THE ECONOMIC IMPACT OF EXCHANGE RATE CHANGES ON OILSEED FEED-MEAL EXPORTS OF THE U. S., BRAZIL AND ARGENTINA, 1965-1976

By

EGIDIO LESSINGER

Engenheiro Agrônomo
Universidade Federal do Rio Grande do Sul
Porto Alegre, Rio Grande do Sul, Brasil
1969

Mestre em Economia Rural
Universidade Federal do Rio Grande do Sul
Porto Alegre, Rio Grande do Sul, Brasil
1971

Submitted to the Faculty of the Graduate College
of the Oklahoma State University
in partial fulfillment of the requirements
for the Degree of
DOCTOR OF PHILOSOPHY
July, 1978

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Thesis Approved:

Thesis Adviser

Dean of the Graduate College

PREFACE

This study is related to economic effects of changes in exchange rates on the trade flows of oilseed feed-meals of three major exporters and nine primary importers.

The author wishes to express his sincere gratitude to Dr. H. Evan Drummond, Graduate Advisory Committee Chairman, for his guidance, patience and understanding during the course of this study.

Appreciation is extended to the other members of the Graduate Advisory Committee, Dr. Leo V. Blakley, Dr. Harry P. Mapp, Jr. and Dr. Michael J. Applegate, for their helpful suggestions and comments.

Special thanks to the Administration of the Ministério da Agricultura in Brazil and of Embrapa for providing financial support during my program and to USAID-Brazil for taking care of the fees and tuitions.

Profound gratitude is directed to my family for the many sacrifices Laura, my wife, and our daughters, Ana Claudia and Julia Andrea, had to endure while daddy was studying. Now, let's go to Brasilia!

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CHAPTER I

INTRODUCTION

Oilseed feed-meal[1] production in calendar year 1978 is forecast at 74.86 million metric tons in soybean meal equivalent[2] and world exports of oilseed feed-meals are forecast at 34.18 million metric tons. As such, the international trade sector is expected to involve approximately 46 percent of world oilseed feed-meal production in 1978.[3]

Soybeans will make up 67 percent of total oilseed feed-meal production and about 78 percent of total trade in oilseed feed-meals in 1978. Estimates are that the average value of world exports of oilseed feed-meals in 1977 was around $6.84 billion of which $5.54 was made up by world-wide soybean exports (1).

World production of soybeans increased from 17.67 million metric tons in 1965 up to a forecast of 50.53 million metric tons for 1978. This will represent an annual geometric rate of growth of about 8.55 percent. World exports involved 61.98 percent of world production in 1977 and are forecast at 26.75 million metric tons for 1978 of which 14.59 million metric tons are expected to be from the U. S., 7.51 mil-

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[1]Includes Peanut, Sunflower, Cotton, Linseed, Rapeseed, Sesame, Palm Kernel and Soybeans.

[2]All values in this study are in soybean meal equivalent, SME, unless otherwise indicated.

[3]Data referenced throughout this chapter are contained in Appendix A.

lion from Brazil and 0.93 million from Argentina (1).

In the U. S. soybeans were probably the most rapidly expanding crop during the 1960's and 1970's. By 1965 production was at 14.25 million metric tons while the forecast for 1978 is at a record of 34.22 million metric tons. This will mean an average annual geometric rate of growth of around 7.40 percent (5).

Total receipts of U. S. farmers for soybeans topped 8 billion dollars in 1973 and 1974 and reached 7 billion dollars in 1975. About half of all sales are derived from exports (2). Soybean sales in general and exports in particular are a major income earner for U. S. farmers accounting for about 20 percent of total cash receipts that farmers receive from sales of all crops (2).

In Brazil, soybeans have been used for food since the 1940's, but production did not expand significantly until the mid 1960's. At that time the derived domestic demand for soybeans to produce margarine, simple edible oil and other byproducts began to increase dramatically. In subsequent years the supply also shifted outward due to improvements in production, technology and expansion of the production area. As a consequence of these forces Brazilian soybean production has expanded from 0.04 million metric tons in the fifties to 3.67 million metric tons in 1973 and is forecast for 1978 at 10.11 million metric tons.

Brazilian exports of soybeans were 0.14 million metric tons in 1965. Annual increases in export volume pushed the 1977 estimated exports to 6.75 million metric tons with a forecast of 7.51 million metric tons for 1978. In 1976, Brazil sold 36 percent of its soybeans, 76 percent of its soybean meal and 23 percent of the oil produced to overseas buyers (3).

In Argentina soybean production expanded in the early to mid 1970's in response to rising world prices. Estimates are that production reached 1.40 million metric tons of beans in 1977 and the forecast for 1978 is at 1.70 million metric tons. Around seventy percent of production is expected to be exported in 1978. This means about 1.2 million metric tons of bean exports and 0.30 million metric tons of soybean meal exports for 1978 (3). Recent increases in Argentina soybean exports may have been caused by favorable oilseed/grain price ratios as well as devaluations of the Argentine peso after 1973.

The direction and intensity of world trade flows in oilseed feed-meals have changed quite significantly during the 20th century. Commercial shipments started with a Japanese delivery of soybeans from Manchuria to England in 1908 (4). Somewhat later, Japanese exports reached Germany, Denmark, Sweden, Norway and Holland. Japan retained its position as the leading exporter until the beginning of World War II. After World War II, the U. S. dominated the soybean and oilseed feed-meal markets for more than two decades. In the late sixties and early seventies competing suppliers began to erode the U. S. dominance in the soybean export market. Prior to this time, Brazil and Argentina had been minor exporters of oilseed feed-meals. In 1973-1974 the supply response to higher prices was quite significant for Brazilian and Argentine producers. Most of the increase in production was sold on the export market. This suggests a relatively inelastic domestic demand schedule in both Brazil and Argentina.

Some of the main factors normally associated with the world-wide increase in production of oilseed feed-meals and with the increase in trade mainly with Europe and Japan are the following:

a) Increased income in the U. S. and in the main importing countries, acting as a shifter of the relevant demand curves. Changes in income acted mainly as a shifter of the meat and meat-product demand. Since oilseed feed-meal demand is a derived demand tied to the meat demand the impact was fully shifted from the meat sector to the oilseed sector.

b) Price responsiveness of farmers in the U. S., Brazil and Argentina.

c) Soybeans and oilseed feed-meals were not subject to tariffs, quotas or other trade barriers in most countries, most of the time.

d) Improvements in marketing systems for grains and oilseeds.

e) Scientific feeding management that uses more oilseed feed-meals.

Recently there has been some controversy about the extent to which changes in the exchange rate system of the United States may have affected the U. S. oilseed feed-meal market. Normally it is expected that countries with appreciating currencies will import more, ceteris paribus. Viewed from a different point of view, devaluations of the exporter's currency are expected to cause greater export volume and value (5, 6, 7, 8, 9, 10). The controversy arises mainly because of a lack of empirical evidence of the impact on the U. S. trade sector of currency fluctuations.

Schuh has argued that an effect can already be seen in the balance of payments position of the U. S. relative to its primary trading partners (5). However, Greenshields found no evidence of exchange rate impacts on the trade of wheat and soybeans between the U. S. and Japan (6). Veliantis attempted to measure the impact of

currency fluctuations on trade patterns using a system of dummy variables, but she found no evidence that changes in exchange rates affected U. S. international agricultural trade (7). Several authors have constructed theoretical models dealing with the impact of exchange rate changes on trade flows. One approach has been to assume an inelastic demand curve and then trace out the effects of currency changes on prices and quantities. Using this approach Kost shows how domestic supply and demand elasticities affect the import demand and export supply curves and what the expected effects on quantities traded and on the price level in exporting as well as importing countries may be if the currency appreciates or depreciates in relation to the currency of the trading partner (8). Bredhal and Gallagher, using a model with no apriori assumptions about elasticities, conclude that the percentage change in equilibrium prices will not exceed the percentage change in exchange rates but that the percentage change in equilibrium quantity traded may or may not exceed the percentage change in the exchange rate (9).

The Problem

Recent changes in the structure of oilseed feed-meal production and trade, coupled with substantial instability in world financial markets warrants a re-evaluation of this market during the recent past. Estimates made in the sixties may not reflect present market conditions. Complete models for the U. S. soybean complex have been developed by Houck and others (4, 2, 10, 11, 12). For the most part those models tend to treat foreign demand as an exogenous component which is insensitive to foreign exchange rates. Since exchange rate

patterns have varied greatly during the past eight years, any evaluation of the world oilseed feed-meal market which indiscriminately aggregates all importers and/or exporters will not be able to appropriately evaluate world market changes.

Hypothesis

The central hypothesis to be tested is that international trade in oilseed feed-meals is not affected by changes in exchange rates among trading partners. Failure to reject this hypothesis would lend support to those who contend that relative prices are not primary determinants of world trade patterns.

Objective

The main objective of this study is to create a market model for oilseed feed-meal exports for each of the principal exporting countries which incorporates exchange rate variations in an explicit manner.

Organization of the Study

The next chapter contains economic concepts and theoretical expectations relating trade in oilseed feed-meals to changes in exchange rates and other relevant factors that act as shifters of the export supply or the import demand curves. Chapters III and IV contain analytical procedures and empirical estimates of the oilseed feed-meal trade model. Some simple analyses based on the empirical estimates are also presented in Chapter IV. Extension of the economic analysis involving some economic impact estimates are presented in

Chapter V. Finally, Chapter VI contains a summary of the study as well as limitations, implications and suggestions for further research.

CHAPTER II

A CONCEPTUAL MODEL

The conceptual model developed in this chapter emphasizes the relationship between the quantity and direction of trade of a commodity and changes in the factors that affected such trade. Special emphasis is given to identify the effects of changes in exchange rates, the effects of policy decisions and the effects of other economic factors commonly associated with international trade analyses.

The way in which economic factors influence domestic supply, domestic demand, export supply and import demand curves is presented in detail in Samuelson (13), Kreinin (14) and Heller (15) among others. In this chapter the derivation and some properties of the export supply and import demand curves are presented. The basic model is extended to explicitly account for exchange rate variations.

Trade Model

Assumptions

The assumptions upon which the model is based are that perfect competition prevails in all markets; that there is one homogeneous product being traded between two countries; that markets are unrestricted; that there is no cost of transportation and that buyers and sellers are able to transact at the stated market price.

Derivation of the Excess Supply and Demand Curves

Under the conditions stated above the basic neo-classical concepts underlying international trade may be derived. Given the domestic supply and demand curves for country A in Figure 1, the equilibrium price is P_o and the equilibrium quantity is Q_o in the absence of trade. At prices above P_o the quantity supplied exceeds the quantity demanded. The quantities supplied in excess of the quantities demanded form the export supply curve (ES_A) in the trade sector. At prices below P_o quantities demanded exceed quantities supplied and this excess demand is plotted in the trade sector as the import demand curve (ID_A).

At prices above P_1 in country B quantities supplied exceed quantities demanded. Curve ES_B in the trade sector represents this excess supply. At prices below P_1 quantities demanded exceed quantities supplied. The excess demand at each price is the import demand of country B shown as ID_B in the trade sector. The equilibrium price level in country A is lower than the equilibrium price in country B assuming outarky. If there is trade between A and B the export supply curves would show the quantities that would be available for export at various prices and the import demand curve depicts the quantities that domestic consumers would want to import at various prices.

