TRADE FLOWS IN THE GRAIN-LIVESTOCK ECONOMY OF THE EUROPEAN ECONOMIC COMMUNITY

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ABSTRACT

TRADE FLOWS IN THE GRAIN-LIVESTOCK
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by

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This study develops an international trade model that represents the grain-livestock economy of the European Economic Community. Since its emphasis is trade patterns it employs a spatial equilibrium model with four types of activities--production, transfer, purchase and sale.

Before this model could be used to predict future trade patterns it had to adequately represent the grain-livestock economy. At this point, the relevant question became how can we know when a model adequately represents reality. The thesis discusses the problem of the overall 'goodness of fit' of spatial models, suggesting some measures and tests of 'goodness of fit.' The 1964 and 1968 grain-livestock economy of the European Economic Community is then simulated. On the basis of the suggested tests and measures the model was accepted as being a 'good' short run predictive model.

Input data for 1970 were compiled. On the basis of this data and the structure of the model, production and trade patterns for grain and livestock products were predicted for 1970. The model shows France becoming not only the major grain producer but also the major livestock producer. To utilize their excess grain production, France produces beef which was formerly produced in Italy and Germany-Benelux. This increased beef production necessitated increased feeder calf imports by France (primarily from Italy and Germany-Benelux) and a shift from food grain to feed grain production in France. This shift to France becoming the major agricultural center of the European Economic Community will

result in the Community achieving more self-sufficiency in the future. Thus, the United States cannot expect their grain exports to Europe to expand. In fact, this model shows United States grain exports to the Community declining.

The intent of this study was to develop a simple, short run predictive model for grain-livestock trade patterns. Within the rather severe limitations imposed on the model the results show that it has the ability to predict. As important as this model's ability to predict, and possibly more so, is its ability to highlight areas where we lack knowledge of the system we are trying to first simulate, then predict from. This model provides added insight into two areas causing prediction errors--the quality of the data and the underlying structure of the model.

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CHAPTER I

Introduction

A recent Michigan State University-United States Department of Agriculture research project focused on the effects of the implementation of the European Economic Community's Common Agriculture Policy upon the grain-livestock economy of the European Economic Community.[1] The major emphasis of this study was to estimate levels of production and consumption of grain and livestock products for 1970 and 1975. Since European markets are important outlets for United States agricultural commodities these production and consumption estimates have an

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[1]George E. Rossmiller, "The Grain-Livestock Economy of West Germany With Projections to 1970 and 1975." Institute of International Agriculture, Research Report No. 1, Michigan State University, March 1968.

Fred A. Mangum, Jr., "The Grain-Livestock Economy of Italy With Projections to 1970 and 1975." Institute of International Agriculture, Research Report No. 2, Michigan State University, April 1968.

Michel J. Petit and Jean-Baptiste Viallon, "The Grain-Livestock Economy of France With Projections to 1970 and 1975." Institute of International Agriculture, Research Report No. 3, Michigan State University, June 1968.

Donald J. Epp, "Changes in Regional Grain and Livestock Prices Under the European Economic Community Policies." Institute of International Agriculture, Research Report No. 4, Michigan State University, June 1968.

Vernon L. Sorenson and Dale E. Hathaway, "The Grain-Livestock Economy and Trade Patterns of the European Economic Community With Projections to 1970 and 1975." Institute of International Agriculture, Research Report No. 5, Michigan State University, August 1968.

important impact on United States exporters and farmers. Their analysis is summarized in the form of supply-demand balances for the European Economic Community member countries. While this tells what the overall supply-demand balance for the European Economic Community is, it does not specify the ensuing trade patterns. By utilizing the data and projections presented in their study as a foundation, I propose to arrive at projected trade flows within the European Economic Community and between it and its major trading partners. Thus, we will have a more exact estimate of the magnitude of this market for United States agricultural commodities, as well as a more complete analysis of intracountry European Economic Community trade.

Objectives

The objectives of this study are:

1. To develop a working international trade model that will represent the grain-livestock trade sector of the European Economic Community and
2. To utilize this model to project grain-livestock trade patterns between the member countries of the European Economic Community and between these countries and their major external trading partners.

CHAPTER II

Grain-Livestock Trade Policy in the European Economic Community

The core of the European Economic Community's trade policy for grain and livestock products depends on a system of variable import levies and export subsidies designed to offset the consequences of the price differentials between the European Economic Community and world markets. The variable import levy brings the price of the imported product up to the price level of the same product produced domestically. Conversely, the variable export subsidy brings the export price of a product down to the world price level. Since these variable import levies and export subsidies depend on domestic prices, trade policy becomes an integral part of the European Economic Community's Common Agriculture Policy.

The basic objectives of the Common Agriculture Policy are to (1) balance European Economic Community supply and demand, both internally and externally, by actions on supply and demand, (2) provide an adequate income to farmers by structural and regional improvements, (3) stabilize markets by protecting farmers from speculative price movements, while at the same time not isolating the domestic market from the long run influences of the world market and (4) assure a fair treatment of consumers by enabling the agricultural industries to find external markets at reasonable and competitive prices.

To obtain these objectives a three point policy was initiated. Trade in agricultural products was gradually freed from restrictions among the European Economic Community member countries. A common external trade policy was developed by the European Economic Community, with variable import levies and variable export subsidies, to replace

all national protection policies. And the European Economic Community members jointly financed the costs of market support for agricultural products, the subsidizing of exports to non-member countries and expenditures on structural and regional improvement in agriculture.

Common agricultural prices are the key component in the European Economic Community's Common Agriculture Policy. These price levels determine the need for support purchasing of agricultural products and the size of the variable levies and subsidies, which in turn determine agricultural trade policy toward non-member countries.

In order to free internal trade in agricultural products a transition period was adopted during which the national policies and price support levels were gradually harmonized.[1] To achieve this price harmonization with minimum disruption a variable levy and subsidy system was used for trade in agricultural products among member countries. Unlike the external levies, these internal levies were gradually lowered until they disappeared by the end of the transition period. These internal levies were lower than the external levies in order to insure a preference for the agricultural products produced in the European Economic Community. Subsequent sections will describe the specific policies adopted for the various grain and livestock products important in this work.

The European Agricultural Guidance and Guarantee Fund

The financing of the Common Agriculture Policy is executed through the European Agricultural Guidance and Guarantee Fund.

About one-fourth of the expenditures of the Fund have been made under the Guidance Section. Expenditures under this Section are aimed

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[1]July 1, 1962 to December 31, 1969.

at structural reform in agriculture. The Fund's goal here is to improve both production and marketing efficiency, particularly the optimum utilization of labor. Assistance under this Section involves capital subsidies for specific projects. In order to receive assistance from the Fund the project must (1) be designed to help agriculture adjust to the Common Agriculture Policy, (2) be a project having long run, lasting economic effects and (3) be a part of a European Economic Community program. Projects devised as an integral part of a regional economic development plan within the European Economic Community will be given priority. Before any project can be funded by the Fund the application must have been submitted through and approved by the member country concerned. When a project is approved the Fund can finance no more than twenty-five percent of the total investment of any one project. The recipient of the subsidy (be it a public, semipublic or private group) must provide at least thirty percent of the total investment. The member country in which the project is to be carried out must also contribute to the financing of the project.

The remaining three-fourths of the Fund's expenditures fall under the Guarantee Section. Expenditure under this Section covers two types of activities. First, funds are used to support internal European Economic Community market prices through market intervention. This is accomplished by withdrawing any excess supply which a market cannot absorb and either carrying this excess supply over to the next time period and/or finding an alternative outlet for this excess supply on the internal market. Guarantee Section funds are also used to provide export subsidies. Since the European Economic Community support prices for exportable commodities are higher than world price levels, export

subsidies are necessary in order to maintain exports and eliminate the buildup of surpluses.

Table II-1 shows the total expenditures of the European Agriculture Guidance and Guarantee Fund by sections for the 1962-1963 to 1968-1969 period. The substantial increase over the period stems from two sources. More and more commodities fell under Common Agriculture Policy regulations during this transition period and, therefore, the Fund became accountable for the financing of programs for these added commodities. Also, throughout the transition period the Fund took over from the member countries an ever increasing share of the Common Agriculture Policy expenditures. Member countries were reimbursed for Guarantee Section expenditures on eligible commodity programs in the following percentages:

1962-1963	16.67%
1963-1964	33.33
1964-1965	50.00
1965-1966	60.00
1966-1967	70.00
1967-1968	100.00

After 1967-1968 only commodities in the unified market stage are qualified for one hundred percent financing. If a commodity has not reached the unified market stage by 1967-1968 only seventy percent of eligible program expenditures for that commodity are to be reimbursed.

During the 1962-1963 to 1966-1967 period, expenditures from the Guidance Section of the Fund could not exceed one-third of total Guarantee Section expenditures. However, since Guarantee Section

Table II-1.--European Agricultural Guidance and Guarantee Fund expenditures

Year	Guidance section	Guarantee section	Special section	Total
	Million Dollars			
1962-1963	9.1	28.7		37.8
1963-1964	17.1	50.7		67.8
1964-1965	54.6	170.9		225.5
1965-1966	80.0	240.1		320.2
1966-1967	123.5	370.5		494.0
1967-1968	285.0	1,312.9	206.3	1,804.2
1968-1969	285.0	2,009.7	138.3	2,433.0

Source: B. L. Berntson, O. H. Goolsby and C. O. Nohre, "The European Community's Common Agricultural Policy: Implications for U.S. Trade," Foreign Agricultural Economic Report No. 55, Foreign Development and Trade Division, Economic Research Service, United States Department of Agriculture, Washington, D.C., October 1969, p. 102.

expenditures were expected to increase rapidly after 1966-1967, a $285 million ceiling was placed on Guidance Section expenditures beginning in 1967-1968.

Special payments were paid to Italian, German and Luxembourg grain producers from a Special Section of the Fund, in addition to those paid under the Guarantee Section during the 1967-1968 to 1969-1970 period. This partial income compensation for the grain producers in these three countries resulted from the abrupt drop in grain prices when the unified grain market went into effect.

A variety of systems have been used to determine the size of each member country's contribution to the Fund. For the 1962-1963 to 1964-1965 period, two systems determined member country contributions. The first, providing one hundred, ninety and eighty percent of the contribution, respectively, in 1962-1963, 1963-1964 and 1964-1965, was based on a percentage scale defined in Article 200 of the Treaty of Rome. This country scale is shown in the first column of Table II-2. The second, providing the remainder of the contributions, was proportionate to the member country's net imports of commodities included in the Common Agriculture Policy from external countries. This part was included because the variable levy proceeds accrued to the member country's treasury during the transition period. For this period a ceiling also existed on any member country's total contribution to the Fund (see the second column of Table II-2).

For 1965-1966 and 1966-1967, the member countries switched to the fixed percentage scale of contributions to the Fund shown in Table II-2.

A different system was initiated in 1967-1968. The member countries contributed ninety percent of their receipts from the variable import

Table II-2.--Member country's percentage contribution to the European Agricultural Guidance and Guarantee Fund

	1962-1965		1965-1966	1966-1967	1967-1969	1970	1971-1974
	Article 200 scale	Ceiling	Total contribution	Total contribution	Contribution not received from variable levy receipts	Total contribution for common agriculture policy expenditure	Contribution not received from variable levy and customs receipts
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Percent						
France	28.00	28.00	32.58	29.26	32.00	28.00	32.60
Italy	28.00	28.00	18.00	22.00	20.30	21.50	20.20
West Germany	28.00	31.00	31.67	30.83	31.20	31.70	32.90
Belgium	7.90	10.50	7.95	7.95	8.10	8.25	6.80
Luxembourg	0.20		0.22	0.22	0.20	0.20	0.20
Netherlands	7.90	13.00	9.58	9.74	8.20	10.35	7.30

Source: European Community Information Service, "The Common Agricultural Policy," Community Topics 28, July 1967, p. 7.

Martin J. Hillenbrand, "New Common Market Financial Regulation and Prospects for British Entry," Information Memorandum, Department of State, Washington, D.C., January 14, 1970, p. 1 (Annex).

Year	1895-1900	1900-1905	1905-1910	1910	1911-1924
1895	Central Park	Hyde Park	[illegible]	[illegible]	[illegible]
1896	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1897	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1898	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1899	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1900	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1901	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1902	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1903	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1904	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1905	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

[illegible] [illegible] [illegible] [

levies on agricultural commodities to the Fund. The remaining portion required to finance Guidance and Guarantee Sections of the Fund was allocated on the fixed percentage scale shown in column five of Table II-2. Contributions to the Special Section were based on the percentage scale defined in Article 200 of the Treaty of Rome.

Contributions for Common Agriculture Policy expenditures by the Fund was again alloted on a fixed percentage scale for the member countries in 1970 (Table II-2, column six). Expenditures for purposes other than those under the Common Agriculture Policy were based on the percentage scale defined in Article 200 of the Treaty of Rome.

For the 1971-1974 period, European Economic Community expenditures will be financed by member countries contributing their variable levy receipts from commodities covered by the Common Agriculture Policy or fifty percent of their total variable levy and customs receipts, whichever is larger. Ten percent of this will be refunded to the member countries to cover collection costs. Any shortages will be made up on the basis of the percentage scale shown in column seven of Table II-2. Regardless of the source of contributions, the percent of total contributions from any one member country will not be less than 98.5 percent nor more than 101.0 percent of that contributed in the previous year. Any deficits caused by this ceiling on contributions will be divided among the member countries that have not already reached their ceiling.

From 1975 on, European Economic Community expenditures will be financed by member countries contributing all of their variable levies from Common Agriculture Policy commodities and all their customs receipts. Ten percent of these contributions will be refunded to cover the costs of collection. To make up any deficits, member countries will

contribute up to one percent of their value-added tax collections (presumably the same percent for each member country). For the 1975-1977 period, the percent of total contributions paid by any one member country will be no less than 98 percent nor more than 102 percent of the percent of the total contributed in the previous year. Again, any deficit caused by this ceiling will be allocated among the member countries which are still below their ceiling. After 1977, there will be no limit on any one member country's percentage contribution. There is, however, an effective ceiling on the total revenue provided the European Economic Community by the member countries. No more than all the variable levy and customs receipts plus one percent of total value-added tax collections can be used for Community expenditures.

A summary of the member country's contributions to and receipts from the European Agricultural Guidance and Guarantee Fund is presented in Table II-3. This imbalance between receipts and contributions has been one of the most difficult political problems facing the European Economic Community during the transition period. This is evidenced by the multiplicity of financing schemes used since 1962.

