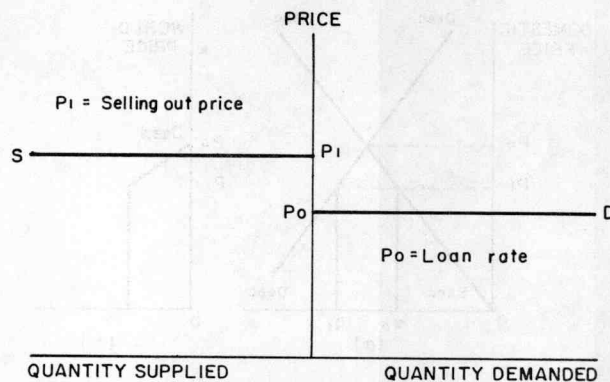


Figure 4.--CCC Operations in feed grains.

rate.<sup>17</sup> These stocks to the limit of their availability, hanging over the market, by their very existence have a moderating influence on price and, when sold, a direct effect on feed grain prices. It is argued, then, that the CCC is a perfectly elastic (to the limit of stocks) supplier of corn at the policy-determined selling-out price. The nature of the CCC in the market is shown in figure 4. If the market-determined price falls within the price range  $P_1 - P_0$ , the CCC does not enter the market; at  $P_0$  it buys and at  $P_1$  it sells. Thus, it is argued, the CCC acts as a buffer stock agency in the United States and world feed grain markets. Its operations are analogous to the operation of the International Tin Agreement.<sup>18</sup>

The model, as a conceptualization of the world feed grain market, is complete. Net exportable surpluses and deficits, as determined by market and policy factors, are projected into the U.S.

<sup>17</sup> See M. R. Benedict and O. C. Stine, *The Agricultural Commodity Programs* (New York: The Twentieth Century Fund, 1956), p. 221. As of December 23, 1966, the resale price has been 115 percent of the loan rate plus charges except for sales under the Emergency Livestock Feed Program, sales of out-of-condition grain, and sales for export. However, it is likely that given present low stock levels, the CCC will apply the restriction across the board. (See U.S. Dept. Agr., *Feed Situation*, ERS, Feb. 1967.)

<sup>18</sup> See United Nations Conference on Trade and Development, Geneva, March 23 to June 16, 1964, *Proceedings*, Vol. III: "Commodity Trade" (New York: United Nations, 1964), pp. 92-93, 104-110. Also see L. Baranyai and J. C. Mills, *International Commodity Agreements* (Mexico: Centro de Estudios Monetarios Latinoamericanos, 1963), pp. 128-147.

## The Model and the Postwar Grain Market

feed grain market where domestic and world price is discovered and, to a large degree, determined. If price so determined falls between the price range bounded by the U.S. loan rate and the selling-out price, the CCC is not active in the market. If price should move outside this range, the CCC acts by purchase or sale to move price back into the range. Thus, world price is stabilized by U.S. action between U.S. policy parameters. The world picture is presented in figure 5, which combines the essential elements of the model.  $S_{us} - S_{us}$  and  $D_{us} - D_{us}$  are U.S. domestic supply and demand functions.  $S_w - S_w$  is the world supply function derived by adding net export supply from other exporters to U.S. supply. It becomes horizontal at  $P_0$ , which is the CCC selling-out price. Similarly,  $D_w - D_w$  is a world demand function which becomes perfectly elastic at  $P_1$ , the U.S. loan rate. As  $S_w - S_w$  and  $D_w - D_w$  are drawn, price  $P_2$  is established without CCC action. If, however, world demand was  $D_w^2 - D_w^2$ , price would be at  $P_0$  rather than  $P_3$  as CCC stocks were sold into the market. If world supply were  $S_w^2 - S_w^2$ , price would be  $P_1$  rather than  $P_4$ , as the CCC took possession of stocks placed under support programs. World price is determined in the U.S. market, and it is in turn influenced by domestic price support operations. The important policy parameters are, therefore, the U.S. loan rate, the selling-out price for feed grain stocks, and the acreage diversion requirements for feed grain programs.

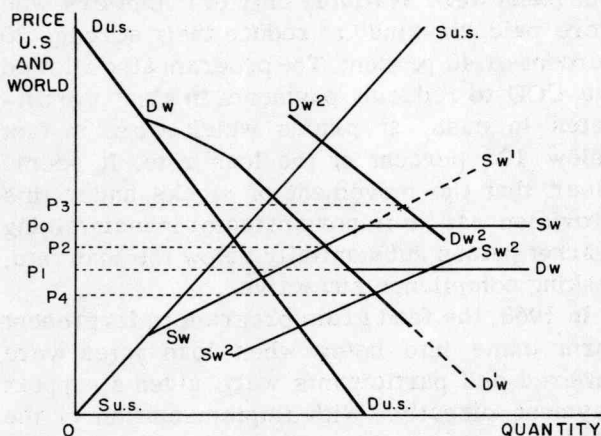


Figure 5.--The feed grain model.