Determination of Direction and Volume of Trade

At prices above P_1 both countries would be net exporters and at prices below P_o both would be net importers. Thus, if there is

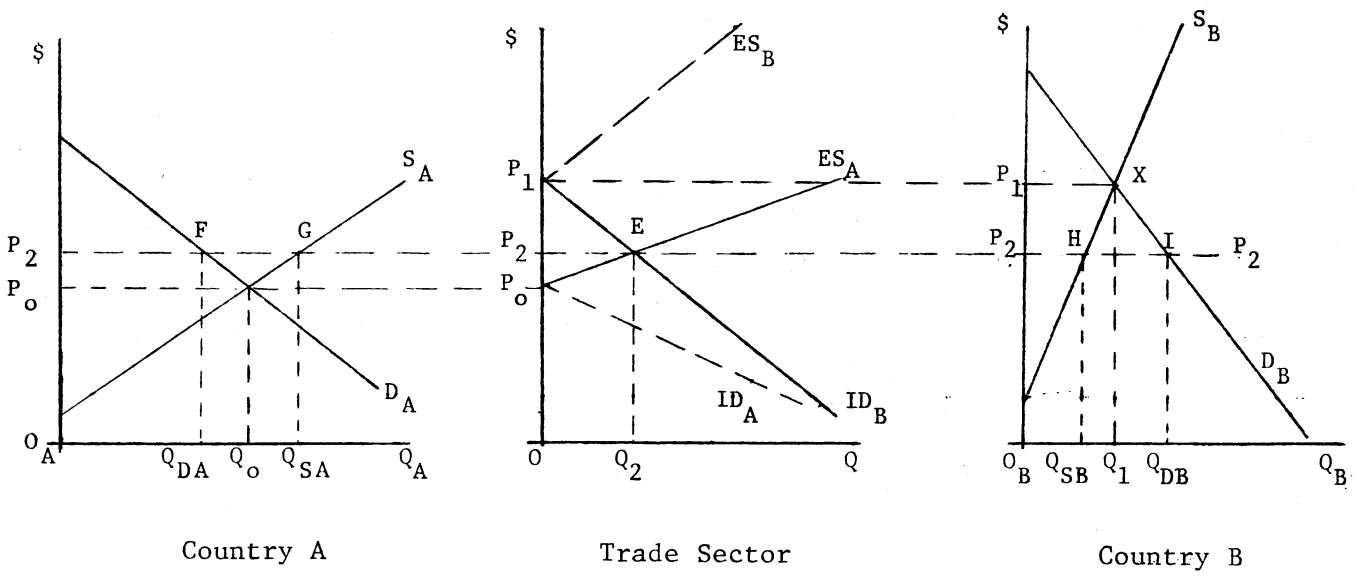
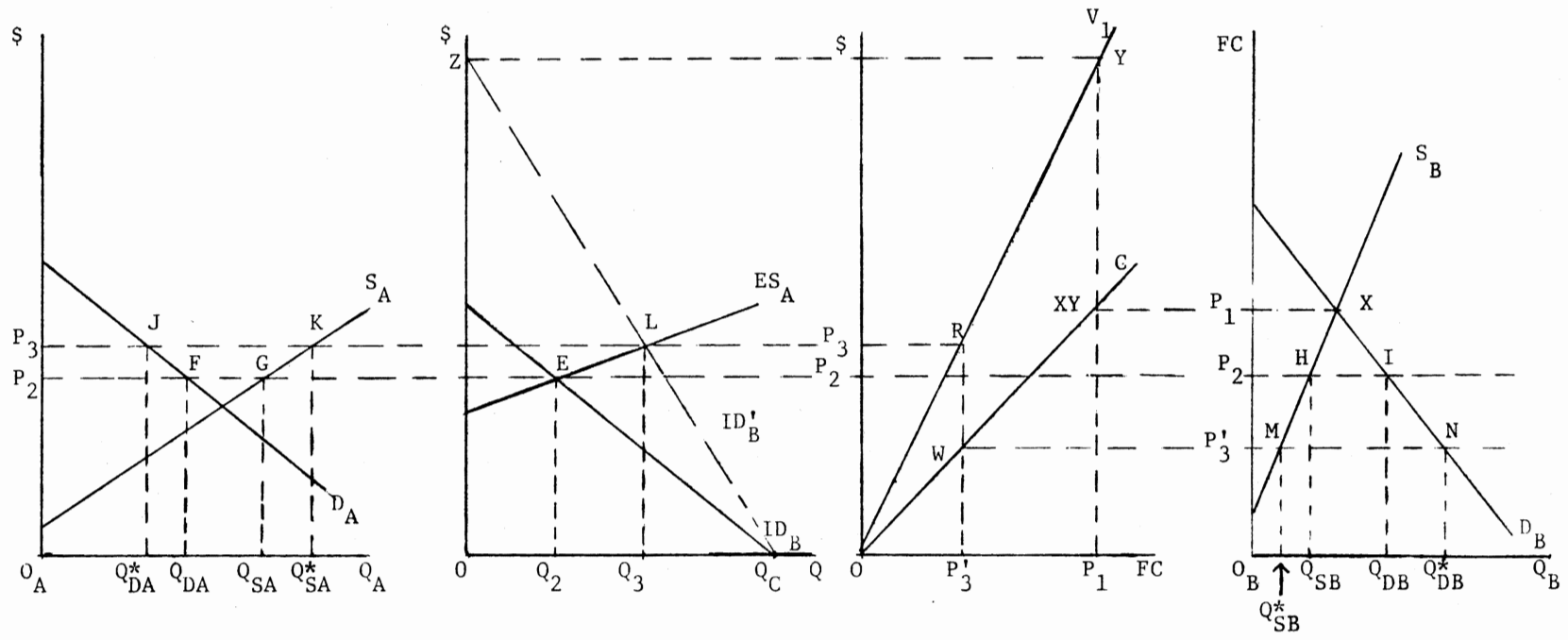


Figure 1. Derivation of Export Supply and Import Demand Curves for Two Countries Engaged in Trade.

trade it will take place at prices between P_o and P_1 since at prices above P_o Country A becomes a net exporter and at prices below P_1 Country B becomes a net importer. The direction of commodity trade flow is then from country A to B. The quantity traded is given by the intersection of the relevant export supply and import demand curves. In Figure 1 this is equal to Q_2 and the market clearing price is P_2. At the world market price (P_2), domestic quantity demanded in A equals OQ_{DA} and the quantity supplied equals OQ_{SA}. The quantity available for exports is equal to $OQ_{SA} - OQ_{DA}$ or the line segment FG. This corresponds to the segment P_2E in the trade sector. In Country B the domestic quantity supplied at P_2 is OQ_{SB} while quantity demanded equals OQ_{DB}. Hence, the quantity imported is equal to $OQ_{DB} - OQ_{SB}$ or HI and P_2E. Exports of A equal imports of B since both equal P_2E or OQ_2 which is the quantity traded on world markets. The price P_2 in the trade sector is the world market price for the commodity and will be the domestic price in both A and B with free trade as long as the assumption that prices in both countries are measured in the same currency is maintained.

Adding A Currency Exchange Sector

A graph representing the currency exchange sector may be added to the previous model as shown in Figure 2. With this modification the assumption that both countries use the same currency can be relaxed. Exchange rates between currencies are represented by exchange rate vector (V_i) on the currency exchange sector. Such a vector is used to reflect against the vertical axis (measured in U. S. dollars) the values of the horizontal axis (measured in units



Country A Trade Sector Currency Exchange Sector Country B

Figure 2. Changes in Trade in Two Countries Due to Changes in Exchange Rates.

of foreign currency). As this vector rotates counter clockwise it reflects any given value off the foreign currency axis at a higher level on the dollar axis. Therefore, counter clockwise rotation of the vector reflects increasing $/FC ratios or dollar depreciations. A 45° line is drawn on the currency exchange sector graph to allow foreign currency values from the vertical axis of the Country B graph to be projected onto the horizontal (foreign currency) axis on the currency exchange sector. This is shown as the OC vector in the currency exchange sector. The combined use of the OC and OV_1 vectors can be seen in the equivalence between the P_3' and P_3 price as shown in Figure 2. To convert the P_3' foreign currency price to dollars, P_3 is traced to point W on the foreign currency sector where P_3' is measured on the horizontal axis equal to the vertical distance $O_B P_3'$ in Country B. Moving from point W to point R on the V_1 vector and then to the vertical dollar axis of the currency exchange sector yields an equivalent dollar price P_3.

Derivation of the New Import Demand Curve

The derivation of the new import demand curve (ID_B) was based on the assumption that prices were the same for both countries. In this case V_o coincides with the 45 degree line. If the dollar were to depreciate then the new exchange rate vector (V_1) rotates to some new position representing the new $/FC ratio. As this happens, prices on the FC axis in Country B are amplified when projected against the dollar axis of the trade sector.

The effects on trade of a depreciation of the dollar can be geometrically shown by the rotation of the import demand curve from ID_B

to ID_B. Currency adjustments do not change the intersection of the original ID_B curve on the quantity axis because at zero prices quantities demanded would be Q_c no matter what the scale on the price axis is.[1] To determine points on the new import demand curve, the quantities demanded in excess of the quantities supplied in Country B are reflected through the currency exchange vector V_1 to the trade sector. To determine the intersection point of the new import demand with the price axis on the trade sector graph, the foreign price at which import demand is zero has to be converted to a dollar price. To make this conversion geometrically, a line starting at point X on Country B is traced to point XY on the OC vector. From there, moved vertically until reaching point Y on the new exchange rate vector V_1 and then left until point Z on the price axis of the trade sector is reached.

This new import demand curve ID'_B determines a new intersection point with the original export supply curve at L. The new equilibrium point is associated with P_3 as the new world dollar price and OQ_3 as the new world wide quantity traded.

Effects of Changes in Exchange Rates on Prices and Quantities

The dollar price in the exporting country increases from P_2 to P_3 as a consequence of what the exporter perceives as a shift in the foreign demand caused by a depreciation of the exporter's currency. Increases in exports from the exporting country are made possible by

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[1]Depreciation of the dollar also can be shown by changing the scale of the price axis in the trade sector, Kost (13).

decreases in domestic quantity demanded (OQ_{DA} to OC^*_{DA}) and increases in the quantity supplied (OQ_{SA} to OQ^*_{SA}).

In the importing Country B the price in foreign currency decreases from P_2 to P_{3B} since the decline in value of the dollar is greater than the increase in the dollar export price. The quantity imported increases due to a decline in domestic quantity supplied (OQ_{SB} to OQ^*_{SB}) and an increase in the domestic quantity demanded (OQ_{DB} to OQ^*_{DB}).

Effect of a Change in the Currency Exchange on Consumer and Producer Surplus

The effect of the dollar devaluation is to increase consumers' surplus in the importing country and decrease consumers' surplus in the exporting country. Producers' surplus is increased in the exporting country and reduced in the importing country. The extent to which each of these groups is affected depends on the domestic elasticities of supply and demand. The more elastic the export supply, ceteris paribus, the larger the effect of a change in exchange rates on the quantity traded and the smaller the effect on price.