Institutional Structure

The institutional setting for the Common Agriculture Policy is outlined in Figure II-1. The European Commission has the sole responsibility for drafting policy proposals. When the Commission reaches agreement on a policy proposal, they submit it to the Council of Ministers. The Council sends the proposal to first, the Economic and

Table II-3.--Total contributions to and receipts from the European Agricultural Guidance and Guarantee Fund, 1962-1963 to 1968[1]

	Guidance section			Guarantee section			Special section			Total		
	Contribution to	Receipts from	Balance	Contribution to	Receipts from	Balance	Contribution to	Receipts from	Balance	Contribution to	Receipts from	Balance
	Million Dollars											
France	82.5	44.1	-38.4	435.7	875.0	439.3	58.3		58.3	576.5	919.0	342.5
Italy	64.2	150.8	86.6	411.2	306.7	-104.5	58.3	65.0	6.7	533.7	522.4	-11.3
West Germany	86.8	56.4	-30.4	538.3	163.3	-375.0	58.3	140.0	81.7	683.3	359.7	-323.6
Belgium	22.9	14.4	-8.5	155.8	95.5	-60.3	16.5		-16.5	195.2	109.9	-85.3
Luxembourg	0.6	2.8	2.2	4.4	0.8	-3.6	0.4	3.3	2.9	5.5	6.8	1.3
Netherlands	27.3	15.9	-11.4	199.6	303.9	104.3	16.5		-16.5	243.4	319.8	76.4
European Economic Community[2]	284.3	284.3		1,745.0	1,745.0		208.3	208.3		2,237.5	2,237.5	

[1]Data represent actual settlement transactions made by the end of 1968. Only seventy-five percent of both the 1966-1967 allocation and the 1967-1968 estimated allocation are included in these figures. Otherwise, they are complete through 1965-1966.

[2]Figures may not add to totals due to rounding.

Source: Berntson, Goolsby and Nohre, "The European Community's Common Agricultural Policy: Implications For U.S. Trade," p. 104.

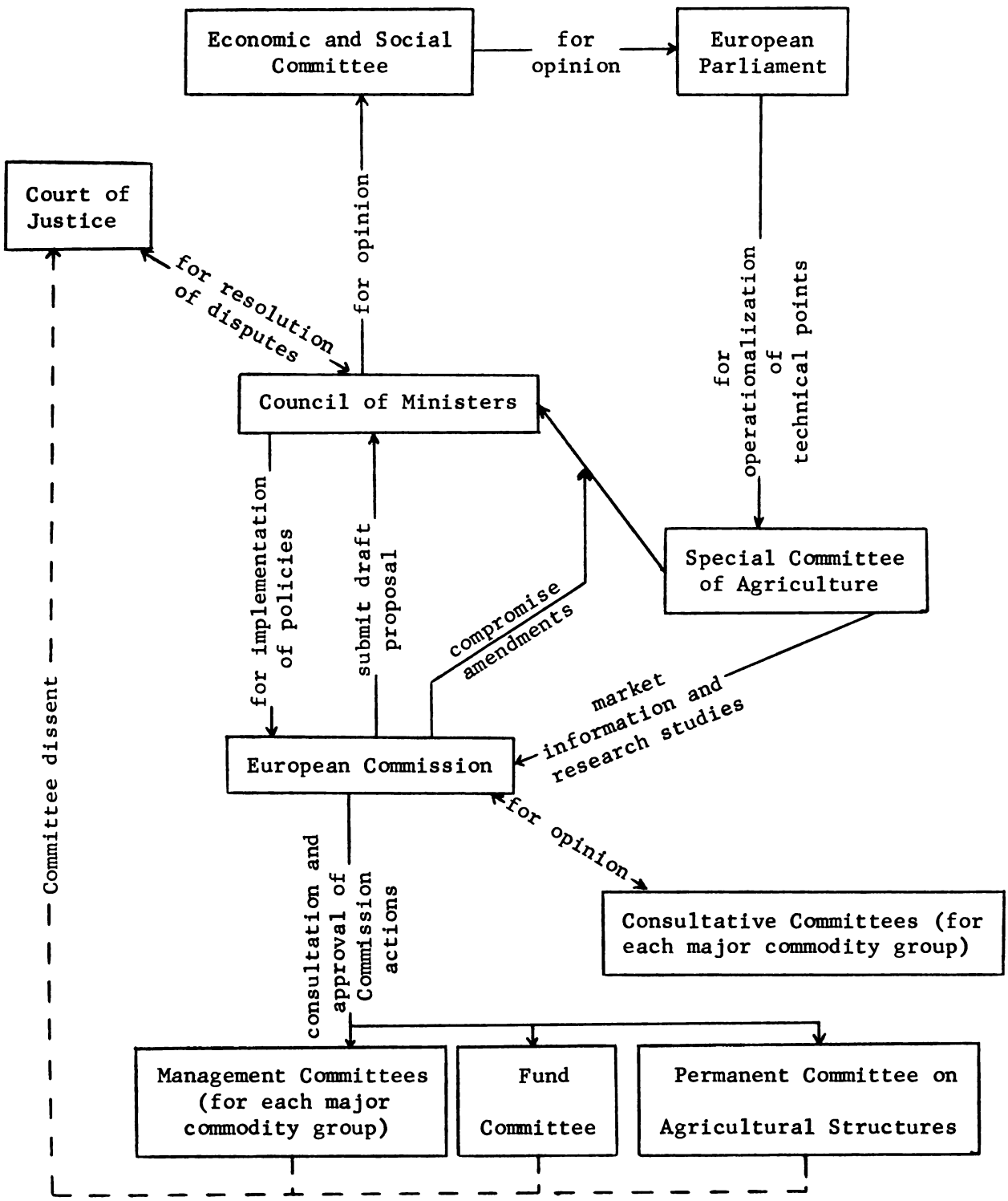

Figure II-1.--Schematic diagram representing the institutional structure of the Common Agriculture Policy

Social Committee and then the European Parliament for an opinion.[2] Before the proposal is debated in the Council, it is sent to the Special Committee on Agriculture where the technical features are clarified and put in an operational form. Then during the debate in the Council of Ministers, the European Commission can submit amendments to its original proposal in order for the member countries to reach a compromise policy. As soon as a decision is reached by the Council, the provisions of the new policy are published in the Official Gazette of the European Communities and are then in effect throughout the European Economic Community.

While the Council of Ministers is the decision making body at the policy level, the European Commission is charged with the responsibility of the everday implementation of the Common Agriculture Policy. To assist it in implementing policy, the Commission is aided by three sets of committees. For every major commodity or group of commodities, a Management Committee exists which must be consulted on all measures affecting the commodities under their jurisdiction. A Fund Committee must also be consulted on all activities involving European Agricultural Guidance and Guarantee Fund expenditures. The Permanent Committee on Agricultural Structures must be consulted on project selection and policy coordination for any activity coming under the auspicies of the Guidance Section of the Fund.

The policy decisions of the European Commission are final in order for effective day-to-day operation to take place. However, if any of these committees reject any of the European Commission's policies by a

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[2]Employers, trade unions, farmers, merchants and consumers are represented on the Economic and Social Committee.

qualified majority vote and the Commission abides by the original decision, the issue comes before the Council of Ministers.[3] The Council of Ministers then has one month in which to revise or reject the Commission's decision, again by a qualified majority vote. The Council of Ministers decision is a final decision.

The European Commission has also set up a series of commodity oriented Consultative Committees, composed of representatives of all groups affected by the Common Agriculture Policy, to confer with on problems originating over the development and execution of the Common Agriculture Policy. The Special Committee on Agriculture also assists the Commission by providing market information and research studies.

Finally, any dispute arising from the Common Agriculture Policy in the Council of Ministers that cannot be settled can be submitted to the European Economic Community's Court of Justice for a final ruling.

The Common Agriculture Policy

Grain

The common organization of the grain market came into effect in August, 1962. All national trade policies, particularly quantitative import restrictions, were eliminated and replaced by a system of variable import levies. This levy system is the only protection against imports from outside. It prevents cheaper grain imports from disrupting internal grain price levels, which are substantially above the world price level.

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[3] A qualified majority vote requires twelve votes out of seventeen. The votes are allocated as follows: France, Italy and West Germany, four votes each; Belgium and Netherlands, two votes each; and Luxembourg, one vote.

For every marketing year,[4] the Council of Ministers sets a target price for each grain. The target price ". . . is fixed to enable farmers to plan production and to give economic guidance to all market users. The common agricultural policy aims at keeping the market price as close as possible to the target price."[5] This price is specified for a grain of standard quality for the marketing center of the major grain deficit region in the European Economic Community--Duisburg, West Germany. Related to these target prices are threshold prices. These threshold prices are the basis for calculating the variable import levies on grain. They are established for Rotterdam, Netherlands as the minimum import price allowable. The threshold price at Rotterdam plus the transport cost of moving the grain from Rotterdam to Duisburg equals the target price in Duisburg. The variable import levy is calculated as the difference between the threshold price and the most favorable c.i.f. world price at Rotterdam. This variable import levy is then applied to all grain imports regardless of the actual offer price, the port of entry or the final destination. The variable import levy is adjusted day-to-day to account for changes in the c.i.f. world prices. Threshold prices are also specified for cereal grains that are imported but not normally produced in the Community. These threshold prices are set at levels such that imports will not undersell competing domestic grains. Import levies on products produced from grain are calculated on the basis of the input grain import levies, plus a margin of protection for the domestic processing industry.

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[4] August 1 to the following July 31.

[5] European Community Information Service, "The Common Agricultural Policy," p. 2.

During the transition period, August, 1962 to July, 1967, a similar variable import levy system was in existence between member countries for grains. Until the end of the transition period, member countries set national target prices which were gradually brought together to achieve a common target price by the end of the transition period. Since target prices differed between member countries, variable import levies were charged on internal grain trade moving from one member country to another with a higher target price. With one exception, this intra-Community variable import levy was calculated in the same manner as in the case of imports from non-member countries. The gross intra-Community import levy equaled the difference between the threshold price in the importing member country and the c.i.f. free-at-frontier price from the exporting member country (rather than the most favorable c.i.f. world price). In order to ensure a margin of preference for European Economic Community grain producers over non-Community producers, the gross variable import levy was reduced by a "lump sum preference." This "lump sum preference" was initially $1.00 per metric ton for whole grains, then $1.10 per metric ton for the remainder of the transition period. This variable import levy system for grains is depicted in Figure II-2.

Even with the variable import levy system, grain prices could fall below their target price. To avert this, the Commission establishes a guaranteed intervention price--usually about seven percent below the target price--at which the official intervention agency in each country is obligated to purchase any domestically produced grain that the producers cannot sell for a higher price in the marketplace. A basic intervention price is established for each grain at Duisburg. Regional intervention prices for other marketing centers are computed on the basis of the Duisburg

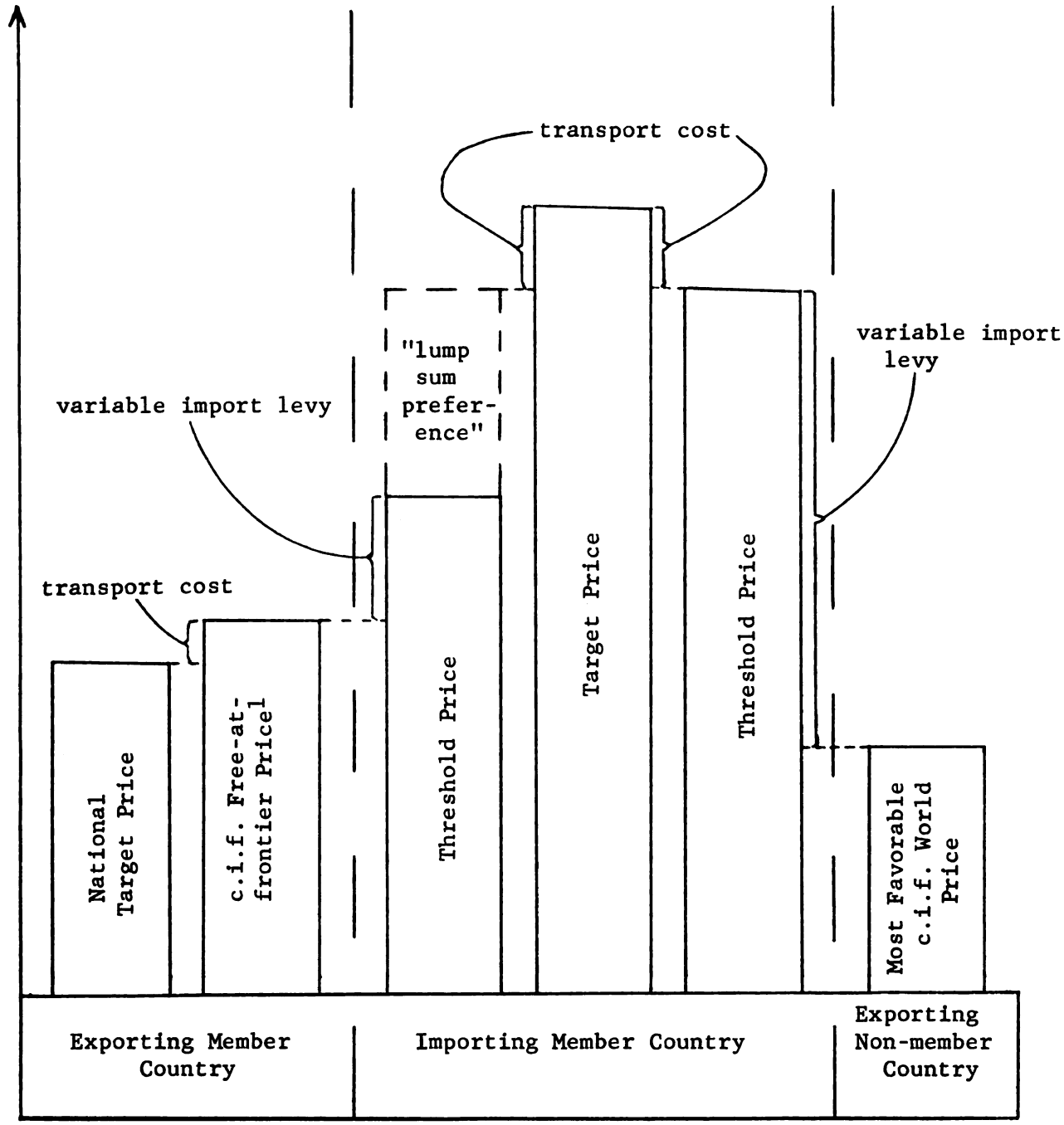

Figure II-2.--The European Economic Community variable import levy system for grain

[1] May be below national target price if producer is located near the border and/or when intervention price plus transport cost is the domestic price.

Source: Adapted from Finn B. Jensen and Ingo Walter, The Common Market, Economic Integration In Europe, J. B. Lippincott Company, Philadelphia, Pennsylvania, 1965, p. 68.

"Lump sum preferences"

intervention price adjusted for transport and other marketing costs. An exception is the intervention price for corn which is the same throughout the Community when the domestically marketed corn is less than forty-five percent of consumption.

An additional subsidy may be paid to producers of durum wheat. A guaranteed minimum price of durum wheat is established for the marketing center of the major producing area. If this guaranteed minimum price for durum wheat exceeds the intervention price, a subsidy equal to the difference is paid on all durum wheat production. This subsidy is uniform throughout the Community.

Also, the target price for grain can be adjusted each month to take account of storage costs. Therefore, grain prices would drop at the end of every marketing year. Because of this, some transitional compensation is granted to holders of year end grain stocks produced in the Community. This compensation cannot exceed the difference between the target price for the last month of the previous year and the target price for the first month of the current year.