In an attempt to relate the model to postwar conditions, the structural assumptions and the major behavioral assumption about the role of the CCC will be discussed in the context of U.S. feed grain policy. The assumption of the competitive nature of the U.S. feed grain market rests on two basic facts. First, the total volume of trade in the market is performed by private traders in sufficient numbers to make the market competitive. Second, the large proportion of production which either is not marketed or is involved in interfarm transactions depends on the decisions of many small (in relation to the total market) farm units. The potential market power of the CCC follows directly from the substantial stocks, sometimes as much as one-third of production, that the CCC holds as a result of support activities.<sup>19</sup> Despite the fact that in 1966-67 stocks have fallen substantially (to about 118 million bushels of corn as of January 1, 1967), the productive potential held in abeyance by Government programs will continue to cause policy decisions by the U.S. Department of Agriculture to have profound influences on U.S. and world market conditions.

The second structural assumption, namely that the U.S. feed grain market is the price-setting market, rests primarily on the fact that the United States produces between 45 and 50 percent (more than 60 percent of corn production) of world feed grain production and exports more than 50 percent (55 percent of corn) of the feed grains entering international channels.<sup>20</sup> This production and trade dominance, the relatively high degree of integration between the domestic and international market, and the role of the CCC as market participant argues strongly for the proposition that world price is discovered and, to a large degree, determined

<sup>19</sup> See U.S. Dept. Agr., Agricultural Statistics, 1965, table 49, p. 37, for CCC stocks of corn as of September 30 for 1954-62 (highest volume 1.371 billion bushels in 1960), and U.S. Dept. Agr., Feed Situation, ERS, June 1966, p. 30, for 1963-66.

<sup>20</sup> See FAO, The Stabilization of World Trade . . . , table 1, p. 2, and table 8, p. 23.



by conditions in the U.S. market. The integration follows from the fact that the United States places few import restrictions on feed grain imports and, since 1961, has not paid export subsidies on feed grains.<sup>21</sup> Further, the existence of large and continuous stocks has placed the United States in a strong position in a world market which in the prewar and immediate postwar period was characterized by highly variable export availability from other suppliers.

The major element of the above model which needs careful consideration is the first behavioral assumption regarding the CCC. (Behavioral assumptions 2, 3, and 4 are widely held assumptions common to economic analysis and are not discussed.) The nature of CCC operations has been, is, and will continue to be dictated by the nature of domestic feed grain policy. It will be worthwhile, then, to review the nature of feed grain support since 1948.

From the beginning of the war until 1948, average prices received by farmers were continuously above the average support prices, resulting in little Government activity in the feed grain market. The year 1947 was a transitional year as national average corn price support rose from \$1.15 to \$1.37 per bushel, but average price received by farmers rose from \$1.53 to \$2.16 per bushel. The result was that 1 percent of production was placed under price support. In 1948, price support rose to \$1.44 per bushel, while average price received

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<sup>21</sup> It is true, however, that the United States has sold some quantities of feed grains under P.L. 480 programs. These disposals have had a price-buoying effect in the sense that they have lessened price-depressing CCC stocks. However, the magnitude of these sales relative to commercial exports has never been large, thus, their price implications have likely been small. For quantification of the last 3 years, see Eleanor N. DeBlois, "High Level Dollar Exports Boost Total Exports of U.S. Farm Products for Second Consecutive Fiscal Year," U.S. Dept. Agr., ERS-Foreign 150, Jan. 1966, pp. 15, 25, and 26; and Eleanor N. DeBlois, "Increased Dollar Exports in Fiscal Year 1965-66 Bring U.S. Exports of Farm Products to Record Level for Third Consecutive Year," U.S. Dept. Agr., ERS-Foreign 177, Nov. 1966, pp. 24, 38, and 39.

fell to \$1.28 per bushel as postwar shortages were rapidly overcome by rising production in North America and Western Europe. The result was the beginning of heavy Government purchases of corn and feed grains. With the exception of 1950 and 1951 (the first 2 years of the Korean conflict), the loan, acquisition, and stock activities of the CCC have been important factors in the U.S. market. From 1948 to 1954, price supports on corn were available to all producers, and CCC stocks of corn rose from almost zero to 622 million bushels. In 1954, acreage allotments were resumed, and in 1956 the Soil Bank Program which resulted in a differentiation in support rates was made between compliers and noncompliers, but the compliers' support rate remained high (\$1.50 in 1956, \$1.40 in 1957, and \$1.36 in 1958). The loan rate was dropped to \$1.12 per bushel in 1959 and to \$1.06 per bushel in 1960, but loans were available to all producers. Despite the lowering of support rates and the constant decline in market prices, production and CCC stocks continued to rise, with stocks standing at 1.37 billion bushels of corn on September 30, 1960.