Effects of Policy Decisions on Trade Flows

Trade policy decisions also affect the import demand and the export supply curves. Some policy decisions which are made for purely domestic reasons in either the importing or exporting country may affect the whole trade sector. Embargoes and the imposition of trade barriers are examples of such policies. Heller (15), Corden (39) and Balassa (40) have evaluated the impact of several examples of trade barriers and restrictions. A graphical presentation of the effects on

trade of an embargo is shown in Figure 3.

Assume that the export supply curve (ES) represents the global export supply of a homogeneous product. It is obtained by the horizontal summation of the individual export supplies of the world exporters A, B and C. ID is the global import demand which is a horizontal summation of all individual import demands. Under these circumstances and before any restrictions, the world price would be P_E and Q_E would be the quantity traded. If any one of the suppliers imposes a quantity restriction the short run export supply would shift inward. In the short run some stocks of the competing country may come into the market at the higher price to partially offset the impact of a quantity restriction by one of the exporters but these offsetting effects would be relatively minor particularly when the export supply is highly inelastic. The new short run export supply ES' determines a new short run equilibrium price P_R at point E and a lower quantity traded at Q_R. The size of the changes in prices and quantities depend on the elasticities of the relevant curves. The less elastic the import demand, the larger the effect on prices of a quantity restriction of any one of the exporters under ceteris paribus conditions. In the long run it is expected that the export supply curve would shift back outward to some extent as a result of adjustments made among the remaining suppliers. Higher prices may encourage adoption of new technologies, higher fertilization levels and opening of new lands that would shift the supply curve outward.

It has been shown in this chapter that each country has its own export supply and its import demand depending upon price. Any changes in domestic demand or in domestic supply will affect the world market

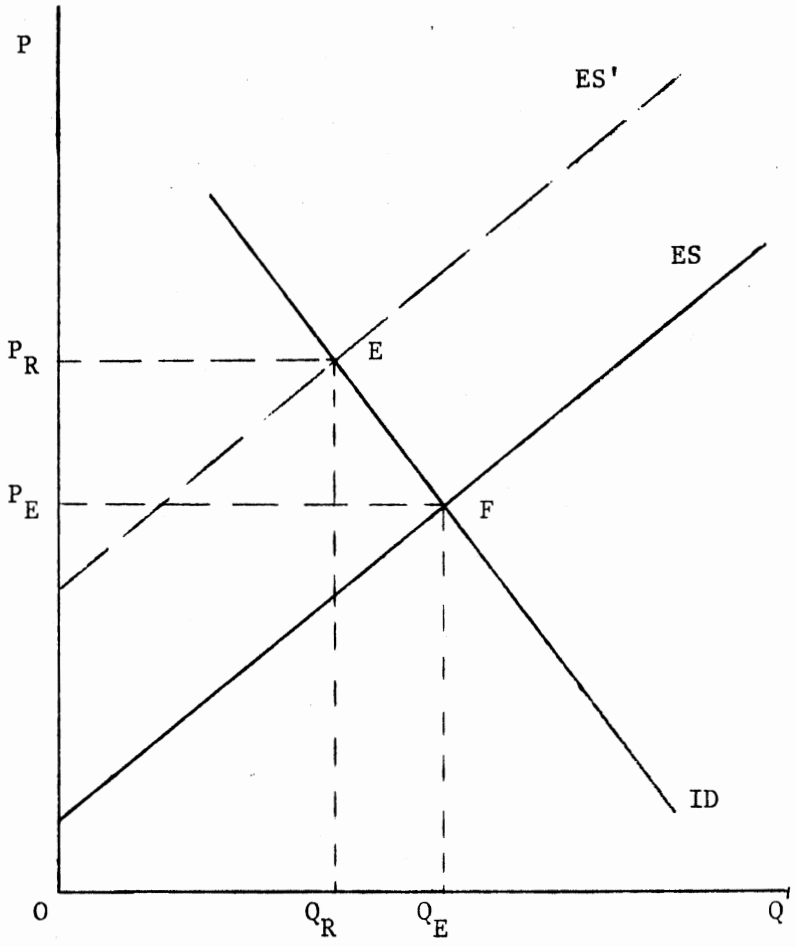

Figure 3. Impact of Export Restriction on World Markets.

curves for that country. Moreover, changes in exchange rates either of the home country or of its trading partners will affect world market import demand and/or export supply curves. Finally, policy changes can have the effect of bringing about shifts of the relevant curves in the world market.

CHAPTER III

THE ANALYTICAL MODEL

Models of world trade flows are more frequently used as a means to explain flows of commodity aggregates than flows of indicidual commodities (34). However, in recent years there has been an increasing use of trade flow models to analyze world market behavior of groups of related commodities or simply one homogeneous commodity. Most trade flow models of commodity aggregates were based on import-export matrices (16, 17, 18, 19, 20, 21, 22). Much of the previous empirical work which has emphasized individual commodities was based on spatial equilibrium and/or temporal equilibrium models (23, 24, 25, 26, 27). There have also been a number of studies of interrelated commodity markets where systems of recursive and/or simultaneous equations are used to represent such market structure (2, 4, 10, 11, 12, 28, 29, 30).

The approach which will be used in this study is one of estimating bilateral trade flows based on economic characteristics of each country. This is frequently referred to in the literature as the structure of trade approach because such models may be used to estimate the actual structure of trade among countries based on income, population, policy decisions, exchange rates, etc.

The specification and identification of a model for the international trade sector of the oilseed feed-meal market should be pre-

ceeded by a review of the oilseed complex. Unfortunately there is little previous empirical work dealing specifically with oilseed feed-meals in the international area. The most relevant studies are several dealing with U. S. soybean exports and an earlier study covering feed-meal markets during the fifties and early sixties (12).

Some of the more complete market structure analyses for the soybean sector are in Houck (4, 10), Jones (11), Ryan (2) and Vandeborre (12). All of those studies have emphasized the interrelationships among the oilseed markets within the U. S., treating foreign demand as an exogenous aggregate. Given the kinds of changes that are occurring in the international financial and economic world that affect the oilseed feed-meal market a reestimation is oriented and bilateral examination of this particular sector is warranted. Rather than treating the oilseed feed-meal export market as being a monolithic market the individual country markets should be analyzed to facilitate accurate identification of the impact of various economic factors on oilseed feed-meal exports.

A Trade Flow Model

A model which relates trade flows of a commodity to a set of explanatory variables will be developed in this section. The formulation of an econometric model will be based on the economic model presented in the previous chapter. The economic variables which determine bilateral trade flows are those which affect domestic supply and demand curves and world market price. The trade flow between two countries is assumed to be a function of world market prices, income in the importing countries and prices of substitutes and complements.

Appropriate variables should also be included to account for shifts in the import demand and export supply curves associated with policy changes. Therefore, the basic model is:

$$Flow_{ijt} = f_1(PRB_t; TEV_{jt}; POL_{i/j}; EXR_{jit}; T) \quad (3.1)$$

where:

$Flow_{ijt}$ = value of commodity trade from country i to country j in year t.

TEV_{jt} = economic variables associated with domestic supply and demand curves in importing countries.

$POL_{i/j}$ = policy decision either in country i or in country j affecting the trade flow.

EXR_{jit} = exchange rate between country j and country i.

T = trend variable.

PRB_t = world price of soybeans in year t.

The trade flow model in (3.1) is an expression representing the import demand of j importers for i exporting countries' exports. It is a model which measures the net impact of changes on the importing (demand) side of the market on the market clearing quantities traded. It is also aimed at depicting the impacts of policy decision variables that may affect the j's imports from the i^{th} exporter. The price of soybeans C.I.F. Rotterdam was used as a proxi variable to prices of oilseed feed-meal in the world market because the latter is not available and its calculation may be subject to severe data limitations.

Shifters of the Domestic Supply and Demand Curves

The TEV_{ij} variable includes a number of economic explanatory variables commonly associated with the oilseed feed-meal market. These are variables which may be shifters of the import demand curve of the importing country:

$$TEV_{jt} = f_2 (GNP_{jt}, TGP_{jt}, TMP_{jt}, POP_{jt}) \quad (3.2)$$

where:

TEV_{jt} = economic variables associated with domestic supply and demand curves in importing countries;

GNP_{jt} = gross national product of country j in year t;

TGP_{jt} = total grain production;

TMP_{jt} = total meat production; and

POP_{jt} = population.

For the population variable, the mid-year estimates were used. The gross national product is in current U. S. dollar values.

Policy Decision Events

Two major policy decisions which may have affected the oilseed feed-meal market structure will be used for the $POL_{i/jt}$ variable:

$$POL_{i/jt} = f(DEMB_{it}, DUMT_{i/jt}) \quad (3.3)$$

where:

$DEMB_{it}$ = binary variable for the U. S. soybean embargo in 1972.

$DUMT_{i/jt}$ = binary variable for changes in the trade flows due to monetary policy decisions in Argentina in 1974.

The binary variable for the U. S. soybean embargo is included to measure the impact on trade flows of oilseed feed-meals of the U. S. embargo on soybeans in 1972. It is expected to be associated with increases in trade flows of U. S. competitors in the world market of oilseed feed-meals. It will be used to test the hypothesis that the U. S. soybean embargo caused a significant increase in oilseed feed-meal exports of competitors.

The binary variable for Argentine monetary policy decisions is included to account for changes in the trade flow of oilseed feed-meals from Argentina following the first of a series of currency devaluations in 1974.

Empirical Trade Flow Model

Substitution of (3.2) and (3.3) in (3.1) provides a completely specified model.

$$FLOW_{ijt} = f(PRB_t, GNP_{jt}, TGP_{jt}, TMP_{jt}, POP_{jt}, DEMB_t, DUMT_t, EXR_{ijt}, T) \quad (3.4)$$

The model in (3.4) is expected to be satisfactory in estimating bilateral trade. If the assumption is made that the coefficients of each of the variables in (3.4) is the same for all countries im-

porting from a given exporter, then the only difference among the importing countries would be the magnitude of the intercept. But (3.4) is not designed in a way in which size differences or scale differences among importing countries can be accounted for in the one single intercept that will be estimated. Kmenta has shown that a model such as (3.4) can be estimated using an "analysis of variance regression" approach in which a binary variable is included for each of the j importing countries. The form of such a model would be:

$$FLOW_{ijt} = f(PRB_t, GNP_{ij}, TGP_{ij}, TMP_{ij}, POP_{ij}, DEMB_t,$$

$$DUMT_t, EXR_{ijt}, T, D_j) \qquad (3.5)$$

where D_j stands for binary variables characterizing the trade flow between an exporter and the j^{th} importer. Some phenomena that are observed or expected to exist in any country but that can not be accurately measured may be singled out by the use of a binary variable. Examples of such specific country characteristics are domestic crushing capacity, transshipment of part of the imported product, and internal policy decisions that affect the size of the particular trade flow but which have not changed over time.

The Specific Trade Flow Models

Model (3.5) will be estimated for three exporters of oilseed feedmeals; the U. S., Brazil and Argentina. The estimated form of the model is slightly different for each one of the three primary exporters. One equation will be estimated for each exporter with the same set of importing countries.

$$\text{U. S.:} \quad FLOW_{1jt} = f_1(EXR_{1jt}, GNP_{jt}, POP_{jt}, TMP_{jt}, TGP_{jt}, PRB_t, T, D_j) \tag{3.6}$$

$$\text{BRAZIL:} \quad FLOW_{2jt} = f_2(EXR_{1jt}, GNP_{jt}, POP_{jt}, TMP_{jt}, TGP_{jt}, PRB_t, T, DEMB, D_j) \tag{3.7}$$

$$\text{ARGENTINA:} \quad FLOW_{3jt}, = f_3(EXR_{1jt}, GNP_{jt}, POP_{jt}, TMP_{jt}, TGP_{jt}, PRB_{jt}, T, DUMT, D_j) \tag{3.8}$$

For Brazil and Argentina the exchange rate variable is the same as for the U. S. This means that it is assumed that what really matters to exporters in Brazil and in Argentina are dollar exchange earnings. Exporters in those countries are assumed to respond to dollar prices. Therefore it seems reasonable to use the exchange rate changes of the dollar rather than the cruzeiro or the peso.