Since grain prices in the European Economic Community are higher than world grain prices, grain exports are not possible without assistance. Community grain export assistance takes the form of variable export subsidies which are the counterpart of the variable import levies. The variable export subsidy equals the difference between the Community grain price and the price in the destination country. Thus, with this variable export subsidy, Community grain can be competitive in any market.

Licenses are required for all Community imports and exports of grain and grain products and are freely awarded upon request. The variable

import levy or subsidy may be determined when the license is issued, rather than when the transaction actually takes place.

As an alternative to subsidizing exports, premiums may be paid for diverting grain into a separate second market. For example, a denaturing premium is used to help support the market for food grain by allowing the surplus soft wheat and rye of milling quality to be sold at a lower price only in the feed grain market. The original methods for doing this consisted of either mixing the surplus food grain with mixed feed grain in a specified fixed proportion (admixture) or crushing the food grain kernals (denaturing). The kernal crushing method of denaturing had the disadvantage of making denatured food grain unsuitable for certain purposes. In order to eliminate this disadvantage, the denaturing process was changed to one of dyeing twenty percent of the kernals blue and mixing them with undyed kernals. The denaturing premium is composed of two separate parts: ". . . a partial amount taking account of the difference between the price for soft wheat and that for barley, [and] the other partial amount shall take account of the technical costs of denaturing, fixed in a standard way, or the special costs of admixture."[6] The difference between soft wheat and barley price is taken into account in the denaturing premium in order that denatured food grain does not disturb the barley and corn market.

Beef and Veal

The Common Agriculture Policy for beef and veal took effect on November 1, 1964, and the common market was established by July 29, 1968.

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[6]Ernest Koenig, "Denaturing of Wheat and Rye," Department of State Airgram, From U.S. Mission to the European Communities, Brussels to Department of State/Washington, Pass Agriculture, July 19, 1968, Encl. 1, p. 2.

European Economic Community imports of beef and veal are subject to two types of trade restrictions: a common external tariff and a supplementary variable import levy. The common external tariff for live cattle is sixteen percent ad valorem and is twenty percent ad valorem for meat.

When domestic beef and veal prices are under pressure from low-cost imports, an additional form of protection--the supplementary variable import levy--can be imposed.

The European Commission sets a guide price for beef and veal products. This guide price is not a guaranteed producer price, but rather an average price which they consider to be desirable for producers to receive for their production. However, this guide price does serve as the basis from which the supplementary variable import levies and the intervention prices are derived. Whenever the internal market price is equal to or less than the guide price, the domestic producers receive the protection of a supplementary variable import levy. If the internal market price is between 100 and 102 percent of the guide price, only 75 percent of the supplementary variable import levy is charged. When the internal market price is from 102 to 104 percent of the guide price, 50 percent of the levy is charged. Only 25 percent of the supplementary variable import levy is collected if the internal market price is between 104 and 106 percent of the guide price; and no levy is collected when the internal market price exceeds 106 percent of the guide price. This supplementary variable import levy is the difference between a calculated import price (plus the ad valorem tariff) and the guide price. The calculated import price for live animals is a weighted average of prices in Austria, Denmark, Ireland and the United Kingdom. The calculated import price for fresh, chilled and smoked beef and veal is based on this price for the

live animal adjusted by a live weight-carass weight conversion factor. For frozen beef and veal, the calculated price is based on the most favorable c.i.f. world price.

Under the General Agreement on Tariffs and Trade, the European Economic Community has agreed to a levy free quota for 22,000 tons of frozen beef. The tariff rate cannot exceed twenty percent on that 22,000 tons. This 22,000 tons, however, is a very small portion of the total imports of frozen beef. If there is a lack of frozen beef available for the processing industry, the Council of Ministers can reduce or eliminate the levy in order to increase imports.

In order to increase beef and veal production without a corresponding increase in milk production, some special concessions are allowed on imports of calves and young fattening cattle. Whenever the internal market price for calves is greater than the guide price, the supplementary variable import levy on calves and young fattening cattle will not be charged. Also, in this case, the common external ad valorem tariff will be cut in half.

During the transition period, the tariff rates in each member country were gradually harmonized. The member countries could also apply a supplementary variable import levy on imports from another member country. If the importing country intervened in their national market the maximum levy they could impose was one that raised the price of the imported product to no more than ninety-six percent of their guide price. If a member country did not intervene in its domestic market, the maximum levy could not raise the price of the imported product to more than ninety percent of their guide price. Neither supplementary variable import levies nor intervention in the domestic market were allowed for calves.

Also, during the transition period guide prices were established for individual member countries. These were gradually aligned until a common guide price was established in 1968.

Two intervention prices exist for mature cattle and, through live weight-carass weight conversion factors, for beef. The first intervention price is set at ninety-eight percent of the guide price. At this price, intervention in the market may take place. The second intervention price is set at ninety-three percent of the guide price. When the market price reaches this level, intervention must take place. No intervention price nor intervention procedure is provided for in the calf market.

The European Economic Community is a net importer of beef and veal; however, variable export subsidies can be paid on any Community exports in order to bring the internal price down to the world price level. This subsidy is the same throughout the Community but can be differentiated by destinations.

Import and export certificates are required for trade in beef and veal. Beef and veal imports are also subject to standarized sanitary and veterinary regulations.

Pork

Since pork is a 'processed' product based primarily on feed grain, the variable import levy for pork is calculated in a different manner than the variable import levy for beef and veal or even grain. The variable import levy consists of two parts. The first takes into consideration the difference between feed grain prices. It equals the difference in the value of the feed grain ration required to produce a unit of pork when that ration is priced at the world market price level and at the European Economic Community price level. A second element,

seven percent of the previous years sluice-gate price, is added in order to give the domestic pork producers a margin of preference.

The sluice-gate price is, in effect, a minimum import price. It differs from a threshold price in that it is not tied in any way to a guaranteed producer price. The sluice-gate price for pork is also composed of two parts. The first is equal to the value, at world market prices, of a specified, efficient feed grain ration required to produce a unit of pork. The second part is a fixed sum representing other costs of production and marketing. When pork imports threaten to enter at a price below the sluice-gate price, a supplementary variable import levy is charged. This supplementary variable import levy is equal to the difference between the sluice-gate price and the lower import price.

During the transition period, July 30, 1962 to July 1, 1967, trade between Community members was subject to two types of protection. First were the member countries customs duties which were gradually eliminated during the transition period. The second was a variable import levy calculated in the same manner for trade between member countries as that between a member country and third countries. As feed grain prices were harmonized, this variable import levy gradually disappeared.

The Common Agriculture Policy also provides for mandatory internal market intervention for pork. However, the intervention mechanism is not via a guaranteed intervention price, as is the case with grain and beef. Base prices are fixed annually and, whenever internal prices fall to this base price, the Council is required to examine the market situation and decide whether any market intervention is called for. Intervention must take place if it appears that internal pork prices will remain below the base price for any length of time. The intervention price must then be

between eighty-five and ninety-two percent of the base price. This base price is set after considering the level of the sluice-gate price, the level of the variable import levy and the desire to maintain stable pork prices without the buildup of surplus pork.

Variable export subsidies are also provided for pork. The level of this variable export subsidy is equal to the difference in the costs of the feed grain required to produce the pork in the two countries. During the transition period, there existed an alternative method of determining the level of the variable export subsidy for trade between member countries. A country could refund an amount equal to the variable import levy on its imports from third countries. If this method was used, however, the importing member country had the option of imposing a variable import levy equal to that it applied to imports from third countries.

Imports of either pork or live animals require import certificates and surety deposits. Pork trade is also subject to standardized veterinary and sanitary regulations.

Eggs and Poultry

The Common Agriculture Policy for eggs and poultry is based only on a system of variable import levies and variable export subsidies. No provisions exist for any internal market intervention activities. Since the European Economic Community has been a deficit production area, it was felt that import restrictions alone would provide sufficient price support for domestic producers.

Eggs and poultry, like pork, are 'processed' products; therefore, the variable import levy on eggs and poultry is calculated in the same manner as that for pork. The levy consists of two elements. The first,

the feed grain differential, equals the difference in value of the feed grain required to produce a unit of eggs or poultry in the European Economic Community and on the world market. Seven percent of the previous years sluice-gate price is added to the feed grain differential in order to give domestic producers an added margin of preference.

The sluice-gate price for eggs and poultry is a minimum import price, as is the case for pork; and it is calculated in the same manner as the pork sluice-gate price. Whenever egg or poultry imports threaten to enter at a price below the sluice-gate price plus variable import levy, a supplementary variable import levy is charged. This supplementary variable import levy equals the difference between the import offer price and the sluice-gate price plus variable import levy.

During the transition period, August 1, 1962 to July 1, 1967, the variable import levy system also applied, but in a slightly modified form. As is the case now, the variable import levy included a feed grain differential. For internal trade this gradually disappeared as feed grain prices were harmonized. A second part of the levy was based on the customs duties in force at the beginning of the transition period. This portion was gradually reduced until finally eliminated by the end of the transition period. A third part, applicable only to non-member countries, gave a preference to Community producers. This portion started at two percent of the previous years sluice-gate price and rose to the present seven percent by the end of the transition period.

Export subsidies are also granted by the European Economic Community in order for producers to sell eggs and poultry to non-member countries at world prices. These variable export subsidies are calculated in the same manner as the ones for pork.

A common system of egg-grading came into effect January 1, 1968, which must be complied with by all imports. A mark of origin must be on all egg containers, also. Poultry products are subject to sanitary and veterinary regulations, too.

Summary

A summary of the Common Agriculture Policy regulations is presented in Table II-4.

Table II-4.--The European Economic Community's Common Agriculture Policy arrangements for grain and livestock products

Arrangements / Commodities	Target price	Threshold price	Sluice-gate price	Free at frontier price	Variable import levy	Supplementary variable import levy
Grain	X	X		X	X	
Beef and veal			X[1]	X	X	
Pork			X		X	X
Eggs and poultry			X		X	X
Milk and dairy products	X[3]	X		X	X	

--Continued

A common system of trade relations came into effect January 1, 1968, which must be complied with by all importers. A mark of origin must be on all egg containers, also. Poultry products are subject to sanitary and veterinary regulations, too.

Summary

A summary of the Common Agriculture Policy regulations is presented in Table II-4.

Table II-4.--The European Economic Community's Common Agriculture Policy arrangements for grain as in effect 1968

	Target price	Threshold price	Guarantee price	Free-at-frontier price	Variable import levy	Variable export levy
Grain	X	X		X	X	
Meat and veal			X[1]	X	X	
Pork			X		X	X
Eggs and poultry			X		X	X
Milk and dairy products	X	X		X	X	

Continued

Table II-4 (cont'd.)

Arrangements / Commodities	Import tariff	Provision for market intervention	Provision for variable export subsidy	Quota	Initial date	Unification date
Grain		X	X		8-1-62	7-1-67
Beef and veal	X	X	X	X[2]	11-1-64	7-29-68
Pork		X	X		8-1-62	7-1-67
Eggs and poultry			X		8-1-62	7-1-67
Milk and dairy products		X[4]	X		11-1-64	7-29-68

[1]Guide price.

[2]Levy free import quota on frozen beef

[3]Milk only.

[4]Butter and skimmed milk powder only.

Source: Adapted from Ministry of Agriculture and Fisheries of the Netherlands, Statistics and Documentation Section, "Selected Agri-Figures of the E.E.C." July 1968, p. 48.

CHAPTER III

Theoretical Framework

The objective of this chapter is to develop an international trade model that will simulate the grain-livestock trade sector of the European Economic Community. Since international trade in agricultural commodities is not completely transacted within a competitive framework, an important aspect of this study will be the incorporation of institutionally controlled policy variables into the model. By incorporating this type of variable in the model, it is hoped that we will be able to more realistically simulate the agricultural trade flows for the European Economic Community.

The general technique applied here will be spatial equilibrium analysis. Spatial equilibrium analysis is a broad methodology covering a wide range of techniques: from fixed production-fixed consumption models at one end of a continuum to supply-demand models at the other end.

There have been numerous interregional studies using the full range of spatial equilibrium techniques. However, there have been few studies of spatial equilibrium analysis applied to international trade.

Dean and Collins used a fixed production-fixed consumption (transportation) model to analyze the effects of European Economic Community tariff policies on world trade in fresh oranges. They estimated production and wholesale demand curves for each country. Given these estimated demand curves, existing price levels were adjusted until world demand equaled world production. These quantities demanded, with the estimates of production, transportation costs and tariff rates, were

used in a transportation model to determine the optimum trade pattern. The solution to the transportation model implied a set of price differentials based on transportation rates and tariff rates. These price differentials were compared with the original adjusted prices, and the quantities demanded were re-adjusted until world demand again equaled world production and until the newly adjusted prices were consistent with those implied in the transportation model solution. A second transportation model was solved, using the re-adjusted estimates of world demand and production. This procedure was repeated until a consistent set of prices, consumption and trading patterns was obtained.[1]

Fox, in his study of the European Economic Community's grain trade, employed activity analysis models--linear programming production models augumented by international transfer activities. Unlike Dean and Collins, he assumed grain prices were predetermined--politically predetermined. Given these prices and demand and resource levels, he estimated trade patterns between countries and resource use and production levels for each country. Fox's models dealt with three commodities: food wheat, feed wheat and feed grain.[2]

In his study of international trade in feed grain, Bjarnason employed a supply-demand spatial equilibrium model. He used a least

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[1]Gerald W. Dean and Norman R. Collins, "World Trade in Fresh Oranges: An Analysis of the Effect of European Economic Community Tariff Policies," Giannini Foundation Monograph Number 18, California Agricultural Experiment Station, January 1967.

[2]Roger William Fox, "Some Possible Production and Trade Effects of the EEC's Common Agricultural Policy for Grains," Unpublished Ph.D. dissertation, Department of Agricultural Economics, Michigan State University, 1965.

squares regression technique to estimate demand and, indirectly, supply. An acreage and a yield function were estimated. The product of these two functions provided a supply function. Given the supply functions, the demand functions and a transportation cost matrix, Bjarnason maximized international consumer surplus or what Samuelson called "net social pay-off" to determine the optimum production, consumption, prices and trade patterns for each country.[3, 4]

Utilizing the same basic spatial equilibrium model as Bjarnason, Bates and Schmitz analyzed international trade in sugar. They also made use of a transportation model to study the efficiency of the world sugar trade.[5]

In 1964, Takayama and Judge developed an interregional supply-demand spatial equilibrium model involving several interrelated commodities.[6] By including trade policies, Bawden adapted this interregional model to international trade.[7] Bawden's model was utilized by

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[3]Harold Frederick Bjarnason, "An Economic Analysis of 1980 International Trade in Feed Grains," Unpublished Ph.D. dissertation, Department of Economics, University of Wisconsin, 1967.

[4]Paul A. Samuelson, "Spatial Price Equilibrium and Linear Programming," American Economic Review, Vol. 42, June 1952, pp. 283-303.

[5]Thomas H. Bates and Andrew Schmitz, "A Spatial Equilibrium Analysis of the World Sugar Economy," Giannini Foundation Monograph Number 23, California Agricultural Experiment Station, May 1969.