From 1948 through 1960, exports of feed grains more than doubled, but, because of the high level of price support in relation to world prices, export subsidies were paid on corn and sporadically on other feed grains from 1954 to 1961. The Emergency Feed Grain Program of 1961 raised the loan rate to \$1.20 per bushel. But loans were available only to compliers, who were paid "in kind" to reduce their acreage 20 percent or 40 percent. The program also allowed the CCC to redeem "payments in kind" certificates in cash, at prices which were in fact below 105 percent of the loan rate. It seems clear that the movement of stocks under this provision was an important factor in maintaining market prices substantially below the loan rate, making compliance attractive.

In 1963, the feed grain program in its present form came into being when loan rates were lowered and participants were given a support payment directly. With implementation of the 1961 program, export subsidies on feed grains

ceased, and the U.S. market price was the availability price to world buyers.<sup>22</sup>

The important elements of the above review are: (1) During the 1950's the determination of the export subsidy on corn by the United States had a direct influence on world price; (2) from 1961 to the present, the loan rate and the disposition of stocks by the United States influenced domestic and, therefore, international corn prices; and (3) on the basis of this analysis, it seems clear that it has been domestic considerations--for example, the need for compliance in 1961-62 and the fear of inflation in early 1966--which have dictated large-scale disposal of U.S. feed grain stocks to stabilize price. Thus, it is held that U.S. domestic agricultural policy heavily influences world feed grain prices and that the major behavioral assumption is consistent with past and present policies.

Two further qualifications must, however, be mentioned. First, sorghum grain exports have continued to receive export assistance in the form of subsidy payments.<sup>23</sup> This result is not completely consistent with the model, but it may be that the substitution between wheat and sorghum grain in the Plains areas means that wheat prices influence sorghum prices more than other feed grain prices. Second, and more important, the statutory selling-out price specified for the CCC has not generally applied to export sales. This is coupled with the fact that in years when compliers have been treated differently from noncompliers, the noncomplier's influence has been sufficient to maintain market prices below the loan rate. This was especially true in the late 1950's and early 1960's. These two factors do not invalidate the major premise of the argument, namely, that U.S. domestic policy considerations heavily influence world feed grain prices. They do, however, tend to suggest that the model's price limits, the loan rate and the selling-out price,

<sup>22</sup> This brief review of feed grain policy is drawn from several sources: Benedict and Stine, *op. cit.*, pp. 215-232; U.S. Dept. Agr., *Feed Situation*, ERS, Nov. 1965, p. 41; U.S. Dept. Agr., *Grain and Feed Statistics Through 1961*, ERS, *Statist. Bul.* 159, June 1962, tables 40, 45, and 46; and U.S. Dept. Agr., *Feed Situation*, ERS, Feb. 1960, p. 16.

<sup>23</sup> U.S. Dept. Agr., *Foreign Agricultural Trade of the United States*, ERS, June 1966, p. 14.

will not always embrace U.S. and world market prices.

It remains now to discuss the implications of the model in relation to the world feed grain market. The residual nature of the international market, where quantities supplied and demanded vary with domestic supply and policy conditions, would suggest that volumes entering the market would demonstrate substantial year-to-year variation. Figure 6 shows the variability of South African, and especially Argentine, exports. The data also reveal that yearly falls in exports from one country are often offset by increases in exports from other countries. Also, the relatively lower degree of variability in year-to-year shipments by the United States from 1949 to 1965 lent a degree of stability to total world exports. The rapid rise in corn exports since 1955 is clearly shown.