There is another dimension to the use of dollar exchange rates instead of cruzeiro or peso rates and this is that Argentina and Brazil need dollars for balance of payments requirements. Consequently, many government programs to expand exports are specifically directed toward dollar earnings. Under these circumstances it is expected that changes in trade flows of oilseed feed-meals for Brazil and Argentina are more strongly associated with changes in the dollar vis-a-vis the currencies of the nine major importers than to the exchange rates involving cruzeiros or pesos.

The Estimation Procedure

The parameters of the trade flow models in (3.6) through (3.8) can be estimated using ordinary least squares procedures (OLS). The theoretical proposition that changes in one variable can be explained by simultaneous changes in several other variables is explicitly stated in a general multiple regression form:

$$Y_{ijt} = \beta_1 + \beta_2 X_{2jt} + \beta_3 X_{3jt} \cdots + \beta_k X_{kjt} + E_{it}$$

where:

Y_{ijt} = denotes the dependent variable with i referring to the exporter, j to the importer, and t to time period.

X_{kjt} = denotes the explanatory variables with k referring to the independent variable, j to the importing country, and t to the time period.

E_{it} = is a stochastic disturbance term with i referring to the exporting country and t to the time period.

The basic assumptions that underly the specification of such an econometric model are that:

a) E_{it} is normally distributed with mean equal to zero and variance equal to σ^2 (homoscedastic), and also, $E(\varepsilon_i \varepsilon_j) = 0$ for $(i \neq j)$ (nonautoregressive residuals).

b) nonstochastic explanatory variables with values fixed in repeated samples so that $\Sigma_{i=1}^{n}(X_{ik} - \bar{X}_k)^2/n$ is a finite number different from zero for every k=2, 3...k.

c) the number of observations exceeds the number of coefficients to be estimated so as to have enough degrees of freedom in the estimation.

d) no exact linear relation exists between any set of explanatory variables. This is to avoid autocorrelation problems.

There is no apriori reason to expect that any of the assumptions would be violated in the estimation of models (3.6) through (3.8).

Data and Sources

Dependent Variable[1]

Observations on the trade flow of oilseed feed-meals were obtained from publications of the United Nations (31) and U.S.D.A. (32). Data given by the importer were used whenever possible because these are generally considered to be more reliable since problems with trans-shipments are avoided.

Explanatory Variables

Exchange Rates. Information on exchange rates was obtained from the International Monetary Fund (33). The specific exchange rate chosen was the market rate because it was available for all countries during the whole period. For estimation purposes all exchange rates were converted to indicies with 1969 as the base year.

Gross National Product. Data on gross national product were taken from International Monetary Fund publications (34). They are

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[1]Raw data for all variables in this section are in Appendix C.

reported in domestic currencies at current prices. These data were transformed into current dollar values using the exchange rates cited above.

Total Meat Production. Production of beef, pork, mutton and poultry meat for each importing country was taken from U.S.D.A. publications (35).

Total Grain Production. Total grain production of each importing country includes the production of food grains like wheat, rye and rice as well as feed grains like barley, oats and corn. These data were collected from U.S.D.A. (36).

Price of Soybeans. International market prices for soybeans are the C.I.F. Rotterdam prices published by U.S.D.A. (37). The series measures annual average prices.

Population. Data on population were taken from publications of the International Monetary Fund (34).

The Selected Countries

The group of countries chosen for analysis is restricted to those which are most important in the oilseed feed-meal trade sector. The United States, Brazil and Argentina were chosen as net exporters. These three exporters provided 81 percent of the international trade in oilseed feed-meals in 1976. The countries selected as net importers are Denmark, Belgium, France, West Germany, Italy, Netherlands, Spain, United Kingdom and Japan. These countries imported about 54 percent of world exports in 1976.

The Study Period

An arbitrary period from 1965 to 1976 was chosen for the analysis. This period provides observations on trade both under fixed exchange rate regime (1965-70) and under flexible exchange rates (1971-76). Therefore, it will be possible to evaluate the ability of the model to accurately predict within both environments.

CHAPTER IV

EMPIRICAL RESULTS

In this chapter the parameters of the trade flow model will be estimated, the relevant elasticities will be calculated and some estimated effects of exchange rate changes on oilseed feed-meal trade flows will be evaluated. In addition, effects of the 1972 U. S. soybean embargo on trade flows and on world prices will be estimated. Whenever possible, the empirical analysis is extended to capture the effects that changes in the estimated parameters may have had on gross farm income of oilseed farmers in the exporting countries.

The Estimated Regression Equations

Three basic equations were estimated each one representing the trade flows in oilseed feed-meals from one exporter to the nine major importing countries. The estimated parameters, t statistics and the coefficients of determination are presented in Table I. The estimated form of the structural equation for each exporter may be slightly different from the theoretical models (3.6) - (3.8). Those differences are a consequence of supression of statistically non significant variables or supression due to multicolinearity problems. The lack of trade flows between Argentina and Japan eliminated the binary variable for Japan in the Argentine equation. The time variable in the U. S. equation was statistically more significant when measured

TABLE I

ESTIMATED PARAMETERS AND T STATISTICS FOR OILSEED FEED-MEAL TRADE FLOWS OF U.S.A., BRAZIL AND ARGENTINA

	United States		Brazil		Argentina	
Parameter	Parameter Estimate	t Values	Parameter Estimate	t Values	Parameter Estimate	t Values
Intercept	715.95	2.30	930.96	4.14	146.22	2.07
EXR	- 10.06	-3.45	- 9.54	-5.20	- 0.85	-1.68
PRB	- 0.48	-0.84	- 1.59	-1.99	- 0.32	-0.86
GNP	0.91	1.15	- 0.49	-1.46	- 0.18	-2.37
POP	32.61	1.09				
TGP					- 5.22	-3.16
TMP	267.60	1.53			65.28	2.92
LTIME	135.10	2.26				
TIME			25.22	2.91		
DEMB			346.54	2.74	31.00	0.50
DUMT					- 37.97	-1.43
DBEL[1]	- 98.10	-0.54	27.20	0.41	7.55	0.37
DFRA	-1,982.35	1.71	98.55	1.14	57.33	0.98
DWGE	-1,160.49	9.85	631.45	6.27	87.86	1.61
DITA	-1,473.76	1.10	231.42	3.00	- 25.27	-1.11
DNET	885.45	3.74	448.25	6.70	177.56	8.33
DSPA	- 560.82	-0.67	154.58	2.29	- 22.91	-1.36
DUNK	-2,237.33	-1.67	125.16	1.48	- 41.67	-1.32
DJAP	-1,967.53	-0.70	123.88	1.15		
R^2	0.91		0.73		0.84	

[1]The variables DBEL, DFRA, DWGE, DITA, DNET, DSPA, DUNK and DJAP refer to trade flows from exporter i to Belgium, France, West Germany, Italy, Netherlands, Spain, United Kingdom and Japan, respectively.

in logarithm. This suggests that oilseed feed-meal trade flows from the U. S. are increasing at a decreasing rate. The reason behind this is probably the maturation of markets with some of the major importers like West Germany, Netherlands, and Japan.

The Exchange Rate Elasticities

The exchange rate elasticities at the mean values of the variables turned out to be -0.89 for the U. S., -4.23 for Brazil and -0.88 for Argentina. These figures imply that the effect of changes in exchange rates on dollar prices in the international market contributed significantly to stimulate Brazilian exports. The relatively high value for the Brazilian exchange rate elasticity, presented in Table II, may explain the strong increases in trade flow that Brazil experienced during the last decade of rapidly rising prices. Further, this high elasticity suggests a strong response of the Brazilian government (in promoting exports)[1], of the private export sector and of farmers to the higher dollar prices that are associated with decreases in the value of the U. S. dollar.

Using the calculated exchange rate elasticities, the estimated average increase in trade flows of oilseed feed-meals for all nine importing countries due to a one percent dollar depreciation, ceteris paribus, may be computed. These estimates are presented in Table II.

Other Relevant Elasticities

The values for the price and income elasticities as well as for

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[1]Tax rebates for exporters are common in Brazil.

TABLE II

EXCHANGE RATE ELASTICITY AND ESTIMATED AVERAGE INCREASES IN TOTAL TRADE FLOWS TO THE NINE MAJOR IMPORTERS DUE TO A ONE PERCENT DOLLAR DEPRECIATION RELATIVE TO ALL CURRENCIES

Exporter	Exchange Rate Elasticity[1]	Trade Flow Increase Thousand Metric Tons
U.S.A.	-0.89	83.69
Brazil	-4.23	79.94
Argentina	-0.88	7.02
Total		170.44

[1]The exchange rate elasticity was calculated at the mean 1965-76 value.

population, total meat production and total grain production in the nine importing countries were also calculated at the mean values of the variables involved. Some of the results in Table III are worthy of deeper examination.

United States exports seem not to be highly affected by changes in income in the importing countries. This is contrary to expectations because most past research covering periods from 1945-47 to 1972-73 found larger elasticities for the aggregate GNP of importers (2, 4, 10). Since the demand for oilseed feed-meals is a derived demand from the final demand for meats and meat products, increases in income are expected to be strongly associated with increasing oilseed feed-meal equivalent imports. The estimates for the income elasticity may be biased downward and exchange rate changes which are associated with price and income effects may have their effects upon trade overestimated. The estimated income elasticities for Brazil and Argentina turned out to be of a sign different from what was expected. After 1973 changes in GNP were negative for several of the largest buyers. Those years, however, were the ones that brought the largest increases in Brazilian exports to those countries. Consequently the sign of the GNP parameter estimate is negative. The explanation may be that the share of Brazil and Argentina in the international oilseed feed-meal market is still not big enough to be affected by economic changes in the importing countries.

The estimates indicate that trade flows of oilseed feed-meals for the U. S. are almost perfectly price inelastic. Nonetheless, Brazilian exports were highly price responsive. The high elasticity in the case of Brazil may be associated with government programs in the late six-

TABLE III

SELECTED ELASTICITIES RELATED TO U.S.A., BRAZILIAN AND ARGENTINE OILSEED FEED-MEAL TRADE FLOWS

Parameter	Elasticity
U.S.A.	
GNP	0.11
POP	1.34
TMP	0.53
PRB	-0.07
Brazil	
PRB	-1.24
Argentina	
TMP	1.53
TGP	-0.78
PRB	-0.59

ties and early seventies to promote exports. On the other hand, the oilseed feed-meal market has been a volatile market in the seventies and such price inelasticity may be a result of shortage in exportable fish meal or other possible substitutes for oilseed feed-meals. Another factor that adds to the inelasticity of the trade flows relative to prices is the absence of domestic production of oilseed feed-meals in the importing countries.