[6]T. Takayama and G. G. Judge, "Spatial Equilibrium and Quadratic Programming," Journal of Farm Economics, Vol. 46, February 1964, pp. 67-93; and T. Takayama and G. G. Judge, "An Intertemporal Price Equilibrium Model," Journal of Farm Economics, Vol. 46, May 1964, pp. 477-484.

[7]D. Lee Bawden, "A Spatial Equilibrium Model of International Trade," speech presented at the annual meeting of the Econometric Society, New York, N. Y., December 30, 1965; and D. Lee Bawden, "A Spatial Price Equilibrium Model of International Trade," Journal of Farm Economics, Vol. 48, November 1966, pp. 862-874.

the North Central Regional Marketing Project No. 33 to analyze the affect of domestic and foreign trade policies on production, consumption, prices and trade patterns for five interrelated commodities and eleven geographic regions.[8]

Formulation of the Model

As already stated, the objective of this chapter is to develop an international trade model that will simulate the trade patterns for the grain-livestock sector of the European Economic Community. A second objective is to do the above with the most elementary model possible. To develop a model that requires only easily available data is also an important criterion.

One conclusion of the North Central Regional Marketing Project No. 33 was:

> "The model can provide realistic and definitive results only if realistic data inputs are obtained. Data requirements are demand and supply equations, including cross price elasticities, transfer costs, and policy assumptions. A complex interaction results. This imposes, more so than in simpler models, the requirement of reliable and consistent data inputs. Data from currently available sources do not always meet these requirements."[9]

For these reasons a supply-demand spatial equilibrium model, similar to that developed by Bawden, was eliminated at the start as a feasible alternative.

The approach, therefore, was to start with the simplest type of spatial equilibrium model: a fixed production-fixed consumption or

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[8]D. Lee Bawden, James G. Kendrick, Carmen O. Nohre and Howard C. Williams, "A Model For Agricultural Trade Analysis," Unpublished contribution to North Central Regional Marketing Project No. 33, "Implications of the European Economic Community for Midwestern Agriculture," June 17, 1968.

[9]Ibid., p. 37

transportation model. A transportation model given production, consumption and transportation costs will generate the trade pattern which minimizes total (world) transportation costs. This model assumes that free trade exists; that transportation costs are the only barrier to trade. However, trade restrictions do exist in the world. Thus, a simple transportation model will not simulate international grain-livestock trade. It can, nevertheless, serve as a base on which a somewhat more complex and realistic model can be constructed.

Since one of the objectives of this study is to incorporate institutionally controlled policy variables into the model, the next step should be to define what forms these institutionally controlled policy variables will take. In general these variables take the form of policies that tend to restrict international trade. The types of institutionally controlled policy variables that one should, if possible, consider include:

1. Import duties
    A. Fixed or specific import duties
    B. Ad valorem import duties
2. Export duties
    A. Fixed or specific export duties
    B. Ad valorem export duties
3. Transit duties
4. Variable import levies
5. Import quotas
6. Export quotas
7. Export subsidies

A. Fixed or specific export subsidies

B. Variable export subsidies

8. Export and import licenses

9. Mark-of-origin regulations

10. Sanitary regulations

11. Mixing and milling regulations

12. Administrative protection devices

These policy variables can be incorporated into the basic transportation model in one of two ways. Some can be incorporated in the form of additional restrictions in the transportation model; the rest can be incorporated in the objective function (the transportation cost function) which is to be minimized. Thus, the objective function must be redefined. Total transfer, not transportation, costs must now be minimized. Transfer costs are all costs involved in moving a commodity from one country to another. They include transportation costs plus other costs.

The above model is defined in terms of a particular commodity. No direct interrelationships between commodities are included in this model. For example, consider four commodities: food grain, feed grain, veal, and beef. Transfer cost models for these commodities can be schematically represented as in Figure III-1.

However, interrelationships do exist between these grain and livestock commodities. Food grain (wheat) can be utilized as feed grain. Thus, the production of food grain and the consumption of feed grain are related. The relationship between veal and beef must be considered. The question here centers around whether one should market his calves in the form of veal or beef. Thus, veal production and beef production

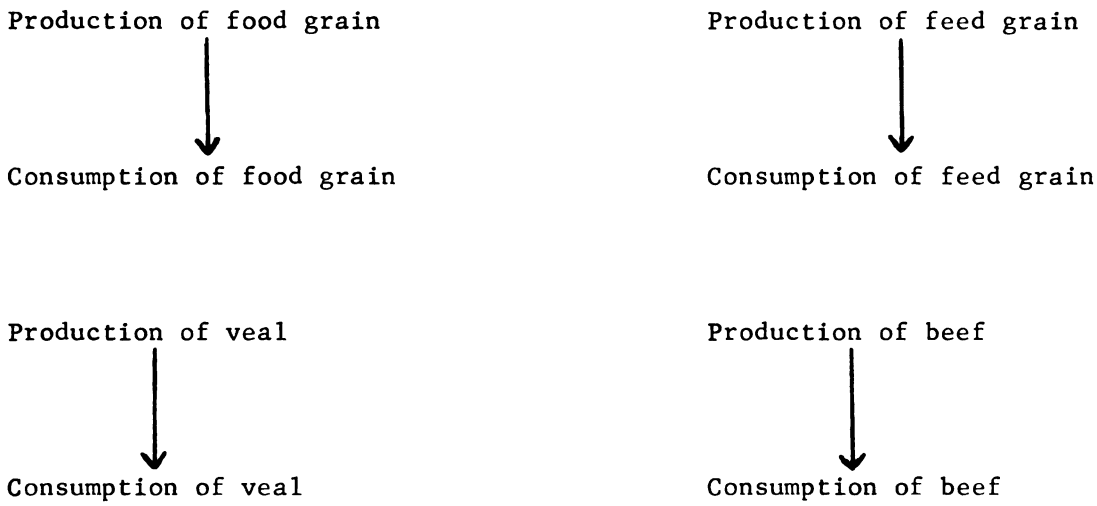

Figure III-1.--Schematic diagram for transfer cost models with no commodity interrelationships

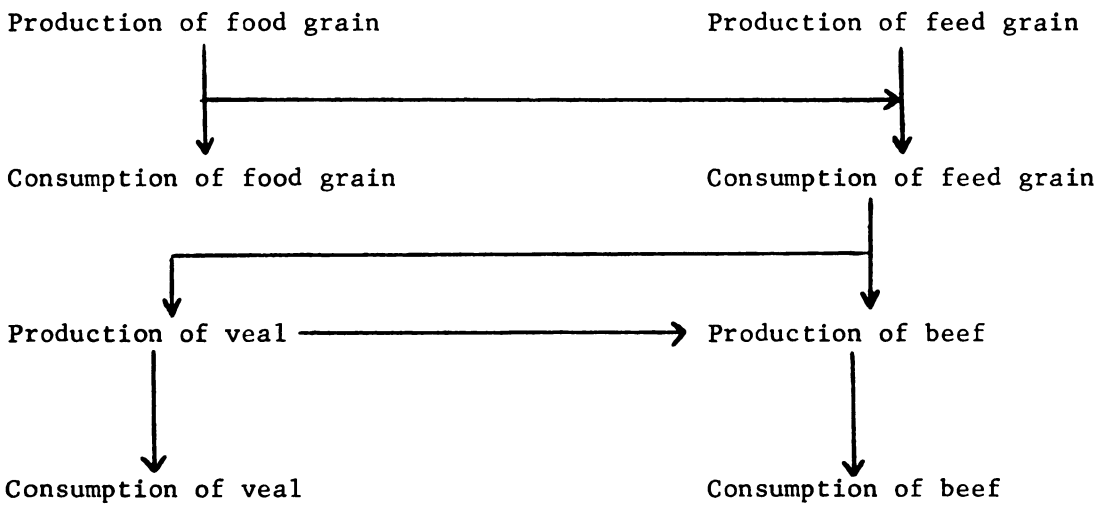

Figure III-2.--Schematic diagram for transfer cost model with commodity interrelationships

are related. A third complication enters, too. The demand for feed grain is a derived demand. We now have a third relationship--that between veal and beef production and feed grain consumption. A schematic diagram including the interrelationships between the commodities listed above is shown in Figure III-2.

Thus, a country must determine how its food grain production will be utilized: consumed as food grain (domestically or exported) and/or consumed as feed grain (domestically or exported). They must also decide how to meet, say, an excess demand for beef. Should they import beef? Or should they utilize any excess feed (or food) grain production and/or import feed grain to domestically produce the beef necessary to meet their demand? If the country has an excess supply of feed grain, should it export feed grain or convert it to meat (for either domestic or foreign consumption)?

The question now arises as to how to include these interrelationships into the model.

The most direct method is to define the production and consumption relationships in the model in terms of supply and demand functions rather than in terms of quantities supplied and demanded. In this manner these cross elasticity type relationships can be incorporated by essentially adding another term to the appropriate supply and/or demand function. This approach has been discarded apriori.

A second method for considering these interrelationships is an indirect one and one that can utilize the minimum transfer cost model as postulated. In the transfer cost model these interrelationships enter through their effects on production and consumption of different commodities. This second method is essentially one of defining a

particular set of circumstances and its corresponding interrelationships. By doing this we define production and consumption to be of a certain magnitude. By changing any assumption or interrelationship, one or more production and/or consumption level will correspondingly change. For example, the transfer cost model can be solved under the assumption that a country with an excess demand for beef will fill this excess demand by importing beef. Conversely, the solution could be based on the assumption that a country with an excess demand for beef will import feed grain and produce beef domestically to fulfill their excess demand. Thus, this transfer cost model, compared to the model assuming beef imports, requires that consumption of feed grain, beef production and veal production be changed for that country. After these changes have been made, a second minimum transfer cost solution can be obtained.

Criteria must then be developed upon which to base a decision as to which of the alternative formulations of the transfer cost model is most relevant. So the interrelationship problem is considered separately from the transfer problem. In fact, it is handled both separately and prior to the transfer problem since this interrelationship problem must be solved before determining the production and consumption levels necessary as inputs for solving the transfer problem. Thus, this doesn't really resolve this interrelationship problem. It just makes the 'total' model a two step model: (1) determine the interrelationships and (2) determine the least transfer cost trade patterns.

The type of interrelationships considered here have been production oriented. They have all involved modifying what was initially final commodities in the transfer cost model to what is, in part at least, an

intermediate commodity. That is, some of the grain and livestock commodities are inputs in the production process for other commodities. A third alternative for including these interrelationships would be to change the minimum transfer cost model into a minimum total cost model where total costs include transfer costs and production costs. This model would include not only transfer activities but also production activities for all commodities. In this model, as opposed to the second alternative above, the criteria for determining the most relevant transfer solution have been directly incorporated. In this total cost model, optimum trade patterns and production levels will be determined simultaneously for all commodities.

What has been described so far is a partial equilibrium world trade model for the grain-livestock sector of the economy. Since the primary interest of this study is the grain-livestock sector of the European Economic Community, the question now is how to limit the above world trade model to the European Economic Community. Production levels in non-European Economic Community countries and trade patterns between these countries are not within the scope of this study. Thus, production activities for 'outside' countries and transfer activities between 'outside' countries are unnecessary in this model. A European Economic Community trade model must, therefore, include four types of activities for each commodity: (1) production activities for the European Economic Community countries, (2) transfer activities for trade between any two European Economic Community countries, (3) purchase activities for imports from 'outside' countries and (4) sale activities for exports to 'outside' countries. This model then lies somewhere

between the transfer cost model and the general (world) total cost model on the continum of spatial equilibrium models.

Another question need be asked now. Is the relevant optimizing criterion minimization of total costs? Three alternative optimizing criteria come to mind: (1) cost minimization, (2) revenue maximization and (3) profit maximization. Microeconomic theory tell us that economic man maximizes profit. This might logically be the best criteria. However, the model being developed here is not a microeconomic model but a macroeconomic model. While not a model of the total economy of the European Economic Community, it is a model of one sector--the grain-livestock sector--of that economy. Therefore, the relevant objective criteria is the macroeconomic equivalent to profit maximization.

Profits are the returns to that factor of production called entrepreneurship. Under competition the other factors--land, labor, and capital--earn their marginal product. This is the maximum that they can earn. Thus, all factors of production are earning the maximum possible returns. At a macroeconomic level, one definition of national income is the sum of the returns to all factors of production. It follows then that the relevant macroeconomic decision criteria would be national income maximization.

The microeconomic decision criteria of profit maximization is a special case of this macroeconomic criteria. Under competition the scarcity of the other factors assures them of receiving their maximum returns (their marginal product); therefore, the decision criteria is maximization of the residual--profits. Maximizing national income will still be the relevant decision criteria even if the economy isn't

competitive. Under conditions of less than perfect competition, some factors of production are able to extract some of the returns to other factors of production. Maximizing national income maximizes the sum of these returns and does not consider the welfare question of how this maximum bundle of returns is distributed among the factors of production. Any welfare considerations could be included in this national income maximizing model by placing additional restrictions on the distribution of resources on the model.

The Model

Before presenting the formal model, it is useful to look at a schematic outline of the commodities included in the model and the interrelationships between these commodities. Figure III-3 represents only one European Economic Community country in detail. The relationships between this country and the other European Economic Community countries are via the transfer items in the outline. Purchase and sale items represent the links of this country with 'outside' countries. The direction of movement in this outline is shown by arrows.

This diagram, and the model, incorporates the following interrelationships between commodities: (1) the utilization of food grain as feed grain for livestock on a farm; (2) the utilization of food grain as feed grain, via a denaturing process; (3) the derivation of feed grain consumption (by livestock); (4) the production of a joint product: milk, beef and feeder calves; (5) the derivation of feeder calf consumption; (6) the production of beef by alternative production techniques; (7) the satisfaction of a commodity consumption level by either domestic production (utilizing domestically produced and/or imported inputs in the case of the livestock commodities), transfer from

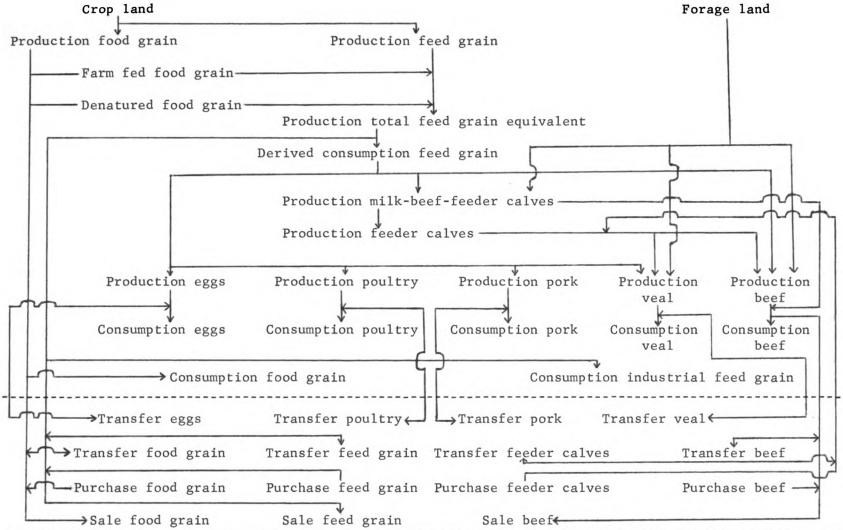

Figure III-3.--A schematic diagram for the European Economic Community trade model

another European Economic Community country and/or purchase from an 'outside' country of that commodity and (8) the export of surplus production of any commodity by a transfer to another European Economic Community country and/or sale to an 'outside' country.