Further insights are gained when total production is compared with exports. U.S. corn production increased rapidly from 1954 to a peak in 1959, then declined until 1962. Since

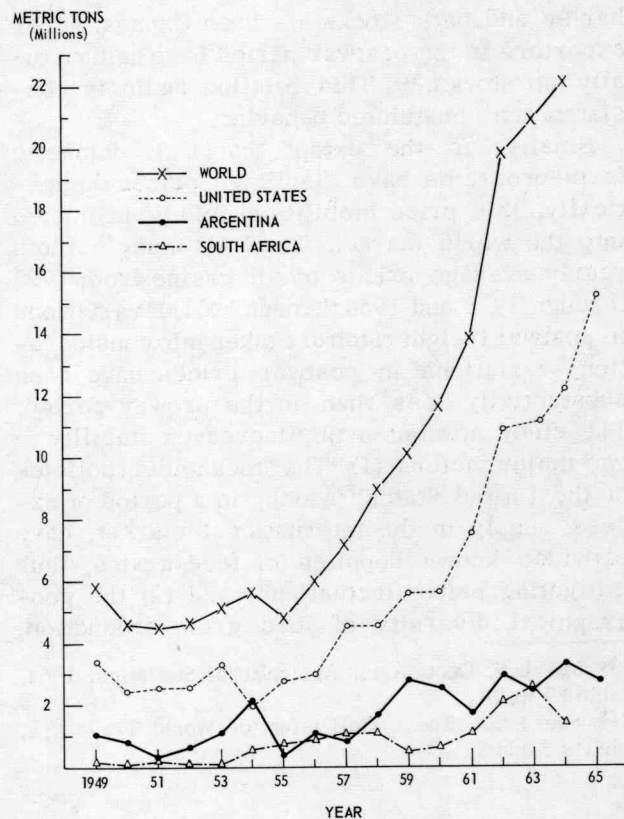


Figure 6.--Corn exports, 1949-65.

then, moderate increases as a result of yield increases have occurred. This is quite a different pattern from the one exports have demonstrated. When production is correlated with export volumes from 1949 to 1963, a correlation coefficient of 0.2 results, suggesting little relationship. On the other hand, when Argentine export volumes are correlated with domestic production from 1955 to 1963, a correlation coefficient of 0.82 results, indicating that variations in Argentine exports are closely related to variations in domestic production. Both of these results are consistent with the behavior suggested by the above model.

A second major implication of the model is that if the United States has operated as a buffer stock agency for the world feed grain market while other countries have marketed total yearly supplies, the United States would be the major stockholder. From 1954 to 1963, the United States consistently held between 90 and 95 percent of world corn stocks, between 50 and 60 percent of oats stocks, about 50 percent of barley stocks, and 80 to 90 percent of sorghum stocks. The other major holder of barley and oats stocks has been Canada. Other exporters in the postwar period have held virtually no stocks.<sup>24</sup> This relation again is consistent with postulated behavior.

Finally, to the extent that U.S. domestic farm programs have stabilized prices domestically, this price stability should be projected into the world market. The FAO study<sup>25</sup> plots yearly average prices of all grains from 1925 through 1938 and 1950 through 1961. If variations in postwar freight rates are taken into consideration, variations in postwar prices have been substantially less than in the prewar period. The study attributes this increased stability to two major factors: (1) "The stockholding policies of the United States" which, in a period of excess supply in the international market, have provided known supplies of feed grains, thus mitigating price fluctuations, and (2) the geographical diversity of feed grain production,

<sup>24</sup> See U.S. Dept. Agr., Agricultural Statistics, 1964, table 69, p. 51.

<sup>25</sup> See FAO, The Stabilization of World Trade . . . , charts 7 and 8.

which means that shortages in some parts of the world are generally offset by surpluses in others. Further, the increasing substitutability among various feed grains in consumption provides a stabilizing function.<sup>26</sup> These results also are consistent with the outcomes suggested by the model.

## Summary and Conclusions

The model of feed-grain pricing presented above gives the United States a dominant or near-monopoly power position in the world feed grain market. Domestic policy parameters, the loan rate, acreage diversion provisions, and the CCC selling-out price are projected into the world market, with the result that CCC operations have direct impacts on world prices. This conceptualization of the world market should be useful to policymakers because it identifies two major elements which must be considered in international discussions.

1. The feed grain policy of the United States has had and will continue to have a profound influence on world markets. While it is true that the present stock position of the United States does not permit large short-term stock disbursements for the purpose of price stabilization, the longer-term impact of alterations in programs to allow larger acreages gives the United States long-term market power. Only in the event that total land utilization is permitted will the direct influences of U.S. policy be eliminated. But even in this event, the U.S. market will still be dominant in setting world feed grain prices.

2. As long as world price remains below the support levels in the major importing markets, namely the EEC and the United Kingdom, domestic objectives rather than international conditions will influence the import demand for feed grains. Expressed differently, international price movements have relatively little effect on the quantities produced and consumed in most importing countries.

<sup>26</sup> FAO, *Ibid.*, pp. V, 28, 37-41.