Estimated Effects of the U. S. Soybean Embargo

Trade Flow

As a consequence of the U. S. soybean embargo in 1972, Brazil had an estimated yearly average gain in exports of oilseed feed-meals of about 346.56 thousand metric tons, ceteris paribus. For Argentina the U. S. embargo caused an annual net increase in exports of 31.00 thousand metric tons. The high statistical significance of the embargo coefficient in the Brazilian cases ($p \leq .7\%$ level of significance) suggests the estimate is highly reliable. The confidence of the estimate for Argentina, however, is low. The total gain for these two countries is estimated to be around 377.56 thousand metric tons. Supposedly this would be an estimate of the loss the U. S. had as a result of the embargo. This is the estimated loss only for the nine major importers.

World Price

The imposition of an embargo may be viewed as a leftward shift of the export supply curve along the import demand curve. Therefore, to estimate the effects of such an embargo on the international price

level, the import demand elasticity for oilseed feed-meals is required. Computation of the aggregate import demand elasticity as shown in Appendix B yielded a value of -0.50.

By definition:

$$E_{qd} = \Delta Q/Q \ * \ P/\Delta P \tag{4.1}$$

or

$$\Delta P = \Delta Q/Q \ * \ P/E_{qd} \tag{4.2}$$

where:

E_{qd} = import demand elasticity (-0.50)

ΔQ = estimated average yearly exports of U. S. competitors attributed to the embargo

Q = yearly average exports of the three main exporters during 1973-1976.

P = average yearly international price of soybeans during 1973-1976.

Since Brazil had an average estimated gain in exports of 346.56 thousand metric tons and Argentina gained 31.00 thousand metric tons, it is assumed that the U. S. had a loss in trade of the same magnitude. Assuming that this loss was the change in quantity traded by the U. S. in the year of the embargo, the estimation of the effects of the embargo on the dollar price of oilseed feed-meal may be estimated by (4.2). The estimated increase in world prices is 8.84 dollars/MT. This represents an increase of 3.47 percent of the observed average price dur-

ing the 1973-1976 period. Given the above assumptions, the world price that would have prevailed in the absence of the embargo, ceteris paribus, would have been 245.66 dollars/metric ton in the 1973-76 period. The actual market price that did exist during this time period was 254.50 dollars/metric ton.

Trade Value

The estimated yearly exports of oilseed feed-meals accruing to Brazil due to the U. S. embargo was around 346.56 thousand metric tons per year during the 1973-76 period. The average international price during these years was 254.50 dollars/MT. Therefore, on the average, 88.19 million dollars per year was the gain in value of trade in oilseed feed-meals during those four years. Around 64 percent of this value goes to the farmers in Brazil (38). Therefore, the boost in Brazilian gross farm income accomplished by the U. S. embargo was about 56.44 million dollars.

In Argentina the estimated gain due to the U. S. embargo is around 7.89 million dollars. Therefore, total estimated gain for these two U. S. competitors in the oilseed feed-meal sector, was around 96.08 million dollars.

The higher price and the smaller quantity yielded 5,568.46 million dollars against what would have prevailed in the absence of the embargo: 5,468.39 million dollars. Therefore, the difference of 100.07 million dollars is an approximation of the gain the U. S. competitors had from the embargo.

CHAPTER V

EFFECTS OF CHANGES IN EXCHANGE RATES ON THE U. S. OILSEED FEED-MEAL TRADE SECTOR

It has been argued that changes in exchange rates have had significant effects on the U. S. agricultural sector (7, 9, 10). Depreciation of the dollar vis-a-vis other currencies should cause higher dollar prices in the U. S. and in the international market as well as stimulate increases in the quantity traded due to lower prices in foreign currencies. A depreciation of the dollar in relation to other currencies is expected to be associated with gains to the U. S. agricultural sector in terms of increases in producers' surplus and losses to the U. S. consumers through reductions in consumers' surplus. In this section the effects of changes in exchange rates on the quantities exported, prices[1] and total value of trade in oilseed feed-meal will be estimated.

The net impact of exchange rate variation will be estimated for two distinct time periods. First, 1970 U. S. oilseed feed-meal exports are going to be estimated based on 1965 exchange rates. The net impact measured will reflect changes in exchange rates from 1965 to 1970 when the Bretton Woods agreement was still intact. Second, U. S. estimated exports for 1976 will be simulated based on 1970 exchange rates. The

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[1]International market prices for soybeans are used as a proxi for prices of oilseed feed-meals.

net change will measure the effects of changes in exchange rates on trade flow of oilseed feed-meals during a period of flexible exchange rates.

Derivation of the Effect of Exchange Rate Variations on Trade Flow

The estimated net impact of changes in exchange rates on the trade flow may be derived from the trade flow model (3.5). The model can be rewritten as:

$$FLOW_{ijt} = a + b_1 EXR_{ijt} + \sum_{k=2}^{k} b_k X_{kt} + Error \qquad (5.1)$$

and since

$$\widehat{FLOW}_{ijt} = \hat{a} + \hat{b}_1 EXR_{ijt} + \sum_{k=2}^{k} b_k X_{kt} \qquad (5.2)$$

(5.2) can be rewritten as:

$$FLOW_{ijt} = \widehat{FLOW}_{ijt} + Error \qquad (5.3)$$

The impact of an exchange rate change on the trade flow in t can be estimated by the model (5.1). Let EXR_{ijw} be a vector of exchange rates for a time period other than t, the estimated trade flow in t that would have occurred with exchange rates from w is given by:

$$FLOW^*_{ijt} = a + b_1 EXR_{ijw} + \sum_{k=2}^{k} b_k X_{kt} + Error^* \qquad (5.4)$$

or

$$FLOW^*_{kjt} = \widehat{FLOW}^*_{ijt} + Error^* \qquad (5.5)$$

where

$$\widehat{FLOW}^{*}_{ijt} = a + \hat{b}_1 EXR_{ijt} + \sum_{k=2}^{k} \hat{b}_k X_{kt} \qquad (5.6)$$

If both error terms are normally distributed with mean zero, then the difference between the estimated trade flow is an appropriate measure of the difference between actual trade flow:

$$\widehat{FLOW}_{ijt} - \widehat{FLOW}^{*}_{ijt} = \widehat{FLOW}^{EXR}_{ijt} \qquad (5.7)$$

where $\widehat{FLOW}^{EXR}_{ijt}$ is the estimated change in t exports caused by exchange rate changes between w and t. Substitution of (5.2) and (5.6) in (5.7) yields:

$$\widehat{FLOW}^{EXR}_{ijt} = \hat{b}_1 (EXR_{ijt} - EXR_{ijw}) \qquad (5.8)$$

Impact of 1965-70 Currency Fluctuations on U. S. Trade Flow of Oilseed Feed-Meals

Trade Flow Impact

The estimated aggregate impact of 1965-70 changes in the value of the dollar on U. S. oilseed feed-meal trade flows to the nine major importers for 1970 is -360.215 thousand metric tons. Total U. S. oilseed feed-meal exports to the nine major importers were about 8,950 thousand metric tons in 1970. Therefore, there was a decrease of about 4.02 percent in 1970 U. S. trade flow as a consequence of dollar appreciation between 1965 and 1970. In other words, the quantity of oilseed feed-meals exported by the U. S. would have been 4.02 percent greater in 1970 than they actually were if the dollar had not appre-

ciated relative to other currencies between 1965 and 1970.

World Price Impact

From the point of view of the exporter, changes in exchange rates cause a shift in the import demand curve. Therefore, the magnitude of the world market price change in the currency of the exporter is dependent on the elasticity of the export supply curve. The export supply elasticity may be expressed as a function of the domestic supply and demand elasticities:

$$n_{es} = n_s(Q_s/Q_x) + (Q_d/Q_x)\ nd \qquad (5.9)$$

where:

n_{es} = export supply elasticity

n_s = price elasticity of domestic supply

nd = price elasticity of domestic demand

Q_x = total U. S. oilseed feed-meal trade flow

Q_s = quantity of oilseed feed-meal domestically supplied in the U. S.

Q_d = quantity of oilseed feed-meal domestically demanded in the U. S.

The export supply elasticity was estimated using (5.9). The values used for quantities exported and domestically supplied and demanded were for 1970 and for 1976. The domestic price elasticity of supply used was 0.39 and the domestic price elasticity of demand

was -0.35 (38).[2] The calculated export supply elasticity turned out to be around 0.44 in both 1970 and 1976.

By definition the export supply elasticity equals:

$$n_{es} = (\Delta\widehat{FLOW}_{ijt}/\widehat{FLOW}_{ijt})^* (P/\Delta P) \quad (5.10)$$

or

$$\Delta P = (\Delta\widehat{FLOW}^{EXR}_{ijt} / \widehat{FLOW}_{ijt})^* (P/n_{es}) \quad (5.11)$$

where:

P = observed dollar price of soybeans in the world market used as a proxi for oilseed feed-meal price.

The estimated U. S. export price of oilseed feed-meal in 1970 based on 1965 exchange rates equals 127.69 dollars/MT or 10.69 dollars/MT more than the actual 1970 price of 117.00 dollars/MT. Thus, an appreciating dollar caused a decrease in the U. S. and world dollar export price of oilseed feed-meals from 1965 to 1970, ceteris paribus.

Trade Value Impact

The change in the value of the U. S. trade flow of oilseed feed-meals due to dollar appreciation between 1965 and 1970 is estimated by:

$$\Delta VT = (P_1 * Q_1) - (P_o * Q_o) \quad (5.12)$$

where:

ΔVT = change in the value of trade in oilseed feed-meals

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[2]In the absence of domestic supply and demand elasticities for oilseed feed-meals, domestic elasticities for soybeans were used.

$$Q_o = Q_1 + \Delta\widehat{FLOW}^{EXR}_{ijt} = 9{,}310 \text{ thousand metric tons}$$

$$P_o = P_1 + \Delta P = 127.69 \text{ dollars/metric ton}$$

The change in value of trade estimated by (5.12) is the difference between the actual and the estimated value of trade for 1970. Using the estimated net impacts of exchange rate changes on trade flows and dollar market prices, the loss in the value of trade from 1965 to 1970 was around 141.64 million dollars. Total U. S. value of trade to the nine major markets in oilseed feed-meals for 1970 was 1,560.00 million dollars. Therefore, the estimated loss in dollar value of exports was 9.08 percent of the total value of oilseed feed-meal trade flow.

Impact of 1970-76 Currency Fluctuations on U. S. Trade Flows of Oilseed Feed-Meals

The estimated 1976 trade flow impact caused by currency fluctuations from 1970-1976 is an increase of about 980 thousand metric tons. This means that estimated U. S. exports to the nine major importers for 1976 would have been 11,690 thousand metric tons if 1970 exchange rates had prevailed. At 1976 exchange rates U. S. exports in 1976 were at 12,670 thousand metric tons or 7.91 percent greater then they would have been with 1970 exchange rates, ceteris paribus. The impacts of currency fluctuations on U. S. oilseed feed-meal trade flows to the nine major importers is shown in Table IV.

To estimate the net impact of 1970 to 1976 exchange rate changes on 1976 prices and value of trade, the procedure used to obtain the 1970 estimates was repeated. The estimated net impacts on U. S. oil-

seed feed-meal trade flows, export prices and value of trade for 1965-1970 and for 1970-1976 due to currency fluctuations are presented in Table V.