From the outline, it can be seen that only one type of external input restriction exists for the production activities: a land restriction. Crop land is a limiting factor on the production of grain in a country and forage land is a limiting factor on the beef and veal production in a country. Feed grain is a second input for the livestock production activities, but it in turn is limited by the amount of crop land available in the country. I have assumed that capital and labor are not limiting factors of production for the agricultural sectors of the European Economic Community. These two factors can be obtained from the other sectors of the economy, at least to the point where the land restrictions become operative. Thus, capital and labor are not limiting resources in this model.

The following notation is used in the formal model:

(1) The subscripts i and j represent countries or regions included in the model, where

i, j = 1 = France

2 = Italy

3 = Germany-Benelux

4 = European Free Trade Area

5 = Eastern Europe

6 = Other Europe

7 = United States of America

8 = Canada

9 = Latin America

0 = Africa and Mid East

A = Other Asia

B = Australia, New Zealand, and South Africa

(2) The superscripts k and h represent the commodities, intermediate and final, included in the model, where

k,h = 1 = food grain

2 = denatured food grain

3 = feed grain

4 = total feed grain equivalent

5 = the joint product, milk-beef-feeder calf[10]

6 = feeder calves

7 = beef (cull dairy cows)

8 = beef (fed more than one year)

9 = beef (fed less than one year)

0 = total beef

A = veal

B = pork

C = eggs

Z = poultry

(3) R = returns to the grain-livestock sector.

(4) P_i^k = the price of commodity k in country i.

(5) P_j^k = the price of commodity k in country j.

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[10]This joint product is a milk cow that produces three separate products; milk, feeder calves and cull cow beef; over her productive life.

(6) S_i^k = the level of production of commodity k in country i.

(7) T_{ij}^k = the unit transportation cost of moving commodity k from country i to country j.

(8) X_{ij}^k = the quantity of commodity k transferred from country i to country j (when i = j, X_{ij}^k = the quantity of commodity k that is produced in country i and consumed in country i).

(9) ID_{ij}^k = the per unit fixed or specific import duty on commodity k from country i imposed by country j.

(10) IDR_{ij}^k = the ad valorem import duty rate on commodity k from country i imposed by country j.

(11) ES_{ij}^k = the per unit export subsidy granted by country i on commodity k exported to country j.

(12) ED_{ij}^k = the per unit fixed or specific export duty on commodity k imposed by country i on exports to country j.

(13) EDR_{ij}^k = the ad valorem export duty rate on commodity k imposed by country i on exports to country j.

(14) F_i = the quantity of forage land in country i.

(15) f_i^k = the number of units of forage land necessary to produce one unit of commodity k in country i.

(16) L_i = the quantity of crop land in country i.

(17) l_i^k = the number of units of crop land necessary to produce one unit of commodity k in country i.

(18) w_i^{14} = the percentage of food grain production in country i that is fed to livestock on the farm (without going through a market).

(19) M_i^k = the minimum production of commodity k in country i.

(20) N_i^k = the maximum production of commodity k in country i.

(21) r_i^{k5} = the proportion of commodity k that can be produced from the joint product milk-beef-feeder calves in country i.

(22) D_j^k = the level of consumption of commodity k in country j.

(23) $D_j^{4'}$ = the level of consumption of total feed grain equivalent for industrial and seed purposes in country j.

(24) s_j^{kh} = the number of units of commodity k necessary to produce one unit of commodity h in country j.

(25) G = net revenue or expenditure by the European Agricultural Guidance and Guarantee Fund.

(26) E_i^2 = the cost of denaturing food grain in country i.

(27) $\%_{ij}^k$ = the historical minimum percentage of commodity k transferred from country i to country j.

The object of the model is to maximize returns to the grain-livestock sector of the European Economic Community where

$$R = \sum_i \sum_j \sum_k ([(P_i^k - E_i^k)S_i^k] + [T_{ij}^k X_{ij}^k] + [(T_{ij}^k - ID_{ij}^k - IDR_{ij}^k P_i^k) X_{ij}^k] - [(P_i^k + T_{ij}^k + (P_j^k - P_i^k) - ES_{ij}^k + ED_{ij}^k + EDR_{ij}^k P_i^k) X_{ij}^k]).^{11}$$

The term in the first pair of brackets represents the production activities in the model. Internal European Economic Community transfer activities are represented by the second term. For these two terms $i, j \leq 3$. The terms in the third bracket represent sale activities. In

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[11] $E_i^k = 0$ for $k \neq 2$.

(19) M_i^k = the minimum production of commodity k in country i.

(20) U_i^k = the maximum production of commodity k in country i.

(21) $r_i^{k,c}$ = the proportion of commodity k that can be produced from the joint product milk-beef-leader calves in country i.

(22) D_i^k = the level of consumption of commodity k in country i.

(23) D_i^{ic} = the level of consumption of total feed crops (optimum for industrial and seed purposes in country i

(24) a_i^{kk} = the number of units of commodity k necessary to produce one unit of commodity k in country i.

these terms $i \leq 3$ and $j > 3$. The final bracketed terms represent purchase activities. Here $i > 3$ and $j \leq 3$.

This objective function allows for import duties, both fixed or specific and ad valorem, imposed on European Economic Community sales by 'outside' countries (see the sale activity term). Export duties, both fixed or specific and ad valorem, on sales by 'outside' countries to members of the European Economic Community are included in the purchase activity term. This purchase activity term also includes an export subsidy imposed on European Economic Community purchases by 'outside' countries. The term representing a European Economic Community export subsidy is incorporated into the production activity term. Prices in the above equation are internal, domestic prices rather than world prices; therefore, an export subsidy is implicit in all European Economic Community sales. For the same reason, variable import levies and variable export subsidies on transfers between European Economic Community members are implicit in the production activity term. The variable levy imposed by European Economic Community members on 'outside' imports is included in the purchase term.

This objective function is subject to the following restrictions:

(1) There is a maximum amount of forage land in country i ($i \leq 3$) available for production of the joint product milk-beef-feeder calves, beef and veal.

$$F_i \geq f_i^5 S_i^5 + f_i^8 S_i^8 + f_i^9 S_i^9 + f_i^A S_i^A$$

(2) All crop land in country i ($i \leq 3$) is used in the production of food grain, denatured food grain and feed grain.

$$L_i = 1_i^1 S_i^1 + 1_i^2 S_i^2 + 1_i^3 S_i^3$$

(3) The amount of total feed grain equivalent produced in country i ($i \leq 3$) is the sum of the amount of farm fed food grain, denatured food grain production and feed grain production.

$$S_i^4 = w_i^{14} S_i^1 + S_i^2 + S_i^3$$

(4) The amount of feed grain produced in country i ($i \leq 3$) is at least as great as the level of consumption of total feed grain equivalent for industrial and seed purposes.

$$S_i^3 \geq M_i^{12}$$

(5) The amount of the joint product milk-beef-feeder calves produced in country i ($i \leq 3$) is at least as great as that necessary for country i to be self-sufficient in milk but no greater than that amount required to produce the surplus of milk projected in the Michigan State University-United States Department of Agriculture study.

$$N_i^5 \geq S_i^5 \geq M_i^5$$

(6) The amount of feeder calves produced in country i ($i \leq 3$) equals the amount that is produced from the joint product milk-beef-feeder calves.

$$S_i^6 = r_i^{65} S_i^5$$

(7) The amount of beef (cull dairy cows) produced in country i ($i \leq 3$) equals the amount that is produced from the joint product milk-beef-feeder calves.

$$S_i^7 = r_i^{75} S_i^5$$

$^{12}M_i^3 = D_i^{4'}$.

(8) The total amount of beef produced in country i ($i \leq 3$) equals the amounts of beef produced by the different production processes in country i.

$$S_i^0 = S_i^7 + S_i^8 + S_i^9$$

(9) The total production of commodity k in country i ($i \leq 3$) is transferred (or sold) to country j. For k = 1

$$S_i^1 - w_i^{14} S_i^1 = \sum_j X_{ij}^1$$

and for k = 4, 6, 0, A, B, C, Z

$$S_i^k = \sum_j X_{ij}^k$$

(10) The total consumption of commodity k (k = 1, 4, 6, 0, A, B, C, Z) in country j ($j \leq 3$) is equal to the amounts of commodity k transferred from country i to country j.

$$D_j^k = \sum_i X_{ij}^k$$

The consumption levels of food grain, total beef, veal, pork, eggs and poultry are predetermined as this represents the demand for final products. The consumption levels for the total feed grain equivalent and feeder calves are not predetermined and represent a derived demand. Total feed grain equivalent in a European Economic Community country ($j \leq 3$) is utilized by livestock and for industrial and seed uses.

$$D_j^4 = s_j^{45} S_j^5 + s_j^{48} S_j^8 + s_j^{49} S_j^9 + s_j^{4A} S_j^A + s_j^{4B} S_j^B + s_j^{4C} S_j^C + s_j^{4Z} S_j^Z + D_j^{4'}$$

Feeder calves in a European Economic Community country ($j \leq 3$) are utilized in some beef production activities and in the veal production activity.

$$D_j^6 = s_j^{68} S_j^8 + s_j^{69} S_j^9 + s_j^{6A} S_j^A$$

(11) There is a maximum amount of net expenditures by the European Agricultural Guidance and Guarantee Fund.[13]

$$G \leq \sum_i E_i^2 S_i^2 + \sum_i \sum_j \sum_k [(P_i^k - P_j^k) - ID_{ij}^k - IDR_{ij}^k P_i^k + ES_{ij}^k - ED_{ij}^k - EDR_{ij}^k P_i^k] X_{ij}^k,$$

where $i \leq 3$, $j = 4$ to B, $k = 1, 4, 6, 0, A, B, C, Z$.

(12) In order to simulate trade patterns more accurately it is necessary to place additional restrictions on the transfer activities, particularly the purchase and sale activities. Because the model is linear, no more than one purchase or sale activity will enter the solution at a positive level for each commodity traded.[14] The restrictions in this model are in terms of minimum quantities of commodity k (k = 1, 4, 6, 0, A, B, C, Z) transferred between countries. This minimum quantity is based on historical trade patterns. The most logical method of determining this minimum is to base it on a historical percentage of consumption in the country.

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[13] G may be negative if the grain-livestock sector of the European Economic Community contributes a net revenue to the European Agricultural Guidance and Guarantee Fund.

[14] This model differs from a transportation type model in that it is not a closed system. It would be, however, if all countries were specified in the same manner as the European Economic Community countries.

$$X_{ij}^{k} \geq \%_{ij}^{k} D_{j}^{k}$$

This formulation will be sufficient in defining the minimum X_{ij}^{k} ($j \leq 3$) for all internal European Economic Community transfer activities and for all purchase activities.[15] It will not define the minimum X_{ij}^{k} for European Economic Community sale activities ($i \leq 3$ and $j \geq 4$). In order to do this, D_{j}^{k} ($j \geq 4$) must be defined. This is not done in this model.[16]

For sale activities the minimum quantity of commodity k ($k = 1, 4, 0$) transferred between countries will be based on a historical percentage of production in a country ($i \neq j$ and $i \leq 3$).

$$X_{ij}^{k} \geq \%_{ij}^{k} S_{i}^{k}$$

This minimum percentage can be determined by solving the above equations for $\%_{ij}^{k}$ and substituting historical data into the right hand side of the equation.[17] It will be based on an average of percentages for a predetermined historical time period.

It would be simpler if these restrictions on the transfer activities could be in terms of fixed minimum quantities of

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[15]When $i = j$, $\%_{ij}^{k}$ represents the amount of domestic consumption that is satisfied via domestic production.

[16]This formulation does define the minimum quantity sold by one European Economic Community country to another, however. This type sale activity is definable since it can be viewed from either end of the transaction; i.e., any internal sale (transfer) activity can be viewed as a purchase (transfer) activity.

[17]$\%_{ij}^{k} = \dfrac{X_{ij}^{k}}{D_{j}^{k}}$ or $\%_{ij}^{k} = \dfrac{X_{ij}^{k}}{S_{i}^{k}}$

commodity k over each feasible route. If consumption (D_j^k) and production (S_i^k) levels were completely predetermined, a fixed minimum percentage would imply a fixed minimum quantity. Since not all consumption and production levels are predetermined, fixed minimum quantity restrictions cannot be used whereas fixed minimum percentage restrictions can be used.

How will this last restriction affect the results of the model? This is a method by which certain rigidities in the economic system can be incorporated in the model. That is, a certain portion of trade will be allocated on the basis of historical trading patterns and the rest will be allocated on the basis of the internal criteria of the linear programming model. If a time dimension were added to this model, this historical minimum percentage would take the form of a moving average of past trading patterns. This, ceteris paribus, would cause the solution over time to converge toward the linear programming solution for the model without this set of restrictions.

CHAPTER IV

Testing the Model

In the previous chapter a theoretical system was postulated that could possible be used to predict future production and trade patterns for the European Economic Community. This set of postulates was an effort to describe the behavior of the European Economic Community. An attempt was first made to make the postulates in the system consistent with that body of knowledge termed 'economic theory.' Within this broad set of postulates bounded by economic theory those included in this specific system were again constrained by limiting the postulates (or hypotheses) to those for which supporting empirical evidence was readily available.

This alone does not assure one of having a theoretical system capable of predicting future production and trade patterns for the European Economic Community. On top of this theoretical framework we must build an empirical framework. This combination of theoretical and empirical structure allows us to test the ability of the model to predict the behavior of the endogenous variables in the model (in this case, production and transfer levels). Making a prediction, then comparing the prediction to reality, is the only way in which any predictive model can be tested. This can be handled either by making a prediction, then waiting to see how well your prediction fits reality; or by building your model to simulate a preexisting situation then postdicting the behavior of the endogenous variables in the system on the basis of the theoretical framework representing this historical period and the empirical values of the exogenous variables in the system.

Thus the core of the model testing problem is one of testing the 'goodness of fit' of the predictions (or postdictions) to reality. Especial problems are involved in testing the 'goodness of fit' of the typical spatial model that predicts a number of different endogenous variables. As long as we are concerned with the prediction of a single variable over a number of replications (time series) standard statistical procedures are available for testing the 'goodness of fit' of the prediction.

With a spatial model many different endogenous variables are predicted simultaneously. Two separate problems arise depending upon whether the spatial model contains a time dimension or not. If a time dimension exists, standard statistical techniques will allow each endogenous variable prediction to be tested for 'goodness of fit' over this time dimension. However, this type of test does not allow for a test of the overall realiability, or overall 'goodness of fit,' of the model. For example, these tests cannot tell us anything about whether a model that predicts ten endogenous variables with seventy percent accuracy is or is not better than a model that predicts the same ten endogenous variables, four with one hundred percent accuracy, one with seventy percent accuracy and five with forty-six percent accuracy.