Over the 1970 to 1976 period a depreciation of the dollar relative to other currencies was observed. This resulted in an increase in the export value of oilseed feed-meals in 1976 of about 701.092 million dollars. The impacts of a depreciating dollar in the 1970's are larger in absolute and percentage values than the impacts of the appreciations in the sixties.

TABLE IV

IMPACTS ON 1970 AND 1976 TRADE FLOWS OF OILSEED FEED-MEALS OF CURRENCY FLUCTUATIONS

Countries	Estimated Impacts of Currency Fluctuations	
	From 1965 to 1970	From 1970 to 1976
	Thousand Metric Tons	
Denmark	- 75.14	226.67
Belgium	- 0.81	277.59
France	-112.23	99.56
West Germany	98.19	351.83
Italy	2.74	- 83.67
Netherlands	2.78	316.94
Spain	-137.90	18.67
United Kingdom	-147.12	-409.96
Japan	9.28	182.27
Total	-360.21	979.90

TABLE V

ESTIMATED NET CHANGE IN U. S. TRADE FLOW, EXPORT PRICE AND VALUE OF TRADE IN OILSEED FEED-MEALS FOR 1965-70 AND 1970-76 DUE TO CURRENCY FLUCTUATIONS

	Due to 1965-70 Currency Fluctuations		Due to 1970-76 Currency Fluctuations	
	Change in 1970 Value	% Over Actual	Change in 1976 Value	% Over Actual
Trade Flow (Thousand Metric Tons)	- 360.21	- 4.02	979.90	7.73
Export Price ($)	- 10.69	- 9.14	40.61	17.58
Value of Trade ($)	-141,640.00	-13.52	701,092.00	23.95

CHAPTER VI

SUMMARY AND CONCLUSIONS

The international trade of oilseed feed-meals increased from 14.35 million metric tons in 1965 to a forecast of 34.18 million metric tons in 1978. Factors associated with this increase are changes in income, grain production and meat production in importing countries. It is the objective of this study to test the hypothesis that recent exchange rate changes among the trading partners also had a significant impact on the trade of oilseed feed-meals. Therefore, a market model was created to estimate oilseed feed-meal trade flows for major exporters. The model deals with exchange rate variations in an explicit manner to facilitate the evaluation of the extent to which exchange rate changes affected agricultural trade flows.

Procedure

Trade flows from each of the three main exporters to nine major importers were estimated by the economic model. Independent variables in the model included the international market price of soybeans and a set of economic variables acting as shifters of the domestic demand and supply curves of oilseed feed-meals in the nine major freeworld importers. The exchange rate of the importer relative to the dollar was also included in the model as an explanatory variable. The model also contained dummy variables to measure the impact of policy changes:

one for the U. S. embargo on soybeans in 1972; and, the other to account for Argentine devaluations of the peso from 1974 to 1976.

Findings and Conclusions

Exchange rate changes had a statistically significant impact on oilseed feed-meal trade flows over the period 1965-76. The largest relative impact of exchange rates was on Brazilian exports of oilseed feed-meals. The estimated elasticities of export volume with respect to exchange rates is less than one for the U. S. and for Argentina but for Brazil it is quite elastic (Table VI).

Trade flows of oilseed feed-meals from the U. S. are highly inelastic with respect to incomes in the importing countries and international price levels. The trade flow between Brazil and the nine importing countries is price responsive.

The estimated economic impact produced by changes in exchange rates involved declines in the U. S. trade of oilseed feed-meal during the dollar appreciation of the late sixties and gains due to dollar depreciations in the seventies. The net impact of exchange rate changes from 1965 to 1976 included gains of about 3.71 percent in the 1976 trade flow, 8.44 percent in the world price and 10.43 percent in value of trade for the U. S. in the oilseed feed-meal export sector (Table VII).

The estimated net effect of the 1972 U. S. embargo on soybeans is a decline in 1973/76 yearly exports of about 377.56 thousand metric tons or a 2.88 percent decrease in the average 1973/76 quantities

TABLE VI

SELECTED TRADE FLOW ELASTICITIES BETWEEN THE U. S., BRAZIL AND ARGENTINA AND THE NINE PRIMARY IMPORTERS OF OILSEED FEED-MEALS, 1965-76

Elasticity	U. S.	Brazil	Argentina	Composite
Exchange Rate	-0.89	-4.23	-0.88	-
World Price	-0.07	-1.24	-0.59	-
Income	0.11	-	-	-
Export Supply	0.44	-	-	-
Import Demand[1]	-0.87	-	-	-0.50

[1]Combined import demand for the nine major importers.

TABLE VII

IMPACT OF CHANGES IN EXCHANGE RATES IN TWO SELECTED PERIODS AND OF THE 1972 U. S. SOYBEAN EMBARGO ON U. S. TRADE FLOWS, WORLD PRICE AND VALUE OF TRADE IN OILSEED FEED-MEALS

	Estimated Impact on		
	Trade Flow of the U. S.	World Price	Value of Trade of the U. S.
	Percent over actual		
Estimated for 1970 using 1965 exchange rates	-4.02	- 9.14	-13.52
Estimated for 1976 using 1970 exchange rates	7.73	17.58	23.95
Impact of the 1972 U. S. soybean embargo on 1973/76 average	-2.88	3.47	- 2.85

traded by the U. S. The embargo caused an estimated annual gain in export value of approximately 100 million dollars to exporters in Brazil and Argentina due to shifts in trade flows following the 1972 embargo.

The main conclusion that can be drawn from this study is that exchange rate variations had a significant impact on the trade flows of oilseed feed-meals for all exporters included in the analysis. Therefore, estimates made in the fifties and sixties for soybean and soybean meal trade flows as related to prices and aggregate income in the importing countries are far from representative of present market conditions. Treatment of the export market on a bilateral rather than aggregate basis lead to estimates of income and price elasticities for the importing countries that are much lower than estimates found in earlier studies. Price elasticity of demand for imports from Brazil was greater than the estimate for the U. S. This suggests that in the U. S. the domestic market is dominant and excess is exported while in Brazil the export market is of primary importance due to its eagerness to increase foreign exchange earnings. Also, the exclusion of exchange rate changes in early models probably introduced some bias in the estimates for income and prices.

Limitations of the Study

Data limitations did not permit the inclusion of the Centrally Planned Economies in the present study. Countries forming the socialist block are becoming important oilseed feed-meal markets and they account for much of the variation that has occurred in the recent past. The inclusion of these countries would generalize the trade flow model and the statistical results.

Another limitation of this study is that it does not account for the trade of oilseed feed-meals among the importing countries. To the extent that re-exports are important, the results may be biased. Hopefully, the analysis of variance regression procedure eliminated much of this bias. Interrelations between the grain feed-meal market and the oilseed feed-meal market were not explicitly treated in the model. Explicit linkage between the oilseed feed-meal export market and the rest of the agricultural sector are not specified in the model even though there are strong economic linkages as suggested by Johnson (48) and Johnson (49).

The time period of the study is limited to 1965/76. Coverage is limited to the nine major importers and three principal exporters. Therefore, only partial analyses are warranted and generalizations within a broader scope may prove hazardous.

Need for Further Research

The model used in this study is designed to measure the effects that exchange rate changes have on oilseed feed-meal bilateral trade flows. The assumption of equilibrium in the world market allows specification of a single equation model using explanatory variables from both sides of the market. Each bilateral trade flow observation is assumed to be determined by the interaction of the export supply and import demand curves. An alternative procedure which could be used to evaluate the effects of exchange rate changes on trade flows is to specify a model in which the independent directly estimated export supply and import demand equations are solved simultaneously to clear the market. There is an unresolved controversy concerning the appro-

priate estimation of the import demand and export supply curves, and the effect that exchange rates may have on exports or trade flows. This controversy centers around two basic points. The first is related to the size of the estimated export supply and import demand elasticities. Different estimation procedures seem to produce conflicting results. Schuh argues that there are serious identification problems in direct estimates of import demand equations. He suggests using indirect estimation procedures based on the domestic supply and demand parameters (45). An alternative procedure is to convert prices of internationally traded commodities to a common currency prior to estimating domestic national demand and supply equations (46). Or, Elliot's procedure of converting domestic supply and demand equations to a common currency after the estimation of the domestic supply and demand curves are completed could be used (47).

The second major problem in specifying multi-equation trade flow models is the way in which the variable that measures the impact of exchange rate changes on the dependent variable is included in the model. Conflicting results have been obtained and opposite conclusions have been reached concerning these effects. Additional research in this field may prove helpful in determining the most logical specification of this variable.

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APPENDIX A

WORLD PRODUCTION AND EXPORTS OF OILSEED FEED-MEALS AND SOYBEAN PRODUCTION, EXPORTS AND PRICES

TABLE VIII

WORLD PRODUCTION OF OILSEED FEED-MEALS[1]
1965-1978

Year	USA	Brazil	Argentina	Other	World
			Million Metric Tons		
1965	17.08	0.84	1.23	18.56	37.71
1966	20.08	0.98	1.09	18.46	40.61
1967	20.91	0.99	1.30	19.42	42.62
19 8	21.65	0.95	1.03	20.24	43.87
1969	24.88	1.26	1.05	19.41	46.60
1970	25.36	1.72	1.31	20.24	48.63
1971	25.22	2.18	1.26	21.72	50.38
1972	26.16	3.40	1.01	21.95	52.52
1973	28.49	4.29	1.33	20.34	54.45
1974	34.08	6.77	1.52	22.65	64.72
1975	27.08	8.00	1.47	23.65	60.19
1976	33.50	8.83	1.88	24.04	68.25
1977[2]	28.03	10.03	2.23	22.05	62.34
1978[3]	27.30	10.75	2.34	24.47	74.86

[1]Soybean Meal Equivalent; includes cotton, linseed, rapeseed, copra, sesame, palm kernel, peanut and sunflower.

[2]Estimates

[3]Forecast

Source: U. S. Department of Agriculture (41).

TABLE IX

WORLD EXPORTS OF OILSEED FEED-MEALS[1]
1965-1978

Year	USA	Brazil	Argentina	Other	World
			Million Metric Tons		
1965	7.17	0.37	1.18	5.63	14.35
1966	7.88	0.54	0.98	6.34	15.74
1967	8.36	0.60	0.93	6.37	16.26
1968	9.28	0.53	0.90	6.85	17.56
1969	9.93	0.98	0.92	6.08	17.91
1970	13.31	1.27	1.05	5.90	21.53
1971	13.44	1.46	1.07	5.90	21.87
1972	13.55	2.62	0.63	6.43	23.23
1973	15.24	3.46	0.84	5.11	24.65
1974	16.37	4.77	0.77	4.10	26.01
1975	14.07	6.32	0.69	4.62	25.70
1976	17.44	7.22	0.85	6.28	31.79
1977[2]	17.11	8.50	1.25	4.23	31.09
1978[3]	18.28	3.10	1.45	5.35	34.18

[1]In soybean meal equivalent; including linseed, rapeseed, copra, sesame, cotton, palm kernel, peanut, sunflower.