If a time dimension is not part of the spatial model only one prediction of each endogenous variable exists. With a sample size of one the 'goodness of fit' tests alluded to above are inoperative and we are immediately confronted with the question of the overall 'goodness of fit' of the model.

Much spatial research avoids, or sidesteps, these problems completely. This kind of research treats spatial models in a normative

sense. These theoretical spatial models are viewed as a norm against which the efficiency of the system simulated can be judged. This, if one can be a little facetious, smacks of 'the model is right; the world's wrong'! As Wallace says, "This rather pointed and perhaps unfair remark serves to remind us that in an area of research confounded by multiple, interdependent hypotheses, satisfactory criteria for judging the "reasonableness" of a model are lacking. The normative approach discards from the outset the single objective criterion by which we may separate good from bad models -- the criterion of predictions."[1]

Many of the researchers that do disregard this normative, efficiency oriented approach and use spatial models in a more positivistic manner for predictive purposes do not come to grips with the problem of model testing. They do one of three types of things.

Some fall back on the idea of building a logical theoretical model that is consistent with economic theory then flesh this framework out with 'good' (meaning best available) empirical data. They then take a more normative stance and say that this model will now predict what the effect on the endogenous variables should be. And, since society is rational and logical and economic theory is rational and logical, society will do what it should; or at least move in that direction. Therefore, the predictions will be good predictions.

Others utilize these models for predictive purposes and let time be the test of their model. However, they seldom return to their predictions

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[1]Thomas D. Wallace, "The General Problem of Spatial Equilbrium: A Methodological Issue," in Richard A. King, Editor, Interregional Competition Research Methods, The Agricultural Policy Institute Series 10, School of Agriculture and Life Sciences, North Carolina State of the University of North Carolina, Raleigh, North Carolina, 1963, p. 13.

when tomorrow becomes today. They seldom test their predictive models. What happens with this approach to predictive models is that not the model but the model builder is subject to some sort of test by inspection of the type 'What does Dr. X have to say about tomorrow; he is right more often than not.'

Not all predictive models that let time be their test of prediction are left untested. Those that are part of long range, continually ongoing research projects are continually checked for predictive accuracy and then modified so that their ability to predict becomes better over time.

Finally there is that group of researchers that test their model by postdicting the levels of the endogenous variables for a known historical period. It seems as if this is a valid way to test a spatial model -- at least as a first approximation test. However, our original set of problems still exist. If we postdict a series of historical periods with a given model we can use standard statistical procedures to test the 'goodness fo fit' of the prediction of each endogenous variable. But what is the overall 'goodness of fit' of the n endogenous variables in the model? If only one postdiction of a single historical period is made we are immediately confronted with the problem of the overall 'goodness of fit' of the model. Wallace says that he knows of no predictive test for spatial models and offers no specific suggestions as to how to test the overall realiability of spatial models.[2] Those who have used their model to postdict have made no real attempt to use this postdiction as a test to evaluate the ability of their model to predict; let

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[2] Ibid., p. 14.

alone to develop some objective criteria to test the predicting ability of a model or its 'goodness of fit'. They have relied on some sort of subjective criteria that somehow indicates to them how much confidence they have in their own research. This seems to be based on some unstated process whereby the researcher, utilizing his prior knowledge and experience, achieves a certain degree of confidence in his predictions.

Even when no explicit attempt is made to test a model's 'goodness of fit' there exists this implicit subjective test before prediction is attempted. The problem is that this implicit test is not subject to replication by others. At a very minimum, some acceptable quantitative measures of 'goodness of fit' are needed in order to compare alternative formulations of a spatial model. This alone will allow one to have some relative scale by which to compare alternative models. Models can then be ranked from best to worse in their ability to postdict.

Ideally this would be just a first step in the test of any spatial model. What is really needed is something more than a relative scale of 'goodness of fit.' The next step involves developing an acceptable criteria for deciding how good is good enough -- good enough for accurate postdictions that is.

This still will not assure that any accurate postdicting spatial model will also be a good predicting model. For this to be true we must be able to assume that the underlying structure of that which we are trying to simulate does not change from the postdicted period to the period we wish to predict. Then we must assume that the theoretical framework of the model does represent that structure and that as 'good' a set of empirical input data exists for the predicting model as existed for the postdicting model. If this assumption cannot be made, if the

underlying structure does change in the interim, this change must be accounted for by adjusting either the theoretical framework or empirical input data in such a way as to account for and be consistent with this underlying structural change.

Reaching this point allows one to predict. The second step in testing of a spatial models ability to predict is the 'test of time' talked about earlier. Were good predictions made? Every time you can say yes to this question you increase your confidence in the ability of the model to make new predictions. Any spatial model used for predictive purposes can only be truly tested when its predictions are evaluated as history. Thus the final testing of a model involves continued effort over time. Actually this testing process should never end, particularly in a model dealing with the social sciences where the underlying structure you are trying to represent is continually in flux.

This whole testing and predicting process, even at best, will involve many decisions that are purely subjective in nature. What I am advocating is that at any point in this whole testing and predicting process (particularly the testing) where a choice can be made between an objective decision criteria and a subjective decision criteria the choice should be in favor of the more objective one. Little has been done in making the testing of spatial models more objective.

Additional effort along this line can help in two ways. It will allow nonparticipants in a research project involving projections from a spatial model to better judge the validity of projections. It can do this by either allowing them to make their own subjective decisions on the basis of these objective criteria or by allowing them to more easily follow the researchers reasoning process in reaching his final predictions.

Also the process of developing (and quantifying) these objective testing criteria should point out some of the problem areas and weakness of the model in question.

'Goodness of Fit' Criteria for Spatial Models

As discussed earlier there are two types of testing problems that arise from spatial models. If a time dimension exists, standard statistical techniques are available for testing the 'goodness of fit' of each endogenous variable. I will not pursue these types of testing procedures here as the model in the previous chapter is a static model. The second type of testing problem involves the testing of a model for its overall 'goodness of fit.' Whether you have a single postdiction or a series of them for each endogenous variable you still have a scale conversion problem of trying to compare 'apples and oranges.'

How can you add crates of oranges to bushels of apples and get a meaningful measure of apples and oranges? The obvious way of course is to view each endogenous variable in terms of a percent error, then these percentages can be jointly evaluated. However, solving one problem in this manner creates other problems of equal importance. Depending upon the base, problems can arise whenever either the actual value or the predicted value of the endogenous variable is zero. This percent error is also strictly a relative measure. Each error is relative to the base for that variable; however, this base changes between variables. A ten percent error on a base of ten is not as important, in many cases, as a ten percent error on a base of ten million. This problem of the importance of both the relative and absolute magnitude of the error is a second type of problem that affects 'goodness of fit' tests for these types of models.

Very little work has been done in trying to develop quantitative measures of overall 'goodness of fit' and/or criteria for accepting or rejecting a spatial model as a good predictor of reality. The next sections will attempt to present some alternative suggestions as to how this might be accomplished.

Key Variables

Wallace suggests that "if the question that promotes the research relates to a specific variable, the research should be keyed on that variable. Reliability of the model should be based upon how well the key variable is predicted."[3]

This is excellent advice in that by their nature spatial models contain a large number of endogenous variables, some of which will be relatively unimportant. However, again by the nature of spatial models and the nature of the problems they typically are used for, more than one key variable exists. Thus this approach narrows down the range of interest but still leaves a subjective decision regarding 'goodness of fit.'

Turing's Test

A second subjective approach to the problem of overall 'goodness of fit' of a model suggests itself from Turing's consideration of whether a machine can think.[4] In terms of the problem we are considering Turing's 'imitations game' would involve giving a noted authority on

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[3] Ibid., p. 15.

[4] A. M. Turing, "Computing Machinery and Intelligence" Mind, October 1950, pp. 433-460.

whatever you are trying to simulate the results from your model and the comparable actual results. These two sets of results would not be labeled. If this noted authority could not tell which was which, the model passes Turing's test. You then have a good model.

This approach is similar to what many do. Only they place themselves in the role of the noted authority. When asking themselves the question they decided they couldn't tell the difference. As a result they effectively say "the results of the model look good enough to me."

Theil's Inequality Coefficient

Theil proposes a special type of correlation coefficient to measure the 'goodness of fit' of the predictions to the actual outcomes.[5] This coefficient, U, he calls the inequality coefficient. The inequality coefficient is defined as:

$$U = \frac{\sqrt{\frac{1}{n}\sum_{i=1}^{n}(p_i - a_i)^2}}{\sqrt{\frac{1}{n}\sum_{i=1}^{n}p_i^2} + \sqrt{\frac{1}{n}\sum_{i=1}^{n}a_i^2}},$$

where $p_1 \ldots p_n$ are the predictions from the model and $a_1 \ldots a_n$ are the actual outcomes of the endogenous variables. The range of U is from zero to one. When the predictions are perfect, $p = a$ for all $i = 1 \ldots n$ and $U = 0$. $U = 1$ when all p_i or all a_i are zero. This

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[5] H. Theil, Economic Forecasts and Policy, North-Holland Publishing Company, Amsterdam, 1961, pp. 31-48.

means that all predictions are zero for nonzero values or else all non-zero predictions for actual values that are all zero. Either of these cases represent the ultimate in bad predicting.

This inequality coefficient as formulated is subject to a major problem. The p_i and the a_i are not necessarily additive (the 'apples and oranges' problem). If a conversion factor can be applied to the p_i and the a_i which will convert them to a scale that is additive this inequality coefficient can still be used. It must, however, be of the following form:

$$U = \frac{\sqrt{\frac{1}{n}\sum_{i=1}^{n}\left[c_i\,(p_i - a_i)\right]^2}}{\sqrt{\frac{1}{n}\sum_{i=1}^{n}(c_i p_i)^2} + \sqrt{\frac{1}{n}\sum_{i=1}^{n}(c_i a_i)^2}}$$

where c_i is a conversion factor that converts each p_i and a_i to units which are additive. This conversion factor must be defined separately from the model and be constant throughout alternative tests of the model. Since U is a function of the set of c_i's, choosing a different weighting system for the c_i will change the magnitude of U. However, <u>given</u> a set of conversion factors, U is a function of the predicted and actual values and U then becomes a measure of the 'goodness of fit' of the model.

This inequality coefficient, unlike a correlation coefficient, is not invariant against additive variations. It measures relative error between p_i and a_i, not absolute error. Thus unit errors on a series with base of 1,000 will produce a lower inequality coefficient than unit errors on a series with a base of ten.

The inequality coefficient provides an objective measure of the relative merits of alternative predictive models. Two subjective decisions are still required however. We must decide how low the inequality coefficient should be before we are willing to accept the predictive model as an adequate representation of the system we are trying to simulate. Also a set of conversion factors, the set of c_i, must be defined.

The Sign Test

The sign test is a nonparametric test whereby the hypothesis that the predicted and actual values of the endogenous variables are identically distributed can be tested. The test statistic involved is the number of plus signs or the number of times the predicted value exceeds the actual value in the paired sample.[6] Each pair of values (p_i, a_i) can be considered a Bernoulli trial and therefore the statistic has a binomial distribution with parameters (n, p) where p = 1/2.

One problem exists with the sign test however. It does not take into account the magnitude of the error. It weights every error identically and only considers the sign of the error. If there are certain key variables the sign test does not allow extra recognition of these variables. This could in part be overcome by multiplying the set of plus signs by an apriori weighting function. This weighting function would allow the researcher to single out or emphasize the key variables in the model. The test statistic would then be the weighted number of plus signs.

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[6]When the predicted value equals the actual value the sign would be neither plus or minus. The best method for handling these equalities is to disregard them.

Regression

A linear regression of the predicted values on the actual values has been suggested by Cohen and Cyert as a method of testing the 'goodness of fit.'[7] If the predicting model were perfect, then $p_i = a_i$ and the resulting regression equation would be one with a zero intercept and a slope of one. The 'goodness of fit' test would then involve testing whether the parameters of the regression are significantly different from zero and one.

Again a measurement scale problem exists. The p_i and a_i must be expressed in common units. Thus regressions cannot be run on the p_i and a_i. However, a set of conversion factors can be used to convert the raw data to units which are additive. The regression analysis can then be applied to these converted data (the $c_i p_i$ and $c_i a_i$). As before, this set of conversion factors must remain constant throughout. Choosing a different set of conversion factors will change the inequality coefficient and thus affect the estimates of the parameters.

A regression equation is concerned with the absolute error (the deviations from the regression equation). It does not take into consideration the relative error. Thus an error of ten units at a level of one hundred units is equally as important as an error of ten units at a level of one million units. If the relative error is important to the model as well as the absolute error the set of converted data must be again weighted by a set of factors that will represent the importance of the relative error. Then the regression analysis should be based on the

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[7] Kalman J. Cohen and Richard M. Cyert, "Computer Models in Dynamic Economics," The Quarterly Journal of Economics, Vol. 75, February 1961. pp. 112-127.

weighted converted data ($w_i c_i p_i$ and $w_i c_i a_i$) where w_i is the set of relative weights attached to the i separate endogenous variables. Since the regression equation is a function of this weighting function it must, like the set of conversion factors, be determined apriori and remain constant throughout alternative tests of a model.

This regression technique can also be applied to different subsets of the endogenous variables or for combinations of key variables. In this manner the regression analysis can not only be a test of 'goodness of fit' but also a technique whereby problem areas in the model become highlighted.

Summary

All of the criteria discussed above are attempts to achieve some indiction of the overall 'goodness of fit' of a spatial model. Whether you have a time series or just a single observation for each endogenous variable the same problem exists. The objective criteria are subject to two possible problems. The first is the problem of not having an additive scale on which two originally noncomparable units can be compared. Secondly, both the relative errors and the absolute errors are of importance in this type of model. Some of these criteria only take account of one type. To take account of both types of error some type of weighting function must be decided upon, then incorporated into the criteria.

Whether the data needs to be adjusted by a scale conversion factor or a weighting function is summarized in Table IV-1.

The European Economic Community Trade Model -- A Test

In order to test the grain-livestock trade model developed for the European Economic Community in the last chapter a postdiction was made for 1964. 1964 was selected as the base for the postdiction because it

Table IV-1.--Data adjustments required for overall 'goodness of fit' criteria

Criterion	Scale conversion factor	Weighting function
Theil's Inequality Coefficient	X	
The Sign Test		X
Regression	X	X

served as the base period for the Michigan State University-United States Department of Agriculture production and consumption projections. The exogenous data developed for the 1964 model, as well as a brief summary of their sources and methods of calculation, are presented in Appendix A. The endogenous variables include production levels and trade levels for the European Economic Community countries. For food grain, feed grain and beef trade internal transfer, purchase and sale activities were allowed. Internal transfer and purchase activities were allowed for feeder calves. Only internal transfer activities were permitted for veal, pork, eggs and poultry.

Predicted production levels for the European Economic Community when compared with actual levels showed errors varying from less than one percent for eggs to twelve percent for poultry and averaged about five percent for the five product categories (total grain, beef and veal, pork, eggs and poultry) in Table IV-2.[8] The predicted production levels for France, Italy and Germany-Benelux also showed errors of a similar small

[8]More detailed production levels for beef, veal and grain are shown in Tables IV-8 and IV-12.

Table IV-2.--1964 production levels

		Total grain	Beef and veal	Pork	Eggs	Poultry
		1,000 metric tons				
France	actual	27,364.0	1,428.3	1,203.1	560.0	550.0
	model	28,288.3	2,809.7	1,439.0	581.4	655.2
Italy	actual	13,955.0	540.5	396.9	458.0	340.0
	model	14,160.8	390.6	364.1	463.1	322.5
Germany-Benelux	actual	19,841.0	1,550.7	2,419.8	1,100.0	363.0
	model	20,574.3	621.8	2,293.4	1,092.6	434.2
European Economic Community	actual	61,160.0	3,519.5	4,019.8	2,118.0	1,253.0
	model	63,023.4	3,822.1	4,096.5	2,137.1	1,411.9

Source (actual): Sorenson and Hathaway "The Grain-Livestock Economy and Trade Patterns of the European Economic Community With Projections to 1970 and 1975".

Table IV-3.--1964 transfer levels: total grain

Exporter \ Importer		France	Italy	Germany-Benelux	EFTA	Eastern Europe	Other Europe	Africa & Mid East	Other Asia
		1,000 metric tons							
France	actual	20,385.9	434.9	1,394.1	1,832.6	676.1	722.4	682.9	619.9
	model	21,066.7	426.1	2,567.3	1,104.0	1,849.5	172.4	551.0	551.0
Italy	actual	55.3	13,572.9	170.3		32.5		106.4	
	model	343.3	13,640.2	0		0		177.2	
Germany-Benelux	actual	0.9	1.3	18,172.6	695.6	600.9		189.6	94.3
	model	686.7	85.8	18,642.2	525.6	211.3		211.3	211.3
EFTA	actual			258.8					
	model			464.2					
United States	actual	602.0	1,108.9	4,062.5					
	model	403.1	1,043.3	5,929.9					
Canada	actual	184.0	66.3	1,000.3					
	model	119.5	177.1	1,242.7					
Latin America	actual	249.6	2,489.9	1,202.1					
	model	231.5	1,720.3	1,723.6					

continued --

Table IV-3 (cont'd.)

Exporter \ Importer		France	Italy	Germany-Benelux	EFTA	Eastern Europe	Other Europe	Africa & Mid East	Other Asia
		1,000 metric tons							
Africa & Mid East ...	actual	119.6		24.8					
	model	291.2		232.1					
Australia, New Zealand, South Africa	actual		157.3	294.4					
	model		343.3	696.4					

Source (actual): Tables IV-13 and IV-14.

Table IV-4.--1964 transfer levels: beef and veal

Exporter \ Importer		France	Italy	Germany-Benelux	All other countries
		1,000 metric tons			
France	actual	1,358.1	2.6	54.8	10.6
	model	1,385.3	350.5	1,073.8	0
Italy	actual	0.1	1,090.4	0	0
	model	0	390.6	0	0
Germany-Benelux	actual	27.2	39.5	1,472.6	9.7
	model	10.1	14.2	597.5	0
EFTA	actual	4.4	58.9		
	model	0	21.3		
Eastern Europe	actual	0.5	16.2		
	model	0	7.1		
Latin America	actual	26.9	114.2	93.4	
	model	0	55.0	46.7	

Source (actual): Sorenson and Hathaway, op. cit.
United Nations, Statistical Office of the United Nations, Department of Economic and Social Affairs, "Commodity Trade Statistics", Statistical Papers, Series D, various issues.

Table IV-5.--1964 transfer levels: pork

Exporter \ Importer		France	Italy	Germany-Benelux
		1,000 metric tons		
France	actual	1,199.6	0.2	2.6
	model	1,153.8	36.0	249.2
Italy	actual	0	396.9	0
	model	0	364.1	0
Germany-Benelux	actual	51.0	3.9	2,363.6
	model	23.5	4.0	2,265.8

Source (actual): Sorenson and Hathaway, op. cit.
United Nations, op. cit.

Table IV-6.--1964 transfer levels: eggs

Exporter \ Importer		France	Italy	Germany-Benelux
		1,000 metric tons		
France	actual	552.2	0.2	5.6
	model	545.9	35.5	0
Italy	actual	0	457.4	0.1
	model	0	463.1	0
Germany-Benelux	actual	1.5	10.5	1,072.7
	model	11.1	15.4	1,066.0

Source (actual): Sorenson and Hathaway, op. cit.
United Nations, op. cit.

Table IV-7.--1964 transfer level: poultry

Exporter \ Importer		France	Italy	Germany-Benelux
		1,000 metric tons		
France	actual	525.7	0	15.5
	model	572.0	35.5	47.8
Italy	actual	0	339.6	0.2
	model	0	322.5	0
Germany-Benelux	actual	0.2	0	354.0
	model	0	0	434.2

Source (actual): Sorenson and Hathaway, op. cit.
United Nations, op. cit.

magnitude. The one exception being beef and veal production. The model shows France becoming the major European Economic Community beef producer instead of the other members, particularly Germany-Benelux.

The trade patterns resulting from these production patterns are presented in Tables IV-3 to IV-7.[9] With two exceptions predicted total grain transfer levels have the same order of magnitude as actual transfers. The two exceptions being French exports to Eastern Europe and French imports from Germany-Benelux. The model does show increases in German-Benelux total grain imports, primarily from the United States, over actual imports.

The difference in beef and veal production is carried over to the transfer sector of the model. The beef that was more profitable to produce in France is now shipped to Germany-Benelux and Italy. The predicted transfer patterns for pork, eggs and poultry are close to actual levels. For both production and transfer activities the predicted values are generally of the same order of magnitude as the actual values.

The 1964 model does show some deviations from what actually happened in 1964. These primarily revolved around a shifting of production patterns and the resulting trade changes. The model showed an increase in meat production in France of over 1.7 million metric ton. Over 1.3 million metric ton of this increase was increased beef production which was exported to Germany-Benelux and Italy. French pork production in the model was also up by over 200 thousand metric ton. The bulk of this excess French pork production was shipped to Germany-Benelux to replace

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[9]Tables IV-9 to IV-11 and IV-13 to IV-14 present more detailed trade levels for beef, veal and grain.

Table IV-8.--1964 detailed beef and veal production levels

		Milk-beef-feeder calves	Feeder calves[1]	Beef (cull cows)	Beef (≥ 1 yr.)	Beef (≤ 1 yr.)	Total beef	Veal	Beef and veal
		1,000 head		1,000 metric tons					
France	actual	11,472.0	8,917.9				1,066.8	361.5	1,428.3
	model	9,501.2	6,413.3	551.1	1,848.2		2,399.3	410.4	2,809.7
Italy	actual	4,483.7	2,647.0				464.9	75.6	540.5
	model	4,522.0	3,052.4	275.8	0	0	275.8	114.8	390.6
Germany-Benelux	actual	8,538.1	6,924.0				1,362.2	188.5	1,550.7
	model	8,504.2	5,740.3	467.7	10.0		477.7	144.1	621.8
European Economic Community	actual	24,493.8	18,488.9				2,893.9	625.6	3,519.5
	model	22,527.4	15,206.0	1,294.6	1,858.2	0	3,152.8	669.3	3,822.1

[1]A cull rate for dairy cattle of 0.2 is assumed in calculating the actual number of feeder calves.

Source (actual): Sorenson and Hathaway, op. cit.

Table IV-9.--1964 transfer levels: feeder calves

Exporter \ Importer		France	Italy	Germany-Benelux
		1,000 head		
France	actual	8,540.6	330.9	46.4
	model	6,374.4	38.9	0
Italy	actual	0	2,647.0	0
	model	2,001.9	1,050.5	0
Germany-Benelux	actual	27.3	174.2	6,722.5
	model	3,796.6	38.9	1,904.8
EFTA	actual		418.0	2,290.7
	model		103.8	291.4
Eastern Europe	actual	0	434.4	204.0
	model	0	64.8	44.8

Source (actual): Sorenson and Hathaway, op. cit.
United Nations, op. cit.

Table IV-10.--1964 transfer levels: beef

Exporter \ Importer		France	Italy	Germany-Benelux	All other countries
		1,000 metric tons			
France	actual				
	model	1,003.4	337.9	1,058.0	0
Italy	actual				
	model	0	275.8	0	0
Germany-Benelux	actual				
	model	10.1	14.2	453.4	0
EFTA	actual				
	model	0	21.3		
Eastern Europe	actual				
	model	0	7.1		
Latin America	actual				
	model	0	55.0	46.7	

Table IV-11.--1964 transfer levels: veal

Importer / Exporter		France	Italy	Germany-Benelux
		1,000 metric tons		
France	actual			
	model	381.9	12.6	15.8
Italy	actual			
	model	0	114.8	0
Germany-Benelux	actual			
	model	0	0	144.1

Table IV-12.--1964 detailed grain production levels[1]

		Food grain	Denatured food grain	Total food grain	Feed grain	Total feed grain equivalent	Total grain
		1,000 metric tons					
France	actual			13,980.0	13,384.0		27,364.0
	model	13,776.1	12,815.2	26,591.3	1,697.0	17,267.4	28,288.3
Italy	actual			9,198.0	4,757.0		13,955.0
	model	8,862.4	0	8,862.4	5,298.4	6,007.4	14,160.8
Germany-Benelux	actual			10,367.0	9,474.0		19,841.0
	model	5,282.8	12,418.5	17,701.3	2,873.0	15,714.1	20,574.3
European Economic Community	actual			33,545.0	27,615.0		61,160.0
	model	27,921.3	25,233.7	53,155.0	9,868.4	38,988.9	63,023.4

[1]Actual and predicted food grain and feed grain production levels are not strictly comparable. No distinction is made between food grain produced for human consumption and for livestock consumption in the published data as was the case in this model.

Source (actual): Sorenson and Hathaway, op. cit.

Table IV-13.--1964 transfer levels: food grain

Exporter \ Importer		France	Italy	Germany-Benelux	EFTA	Eastern Europe	Africa & Mid East	Other Asia
		1,000 metric tons						
France	actual		202.0	371.8	880.3	676.1	682.9	619.9
	model	5,616.5	168.6	1,870.9	413.3	1,849.5	551.0	551.0
Italy	actual	0		0		32.5	106.4	
	model	0	7,976.2	0		0	177.2	
Germany-Benelux	actual	0.5	1.3		364.1	600.9	189.6	94.3
	model	0	0	4,014.9	211.3	211.3	211.3	211.3
United States	actual	195.0	112.9	851.1				
	model	59.8	442.7	828.9				
Canada	actual	184.0	66.0	1,000.3				
	model	179.5	177.1	1,242.7				
Latin America	actual	191.0	151.0	292.0				
	model	59.8	88.5	331.6				
Africa & Mid East	actual	96.0						
	model	119.5						

Source (actual): Sorenson and Hathaway, op. cit.
United Nations, op. cit.

Table IV-14.--1964 transfer levels: feed grain

Exporter \ Importer		France	Italy	Germany-Benelux	EFTA	Other Europe
		1,000 metric tons				
France	actual		232.9	1,022.3	952.3	722.4
	model	15,450.2	257.5	696.4	690.7	172.7
Italy	actual	55.3		170.3		
	model	343.3	5,664.0	0		
Germany-Benelux	actual	0.4	0		331.5	
	model	686.7	85.8	14,627.3	314.3	
EFTA	actual			258.8		
	model			464.2		
United States	actual	407.0	996.0	3,211.4		
	model	343.3	600.6	5,101.0		
Latin America	actual	58.6	2,338.9	910.1		
	model	171.7	1,631.8	1,392.3		
Africa & Mid East	actual	23.6		24.8		
	model	171.7		232.1		
Australia, New Zealand, South Africa	actual		157.3	294.4		
	model		343.3	696.4		

Source (actual): Sorenson and Hathaway, op. cit.
United Nations, op. cit.

their decrease in pork production. The model's poultry production in France was also up by over 100 thousand metric ton. This increased poultry production was consumed equally by the three European Economic Community regions. There was also a slight increase in the French egg production which was then exported to Italy.

To achieve their increased beef production France imported large numbers of feeder calves from both Germany-Benelux and Italy. Almost two-thirds of their production was shipped to France. These feeder calf imports were in lieu of producing these calves domestically. With fewer calves being produced fewer cows were required in France. Thus the model postulated a sixty percent lower milk surplus in France than that predicted in the Michigan State University-United States Department of Agriculture study. The model predicted a milk self-sufficiency position for Italy and a milk surplus level equal to that predicted in the above study for Germany-Benelux. Also, since France increased their beef production at the expense of Italian and German-Benelux production, European Free Trade Area and Eastern Europe exports of feeder calves to Germany-Benelux and Italy dropped accordingly.

This increase in meat production also resulted in an increase in feed grain consumption in France. This need for feed grain was met through an increase in the production of feed grain in France by over one million metric ton and through a one million metric ton increase in imports. These imports were from Germany-Benelux, Italy, Africa and the Mid East and Latin America. These increased exports of feed grain by Italy and Germany-Benelux were the result of a shift from food grain to feed grain production in the two countries. To fill their newly created

shortage of food grain they increased their food grain imports: Italy from North America and Germany-Benelux from France and Canada.

The difference between predicted 1964 and actual 1964 hinges about one central point. The 1964 model shows France developing into the major agricultural center of the European Economic Community. It is the major grain producer already and to utilize this grain most efficiently it also needed to become a major producer of livestock products. Italy and Germany-Benelux support this shift by becoming major input suppliers for France (particularly for feeder calves). With France assuming this new role the European Economic Community would move to virtual self sufficiency in livestock production. With the shift from food grain to the feed grain production necessary for the livestock production the net exports of food grain by the European Economic Community decreased. This shifting production mix between grains however was not adequate to meet consumption requirements under livestock self-sufficiency and net European Economic Community imports of feed grains increased.

A final difference should be pointed out. The composition of the feed grain fed is different from what the model predicts. According to the model a substantial portion of the grain fed in France and in Germany-Benelux is denatured food grain rather than feed grain. In fact, only that amount of feed grain required for seed and industrial purposes is produced in these two regions.

Theil's Inequality Coefficient -- the 1964 Model

The Theil inequality coefficient is a type of correlation coefficient used to measure the 'goodness of fit' of predicted to actual outcomes. This coefficient ranges from zero (a perfect fit) to one (no correlation)

in value. The calculated coefficients for the 1964 model are presented in Table IV-15. Coefficients are given for the production and transfer subsections of the model as well as for the complete model.

As you will recall one problem with Theil's inequality coefficient is that the predicted and actual values must be additive. The values presented in Tables IV-2 to IV-14 obviously are not additive. In order to convert these data to a scale that was additive a conversion factor was defined for use throughout the testing of this basic model. A commonly accepted conversion factor in economic literature is price (the additive scale then being dollars). The 1964 price, however, could not be used to convert the production and transfer data to common units because the levels of the activities in 1964 are functions of these prices. Thus a change in the conversion factors would cause not only immediate changes in Theil's inequality coefficient but also changes in the activity levels. These changing activity levels would again alter the value of the coefficient.