[2]Estimated

[3]Forecast

Source: U. S. Department of Agriculture (41)

TABLE X

WORLD PRODUCTION OF SOYBEANS
SOYBEAN MEAL EQUIVALENT[1]
1965-1978

Year	USA	Brazil	Argentina	Other	World
			Million Metric Tons		
1965	14.25	0.37	0.01	2.48	17.67
1966	17.20	0.42	0.01	2.45	20.77
1967	18.88	0.51	0.01	2.43	22.71
19 8	19.86	0.47	0.02	2.49	23.69
1969	22.51	0.76	0.02	2.32	26.61
1970	23.05	1.10	0.02	2.22	27.35
1971	22.92	1.52	0.04	2.47	28.15
1972	23.92	2.68	0.06	2.40	30.29
1973	25.84	3.67	0.20	2.32	33.30
1974	31.47	5.82	0.36	7.86	42.14
1975	24.71	7.31	0.35	3.40	37.36
1976	31.44	7.99	0.51	3.58	45.65
1977[2]	25.73	3.48	1.02	3.40	40.66
1978[3]	34.22	10.11	1.24	3.58	50.53

[1]Seed harvest in previous calendar year for the U. S., and meal potential production calculated on assumed extraction and crushing rates (52 pg 3)

[2]Estimated

[3]Forecast

Source: U. S. Department of Agriculture (1)

TABLE XI

WORLD EXPORTS OF SOYBEANS[1]
SOYBEAN MEAL EQUIVALENT
1965-1978

Year	USA	Brazil	Argentina	Other	World
			Million Metric Tons		
1965	5.86	0.14	-	1.54	7.54
1966	6.51	0.26	-	1.63	8.40
1967	6.96	0.32	-	1.73	9.01
1968	7.73	0.38	-	1.84	9.85
1969	8.31	0.49	-	1.89	10.69
1970	11.16	0.71	-	2.43	14.30
1971	11.33	1.04	-	2.39	14.76
1972	11.15	2.05	-	2.55	15.75
1973	12.71	3.75	0.05	1.63	18.14
1974	13.66	5.23	0.06	1.44	20.39
1975	11.63	6.64	0.18	1.63	20.07
1976	14.59	6.64	0.25	3.51	24.89
1977[2]	14.23	6.75	0.67	3.55	25.20
1978[3]	14.59	7.51	0.33	3.72	26.75

[1]Meal potential exports based on assumed extraction rates.

[2]Estimates

[3]Forecast

Source: U. S. Department of Agriculture (1)

TABLE XII

AVERAGE SOYBEAN PRICES
1965-1976

Calendar Year	Received by Farmers		CIF Rotterdam
	U. S.	Brazil	
	U. S. $/M		
1965	93.33	58.78	117.00
1966	101.04	66.87	126.00
1967	91.49	64.29	112.00
1968	88.92	62.83	106.00
1969	86.35	69.81	92.00
1970	104.72	76.42	117.00
1971	111.33	85.24	126.00
1972	170.49	86.71	140.00
1973	223.60	187.33	290.00
1974	243.97	167.72	277.00
1975	180.77	181.49	220.00
1976	246.54	176.72	231.00

Source: CIF Rotterdam prices from U. S. Department of Agriculture (42) and prices received by farmers from Broadbent, E. E. and F. P. Nixon (38).

APPENDIX B

ESTIMATION OF IMPORT DEMAND AND OF THE U. S. EXPORT SUPPLY ELASTICITIES

Estimation of the United States Export Supply Elasticity

The U. S. export supply elasticity is calculated by:

$$N_{es}^{us} = N_{s}^{us} \, (Q_{s}^{us}/Q_{x}^{us}) + (Q_{d}^{us}/Q_{x}^{us}) \, N_{d}^{us} \qquad \text{(B-1)}$$

where:

N_{es}^{us} = U. S. export supply elasticity of oilseed feed-meals

N_{s}^{us} = Domestic supply elasticity

Q_{s}^{us} = Domestic quantity supplied

Q_{d}^{us} = Domestic quantity demanded

Q_{x}^{us} = U. S. exports of oilseed feed-meals

N_{d} = Domestic price elasticity of demand

The U. S. export supply elasticity for the period 1965/76 was estimated by (B-1) using the following values:

N_{s}^{us} = 0.39

Q_{s}^{us} = 24.32 million metric tons

Q_{d}^{us} = 13.98 million metric tons

Q_{x}^{us} = 10.34 million metric tons

N_{d} = -0.35

Substituting these values in (B-1) yields:

N_{es}^{us} = 0.44

The quantities used are 1965-76 averages of values presented in Appendix A. It was assumed that there are no stoks.

The calculation of the U. S. export supply of oilseed feed-meals was also performed for 1970 and 1976 quantities and the result was also around the 0.rr value.

A one percent increase in the dollar price of oilseed feed-meals in the international market is expected to cause a 0.44 percent increase in the quantities supplied for exports by the U. S., ceteris paribus.

Estimation of the Import Demand Elasticity for U. S. Exports of Oilseed Feed-Meals

The aggregate import demand elasticity of the nine major importers for U. S. oilseed feed-meals can be derived from the equation of the exchange rate elasticity as given by (14) and calculated in Chapter IV:

$$E^{us}_{q,EXR} = (N^{us}_{id} \cdot N^{us}_{es})/(N^{us}_{es} - N^{us}_{id}) \qquad \text{(B-2)}$$

where:

$E^{us}_{q,EXR}$ = exchange rate elasticity of U. S. exports

N^{us}_{es} = U. S. export supply elasticity

N^{us}_{id} = import demand elasticity for U. S. exports of oilseed feed-meals.

Substituting the export supply elasticity from previous section and the exchange rate elasticity from Chapter IV in equation (B-2) yields:

$$-0.89 = [N_{id}^{us} \cdot (0.44)]/[(0.44) - N_{id}^{us}]$$

or:

$$N_{id}^{us} = -0.87$$

This is an estimate of the import demand elasticity of the nine importers in this study for U. S. exports of oilseed feed-meals. A one percent decrease in dollar prices is expected to be associated with a 0.87% increase in quantities imported from the U. S., ceteris paribus. Similar result was obtained for the short run export supply elasticity of soybeans by Ryan (2 pg 8) for the 1971-1974 period.

Estimation of the Import Demand Elasticity from Major Oilseed Feed-Meal Exporters

The import demand elasticity of the nine major importers for exports of the U. S., Brazil and Argentina may be indirectly estimated based on some assumptions concerning the export supply elasticities of the countries competing with the U. S. in the oilseed feed-meal sector. The elasticity of demand for a country's exports may be presented in (14):

$$N_{id}^{us} = \frac{w}{w - e} N_w + \frac{e}{w - e} N_e \qquad \text{(B-3)}$$

where:

w = quantities demanded by the nine importers

e = quantities exported to the nine countries by Brazil and Argentina

$w-e$ = quantities exported to the nine importers from the U. S.

N_w = world demand elasticity

N_e = export supply elasticity of Brazil and Argentina

N_{id}^{us} = elasticity of demand for U. S. exports (-0.87) from previous calculation.

Expression (B-3) can be rewritten as:

$$N_w = [N_{ix} + (e/w-e)N_e]/(w/w-e) \qquad \text{(B-4)}$$

Since no estimates of the aggregate export supply elasticities of Brazil and Argentina are available, it will be assumed that the domestic demands for oilseed feed-meals in Brazil and Argentina are quite inelastic.

Price responsiveness of farmers in underdeveloped countries is not expected to be larger than in the U. S. Brazilian and Argentine farmers and governments do not carry stocks of oilseeds making the very short run export supply elasticity almost insensitive to price movements. Therefore, it is assumed that the short run aggregate export supply elasticity for Brazil and Argentina is equal to the U. S. domestic supply elasticity of 0.26 estimated by Trapp (44).

By substituting these values in (B-4) the calculated aggregate import demand is equal to:

$$N_w = -[(0.87) + (13.12/8.76)(0.26)]/(21.88/8.76)$$

$$N_w = -0.50$$

This elasticity may be used to evaluate the impact of the U. S. soybean embargo in 1972 on international price levels since it is based on global markets including all three exporters and the nine primary importers. It is less elastic than the import elasticity of the nine importers for U. S. exports because the share of all three exporters is obviously larger than the share of the U. S. alone. The import demand elasticity for a country's exports is inversely related to its share in the market. Therefore, the import demand elasticity for the group's exports is less elastic than the elasticity for just the U. S. exports.

APPENDIX C

VOLUME OF OILSEED FEED-MEAL TRADE BETWEEN THE U. S., BRAZIL AND ARGENTINA AND PRIMARY IMPORTERS, 1965-1976

TABLE XIII

OILSEED FEED MEAL TRADE FLOWS

Year	Importer	Exporter		
		U.S.A.	Brazil	Argentina
1965	Denmark	461.98	21.00	94.00
	Belgium	307.36	7.90	0.00
	France	408.40	30.37	104.00
	West Ge ma y	925.22	138.06	253.58
	Italy	472.01	9.90	24.00
	Netherlands	899.31	76.32	222.00
	Spain	294.31	5.16	2.79
	United Kingdom	249.28	3.00	63.00
	Japan	1,183.45	15.00	0.00
1966	Denmark	445.87	8.00	96.00
	Belgium	387.58	28.00	58.00
	France	607.64	30.79	123.00
	West Germany	1,214.47	342.14	259.58
	Italy	489.03	25.49	17.00
	Netherlands	1,066.87	46.53	242.00
	Spain	608.11	7.90	8.79
	United Kingdom	222.86	0.00	90.00
	Japan	1,462.88	42.79	0.00
1967	Denmark	425.11	28.38	78.00
	Belgium	326.12	23.95	74.00
	France	441.66	28.37	163.00
	West Germany	1,193.38	299.89	180.79
	Italy	510.25	61.88	15.00
	Netherlands	1,235.13	51.70	201.00
	Spain	634.57	35.55	6.00
	United Kingdom	217.86	1.00	87.00
	Japan	1,297.07	20.37	0.00
1968	Denmark	382.75	12.00	63.79
	Belgium	362.18	52.00	110.00
	France	468.69	8.00	35.00
	West Germany	1,728.10	244.54	184.58
	Italy	588.46	15.01	14.00
	Netherlands	1,430.88	154.80	369.58
	Spain	771.01	3.95	13.79
	United Kingdom	153.95	0.00	74.00
	Japan	1,724.86	21.00	0.00

TABLE XIII (Continued)

Year	Importer	Exporter		
		U.S.A.	Brazil	Argentina
1969	Denmark	335.03	85.61	52.00
	Belgium	376.71	96.53	69.00
	France	497.03	31.00	133.00
	West Germany	1,917.90	356.72	222.58
	Italy	606.41	93.41	21.00
	Netherlands	1,270.84	236.01	312.00
	Spain	790.20	32.65	23.58
	United Kingdom	195.76	2.00	77.00
	Japan	2,140.15	26.74	0.00
1970	Denmark	476.65	100.00	79.00
	Belgium	501.45	124.00	105.00
	France	997.18	86.00	232.00
	West Germany	1,850.36	378.92	269.79
	Italy	783.29	146.83	26.00
	Netherlands	1,757.23	249.79	254.00
	Spain	961.73	33.97	2.79
	United Kingdom	199.12	2.00	54.00
	Japan	2,449.08	39.00	0.00
1971	Denmark	511.89	32.00	47.00
	Belgium	504.48	96.00	98.00
	France	1,060.50	97.00	177.00
	West Germany	2,521.89	455.72	372.16
	Italy	861.01	109.63	37.95
	Netherlands	1,560.52	366.37	234.74
	Spain	1,033.14	67.55	14.00
	United Kingdom	196.01	0.00	15.00
	Japan	2,170.31	7.00	0.00
1972	Denmark	500.80	94.27	24.00
	Belgium	283.94	98.74	67.00
	Frnace	1,105.26	120.82	94.00
	West Germany	2,432.96	721.84	247.06
	Italy	760.67	316.68	36.48
	Netherlands	1,609.41	383.28	111.27
	Spain	1,030.67	169.45	2.00
	United Kingdom	309.39	22.12	10.00
	Japan	2,530.54	11.85	0.00

TABLE XIII (Continued)

Year	Importer	Exporter		
		U.S.A.	Brazil	Argentina
1973	Denmark	477.24	78.12	58.00
	Belgium	405.21	162.28	42.00
	France	1,065.89	134.21	60.00
	West Germany	2,760.14	454.75	229.00
	Italy	1,048.94	215.84	20.00
	Netherlands	2,084.38	869.14	328.78
	Spain	897.98	530.93	3.00
	United Kingdom	322.97	43.17	54.00
	Japan	2,786.47	340.90	0.00
1974	Denmark	369.63	207.19	18.79
	Belgium	621.23	222.77	86.23
	France	1,419.31	124.46	10.79
	West Germany	3,258.37	1,003.56	172.86
	Italy	1,300.37	352.09	14.74
	Netherlands	1,640.92	1,360.73	392.87
	Spain	1,145.44	294.51	4.00
	United Kingdom	266.08	116.55	3.00
	Japan	2,434.96	78.78	0.00
1975	Denmark	239.57	126.94	0.79
	Belgium	470.41	157.38	15.80
	France	933.81	258.89	87.79
	West Germany	2,692.64	1,459.48	100.28
	Italy	952.89	449.61	1.58
	Netherlands	2,382.74	1,384.91	164.63
	Spain	1,056.83	625.27	13.69
	United Kingdom	297.41	69.78	0.00
	Japan	2,422.39	51.76	0.00
1976	Denmark	302.80	197.09	3.95
	Belgium	526.48	80.54	65.57
	France	989.10	306.44	98.16
	West Germany	2,029.10	1,080.81	229.13
	Italy	1,075.70	270.10	6.32
	Netherlands	2,983.50	1,173.91	364.48
	Spain	1,408.50	682.40	49.76
	United Kingdom	322.80	52.39	0.00
	Japan	2,742.80	119.40	0.00

Source: United Nations (31) and U. S. Department of Agriculture (32).

APPENDIX D

ECONOMIC BASE DATA FOR SAMPLE COUNTRIES, 1965-1976

TABLE XIV

EXCHANGE RATES OF SAMPLE COUNTRIES, 1965-1976

Year	Denmark Kroner/ U.S. $	Belgium Francs/ U.S. $	France Francs/ U.S. $	West Germany Dentche Marks/ U.S. $	Italy Lire/ U.S. $	Netherlands Guilders/ U.S. $	Spain Pesetas/ U.S. $	United Kingdom Pounds Sterling/ U.S. $	Japan Yen/ U.S. $
1965	6.92	49.64	4.90	4.01	624.70	3.61	59.99	0.3568	360.90
1966	6.89	50.05	4.95	3.98	624.40	3.61	60.00	0.3584	362.50
1967	6.91	49.63	4.91	4.00	623.90	3.60	69.70	0.4155	361.90
1968	7.46	50.14	4.95	4.00	623.50	3.61	69.82	0.4194	357.70
1969	7.50	49.67	5.56	3.69	625.50	3.62	70.07	0.4166	357.80
1970	7.48	49.68	5.52	3.65	623.00	3.60	69.59	0.4177	357.60
1971	7.06	44.75	5.22	3.27	594.00	3.25	65.90	0.3918	314.80
1972	6.84	44.06	5.12	3.20	582.50	3.23	63.45	0.4259	302.00
1973	6.29	41.32	4.71	2.70	607.90	2.82	56.85	0.4304	280.00
1974	5.69	36.12	4.44	2.41	649.40	2.51	56.11	0.4258	300.90
1975	6.18	39.53	4.48	2.62	683.50	2.69	59.77	0.4942	305.20
1976	5.79	35.98	4.97	2.36	675.00	2.46	68.29	0.5874	292.80

Source: International Monetary Fund (33).

TABLE XV

GROSS NATIONAL PRODUCT OF SAMPLE COUNTRIES IN U. S. DOLLARS, 1965-1976

Years	Denmark	Belgium	France	West Germany	Italy	Netherlands	Spain	U. Kingdom	Japan
				Billions of Dollars					
1965	10.14	17.10	99.96	114.81	58.94	19.22	21.45	100.42	88.08
1966	11.13	18.24	107.45	123.32	63.74	20.89	24.62	106.53	100.80
1967	12.20	19.70	117.07	123.67	70.21	23.05	23.41	96.82	119.09
1968	12.34	20.84	127.52	134.72	75.83	25.02	25.85	103.00	144.56
1969	14.04	23.35	132.01	163.98	83.28	28.25	28.70	111.33	168.36
1970	15.59	26.05	141.96	187.83	93.43	31.92	36.83	121.76	198.49
1971	18.03	31.71	167.26	232.05	106.58	39.99	44.04	133.54	250.82
1972	21.14	35.81	191.66	258.91	119.00	45.58	53.71	149.54	300.07
1973	26.10	43.37	236.75	340.78	135.45	60.00	72.42	170.65	396.53
1974	32.09	58.28	286.96	409.50	152.52	74.95	89.66	195.65	439.56
1975	32.65	58.99	321.96	393.24	163.58	75.94	98.76	210.84	476.57
1976	35.78	70.32	305.89	475.93	166.38	94.65	99.68	207188	561.71

Source: GNP data from (34) converted to U. S. Dollars by exchange rates table.

TABLE XVI

POPULATION OF SAMPLE COUNTRIES, 1965-1976

Years	Denmark	Belgium	France	West Germany	Italy	Netherlands	Spain	U. Kingdom	Japan
					Millions of Persons				
1965	4.76	9.46	48.76	56.84	51.58	12.29	32.06	54.37	97.95
1966	4.80	9.53	49.16	59.15	52.58	12.45	32.39	54.47	99.79
1967	4.84	9.58	49.55	59.28	52.70	12.60	32.73	54.75	100.82
1968	4.86	9.62	49.91	59.45	52.91	12.72	33.08	55.05	101.95
1969	4.89	9.65	50.32	60.01	53.23	12.87	33.43	55.27	103.16
1970	4.93	9.66	50.77	60.77	53.57	13.03	33.78	55.41	104.33
1971	4.96	9.67	51.25	61.29	53.90	13.19	34.13	55.57	105.60
1972	4.99	9.71	51.72	61.67	54.35	13.33	34.49	55.79	106.96
1973	5.02	9.74	52.18	61.97	54.91	13.44	34.86	55.93	108.70
1974	5.05	9.77	52.56	62.04	55.41	13.54	35.22	55.97	110.20
1975	5.06	9.80	52.79	61.83	55.81	13.65	35.60	55.96	111.60
1976	5.07	9.89	52.92	61.50	56.19	13.77	35.97	55.93	112.80

Source: International Monetary Fund (34).

TABLE XVII

TOTAL MEAT PRODUCTION OF SAMPLE COUNTRIES, 1965-1976

Years	Denmark	Belgium	France	West Germany	Italy	Netherlands	Spain	U. Kingdom	Japan
					Million Metric Tons				
1965	0.9	0.6	3.3	3.6	1.5	0.9	0.8	2.4	1.0
1966	1.0	0.6	3.4	3.6	1.6	1.0	0.9	2.5	1.3
1967	1.0	0.7	3.5	3.8	1.7	1.1	1.0	2.5	1.5
1968	1.0	0.7	3.6	4.0	1.7	1.2	1.1	2.5	1.5
1969	0.9	0.7	3.8	4.1	2.0	1.1	1.1	2.6	1.6
1970	1.0	0.8	4.0	4.2	2.0	1.3	1.3	2.7	1.7
1971	1.1	0.9	3.9	4.3	2.0	1.4	1.2	2.8	1.7
1972	1.1	0.9	3.8	4.2	2.0	1.3	1.3	2.8	1.8
1973	1.0	1.0	3.7	4.3	2.2	1.4	1.4	2.8	1.9
1974	1.1	1.1	4.2	3.9	2.7	1.5	1.9	3.0	2.2
1975	1.1	1.0	4.2	3.9	2.6	1.5	1.8	2.9	2.3
1976	1.1	1.0	4.4	4.0	2.8	1.5	1.9	2.8	2.3

Source: U. S. Department of Agriculture (35).

TABLE XVIII

TOTAL GRAIN PRODUCTION OF SAMPLE COUNTRIES, 1965-1976

Years	Denmark	Belgium	France	West Germany	Italy	Netherlands	Spain	U. Kingdom	Japan
					Million Metric Tons				
1965	6.2	1.9	29.1	13.9	14.5	1.8	8.3	13.7	18.3
1966	5.9	1.7	26.7	14.8	14.4	1.6	9.3	13.4	18.3
1967	6.1	2.1	31.4	18.0	15.2	1.8	10.7	14.6	20.3
1968	6.8	2.0	32.8	19.1	15.0	1.6	11.9	13.4	20.3
1969	6.8	1.9	33.1	18.9	15.8	1.6	11.5	13.6	19.3
1970	6.2	1.7	31.1	17.3	16.1	1.4	10.2	13.2	17.0
1971	7.1	2.1	37.1	20.9	16.4	1.5	13.7	15.0	14.0
1972	7.0	2.1	41.0	21.2	16.3	1.3	12.3	15.4	11.6
1973	6.7	2.2	42.8	21.2	15.9	1.4	11.6	15.3	11.4
1974	7.2	2.2	40.3	21.4	16.8	1.3	13.1	16.2	12.5
1975	6.2	1.6	45.8	20.1	17.1	1.1	14.8	13.8	12.5
1976	5.8	1.8	31.6	18.3	16.9	1.0	11.9	13.4	13.6

Source: U. S. Department of Agriculture (36).

VITA

Egidio Lessinger

Candidate for the Degree of

Doctor of Philosophy

Thesis: THE ECONOMIC IMPACT OF EXCHANGE RATE CHANGES ON OILSEED FEED-MEAL EXPORTS OF THE U. S., BRAZIL AND ARGENTINA, 1965-1976.

Major Field: Agricultural Economics

Biographical:

Personal Data: Born in Nova Petropólis, Rio Grande do Sul, February 25, 1943, the son of Edmundo Leopoldo and Elisabeta Elma Lessinger.

Education: Graduated from Colégio 25 de Julho, Novo Hamburgo, Rio Grande do Sul, Brasil, in 1965; received the Engenheiro Agrônomo Degree from the Universidade Federal do Rio Grande do Sul, Porto Alegre, Rio Grande do Sul, Brasil, in 1969; received the Mestre em Economia Rural degree from the Universidade Federal do Rio Grande do Sul, Porto Alegre, Rio Grande do Sul, Brasil in 1971; completed the requirements for the Doctor of Philosophy degree at Oklahoma State University in July, 1978.

Professional Experience: Researcher at the Ministério do Agricultura, Brasilia, Brasil, from October, 1971 to the present.

Organizations: American Agricultural Economics Association; International Agricultural Economics Association.