The 1960-1968 average world price for the grain-livestock products was used to convert the 1964 results to common units. This is still a price but is as far removed as possible from being an exogenous variable in the model. This average price will be used throughout wherever a scale conversion is necessary in order to carry out any 'goodness of fit' test. Thus any changes in the test results will be due only to changes in the levels of the activities. The average world prices used in this conversion process are presented in Table IV-16.

This coefficient does not provide a test of the 'goodness of fit' of this model. It does provide a relative measure of the 'goodness of fit' of separate portions of the model. Thus sectors of the model can

Table IV-15.--'Goodness of fit' criteria -- the 1964 model

	Theil's inequality coefficient	The sign test (α=0.05)	Regression: $p_i = \beta_o + \beta_1 a_i$				
			$\hat{\beta}_o$	$\hat{\sigma}_{\beta_o}$	$\hat{\beta}_1$	$\hat{\sigma}_{\beta_1}$	$\hat{\sigma}_{p_i a_i}$
Production activities:							
All	0.15	accept	715.70	1,108.77	0.89	0.07	4,598.71
Transfer activities:							
Food grain	0.38	accept	30.46	72.54	1.12	0.27	260.44
Feed grain	0.23	accept	4.76	132.88	1.17	0.15	475.78
Total grain	0.08	accept	27.95	85.39	1.12	0.02	455.36
Feeder calves	0.77	reject	543.28	636.70	0.48	0.14	2,049.19
Beef and veal	0.37	reject	589.27	575.20	0.56	0.15	2,252.45
Pork	0.05	accept	257.61	238.97	0.94	0.04	621.02
Eggs	0.02	accept	40.86	27.84	0.99	0.01	70.17
Poultry	0.07	accept	70.91	81.37	1.07	0.05	200.15
All transfer	0.54	accept	183.71	122.32	0.86	0.04	1,331.13
The complete model	0.29	accept	211.85	204.65	0.91	0.03	2,437.10

Table IV-16.--Average world prices: 1960-1968

	Unit	Price
Food grain	1,000 m.t.	$ 64,252
Feed grain	1,000 m.t.	88,521
Total grain	1,000 m.t.	74,066
Milk-beef-feeder calves	1,000 head	144,770
Feeder calves	1,000 head	144,770
Beef	1,000 m.t.	738,256
Veal	1,000 m.t.	738,256
Pork	1,000 m.t.	706,459
Eggs	1,000 m.t.	553,222
Poultry	1,000 m.t.	674,943

Source: United Nations, Food and Agriculture Organization, Trade Yearbook, various issues.

be ranked according to their 'goodness of fit.' As can be seen from Table IV-15 the transfer sections for eggs, pork, poultry and total grain have the 'best fit' of all sections. A second grouping; consisting of the production activities, feed grain transfer and the total model (all production and transfer activities); fall into a 'second best fit' category. The 'third best fit' grouping includes beef and veal transfer, food grain transfer and total transfer activities. Finally, come the feeder calf transfer activities. This ordered ranking of the coefficients is consistent with where the major variations between the 1964 predicted results and the 1964 actual results occurred: a shift in beef production and the resulting shifts in feeder calf production and transfer.

The Sign Test -- the 1964 Model

The hypothesis that the predicted and actual quantities for sections of the 1964 model were distributed equally was tested by sign tests. The results of these tests are presented in Table IV-15. All parts of the model, except the feeder calves transfer and beef and veal transfer activities, were accepted as being equally distributed with their actual counterparts at the 0.05 level.

This again is consistent with a visual inspection of the data. Beef is, in the model, produced in France from feeder calves imported from Germany-Benelux and Italy. This is not what actually happened in 1964; therefore, these two parts of the model were rejected by the sign test.

Regression -- the 1964 Model

A third test of 'goodness of fit' centers around a regression of predicted values of the activities on actual values. A 'perfect' model would be one where all predicted values equaled actual values. This is equivalent to a regression equation with parameters zero and one.[10] Regression coefficients, and their standard errors, for different parts of the 1964 model are presented in Table IV-15. The regression results are not based on the data in Tables IV-2 to IV-14. These data have been converted on the basis of 1960-1968 average world prices (see Table IV-16) in order to provide an additive scale.

The hypothesis that the intercept of the regression equations equaled zero was accepted at a significance level of 0.05 for all groupings of activities on the basis of a t-test. Using the same type of

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[10] That is $p_i = \beta_o + \beta_1 a_i$ with $\beta_o = 0$ and $\beta_1 = 1$.

test the hypothesis that the slope of the regression equations equaled one was rejected for total grain transfer, feeder calves transfer, beef and veal transfer, all transfer and the complete model. The hypothesis was accepted for the other divisions of activities. This implies that the predictions of the total grain activities are overestimated while the whole model, particularly the feeder calves and beef and veal transfer activities, are underestimated.

Again the results of the regression analysis are consistent with where the predicted and actual variations occur in the 1964 model.

A Further Test -- 1968

As a second test of the model, comparable input data for 1968 was introduced into the model. This input data can also be found in Appendix A. Only the input data was changed. The basic structure of the model remained the same from 1964 to 1968.

Predicted production levels for 1968, when compared with actual levels for the European Economic Community, showed errors ranging from less than one fourth of one percent to eighteen percent and averaging about five percent for total grain, beef and veal, pork, eggs and poultry (see Table IV-17).[11] As with 1964, with the exception of beef and veal, the predicted production levels for the three European Economic Community regions were close to the actual production levels.

The resulting 1968 transfer patterns are shown in Tables IV-18 to IV-22.[12] With the exception of French-Eastern Europe, Italian-French,

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[11]More detailed production levels for beef, veal and grain are presented in Tables IV-23 and IV-27.

[12]Tables IV-24 to IV-26 and IV-28 to IV-29 show more detailed trade levels for beef, veal and grain.

Table IV-17.--1968 production levels

		Total grain	Beef and veal	Pork	Eggs	Poultry
		1,000 metric tons				
France	actual	32,704.0	1,648.0	1,344.0	621.0	680.0
	model	34,238.2	3,019.6	1,624.1	850.5	791.6
Italy	actual	14,331.0	590.0	528.0	480.0	532.0
	model	15,443.8	438.7	411.0	416.1	455.9
Germany-Benelux ..	actual	22,153.0	1,714.0	3,575.0	1,225.0	514.0
	model	22,855.1	550.7	2,407.9	997.4	475.4
European Economic Community	actual	69,188.0	3,952.0	5,447.0	2,326.0	1,726.0
	model	72,537.1	4,009.0	4,443.0	2,264.0	1,722.9

Source (actual): Organization for Economic Co-Operation and Development "Agricultural Statistics: 1955-1968", Paris, 1969.

Table IV-18.--1968 transfer levels: total grain

Exporter \ Importer		France	Italy	Germany-Benelux	EFTA	Eastern Europe	Other Europe	Africa & Mid East	Other Asia
		1,000 metric tons							
France	actual	22,423.6	322.8	3,230.2	1,561.1	418.2	552.0	1,843.9	768.0
	model	24,954.1	364.1	3,656.3	1,845.5	1,104.9	927.6	966.8	414.3
Italy	actual	2.5	14,033.7	13.3		0		242.4	
	model	1,145.3	13,774.0	249.7		0		274.9	
Germany-Benelux	actual	7.6	2.8	20,690.7	457.1	100.6		382.5	176.7
	model	0	91.9	21,476.7	659.8	160.4		320.7	106.9
EFTA	actual			653.2					
	model			499.4					
United States	actual	725.6	2,350.6	5,521.0					
	model	820.9	1,708.6	2,217.1					
Canada	actual	50.9	358.3	673.6					
	model	111.7	179.2	626.4					
Latin America	actual	165.4	2,961.2	1,145.5					
	model	329.4	2,268.9	656.0					

continued --

Table IV-18 (cont'd.)

Exporter \ Importer		France	Italy	Germany-Benelux	EFTA	Eastern Europe	Other Europe	Africa & Mid East	Other Asia
		1,000 metric tons							
Africa & Mid East ...	actual	39.3		203.6					
	model	0		0					
Australia, New Zealand, South Africa	actual		440.9	292.5					
	model		95.2	3,418.7					

Source (actual): Tables IV-28 and IV-29.

Table IV-19.--1968 transfer levels: beef and veal

Importer / Exporter		France	Italy	Germany-Benelux	All other countries
		1,000 metric tons			
France	actual	1,493.1	11.4	119.0	20.2
	model	1,362.9	436.3	1,220.3	0
Italy	actual	0	589.6	0.4	0
	model	0	438.7	0	0
Germany-Benelux	actual	15.1	62.6	1,619.2	8.9
	model	0	9.8	541.0	0
EFTA	actual	2.6	50.9		
	model	10.0	88.0		
Eastern Europe	actual	4.5	45.7		
	model	0	58.6		
Latin America	actual	8.5	40.9	63.5	
	model	10.0	107.5	32.8	

Source (actual): Organization for Economic Co-Operation and Development, op. cit.
United Nations, Statistical Office of the United Nations, Department of Economics and Social Affairs, "Commodity Trade Statistics", Statistical Papers, Series D, various issues.

Table IV-20.--1968 transfer levels: pork

Exporter \ Importer		France	Italy	Germany-Benelux
		1,000 metric tons		
France	actual	1,338.7	1.8	1.4
	model	1,159.7	44.9	419.5
Italy	actual	0	528.0	0
	model	0	411.0	0
Germany-Benelux	actual	105.1	24.4	3,443.0
	model	48.3	29.1	2,330.5

Source (actual): Organization for Economic Co-Operation and Development, op. cit.
United Nations, op. cit.

Table IV-21.--1968 transfer levels: eggs

Exporter \ Importer		France	Italy	Germany-Benelux
		1,000 metric tons		
France	actual	613.4	1.9	3.6
	model	602.9	70.0	177.6
Italy	actual	0	479.6	0
	model	0	416.1	0
Germany-Benelux	actual	12.7	3.1	1,195.8
	model	6.1	4.9	986.4

Source (actual): Organization for Economic Co-Operation and Development, op. cit.
United Nations, op. cit.

Table IV-22.--1968 transfer levels: poultry

Exporter \ Importer		France	Italy	Germany-Benelux
		1,000 metric tons		
France	actual	662.0	0	10.0
	model	624.0	82.1	85.6
Italy	actual	0	529.4	2.1
	model	0	455.9	0
Germany-Benelux	actual	1.2	1.1	498.0
	model	0	0	475.4

Source (actual): Organization for Economic Co-Operation and Development, op. cit.
United Nations, op. cit.

United States-German-Benelux and Australian, New Zealand, South African-German-Benelux trade predicted total grain shipments were similar to actual shipments. Again trade patterns for beef and veal depended on production patterns. With the exception of French beef exports to Germany-Benelux and Italy and a slight tendency for a similar pattern in other livestock products the predicted trade levels for all the livestock products were also close to actual levels.

The 1968 model shows the same type of deviation from what actually happened as did the 1964 model. France is still, in this model, the major producer of livestock products in the European Economic Community. This is particularly true for beef and veal. The model shows that in 1968 75.3 percent of the European Economic Community's beef and veal production (rather than the actual 41.7 percent) is produced in France. This excess production is shipped to Germany-Benelux and Italy. France is supplying over two-thirds of the beef consumed in Germany-Benelux and over a third of that consumed in Italy. French exports of beef and veal are increasing (from 59.6 to 134.7 thousand metric ton during the 1964-1968 period), however, not as fast as the model predicts.

What is true for beef and veal is true, to a lesser extent for the other livestock products in the model. French pork production is twenty percent over what it really was in 1968. The model shows this extra production being shipped primarily to Germany-Benelux with some to Italy. Total pork production in the European Economic Community was larger than predicted. The model, however, does not allow for any exportable surplus of pork to build up. Over a 200 thousand metric ton increase over actual in egg production is indicated for France. This is in large part at the expense of German-Benelux production with France supplying about fifteen

Table IV-23.--1968 detailed beef and veal production levels

		Milk-beef-feeder calves	Feeder calves	Beef (cull cows)	Beef (≥ 1 yr.)	Beef (≤ 1 yr.)	Total beef	Veal	Beef and veal
		1,000 head			1,000 metric tons				
France	actual	8,762.0							1,648.0
	model	10,172.6	6,866.5	600.2	1,992.6		2,592.8	426.8	3,019.6
Italy	actual	4,740.0							590.0
	model	4,949.5	3,340.9	301.9	0	0	301.9	136.8	438.7
Germany-Benelux	actual	8,833.0							1,714.0
	model	7,488.3	5,054.6	419.3	0		419.3	131.4	550.7
European Economic Community	actual	22,335.0							3,952.0
	model	22,610.4	15,262.0	1,321.4	1,992.6	0	3,314.0	695.0	4,009.0

Source (actual): Organization for Economic Co-Operation and Development, op. cit.

Table IV-24.--1968 transfer levels: feeder calves

Importer / Exporter		France	Italy	Germany-Benelux
		1,000 head		
France	actual		569.5	248.8
	model	6,820.1	46.4	0
Italy	actual	0		0
	model	2,089.0	1,251.9	0
Germany-Benelux	actual	40.6	370.9	
	model	3,456.3	46.4	1,551.9
EFTA	actual		464.4	930.6
	model		123.6	237.4
Eastern Europe	actual	0	1,472.2	460.2
	model	0	77.3	36.5

Source (actual): Organization for Economic Co-Operation and Development, op. cit.
United Nations, op. cit.

Table IV-25.--1968 transfer levels: beef

Exporter \ Importer		France	Italy	Germany-Benelux	All other countries
		1,000 metric tons			
France	actual				
	model	964.4	411.7	1,196.7	0
Italy	actual				
	model	0	301.9	0	0
Germany-Benelux	actual				
	model	0	9.8	409.6	0
EFTA	actual				
	model	10.0	88.0		
Eastern Europe	actual				
	model	0	58.6		
Latin America	actual				
	model	10.0	107.5	32.8	

Table IV-26.--1968 transfer levels: veal

Importer / Exporter		France	Italy	Germany-Benelux
		1,000 metric tons		
France	actual model	378.5	24.6	23.6
Italy	actual model	0	136.8	0
Germany-Benelux	actual model	0	0	131.4

Table IV-27.--1968 detailed grain production levels[1]

		Food grain	Denatured food grain	Total food grain	Feed grain	Total feed grain equivalent	Total grain
		1,000 metric tons					
France	actual			14,842.0	17,862.0		32,704.0
	model	13,811.6	18,542.6	32,354.2	1,884.0	23,188.9	34,238.2
Italy	actual			9,590.0	4,741.0		14,331.0
	model	9,163.3	0	9,163.3	6,280.5	7,013.6	15,443.8
Germany-Benelux	actual			11,166.0	10,987.0		22,153.0
	model	5,345.4	12,726.7	18,072.1	4,783.0	17,937.0	22,855.1
European Economic Community	acutal			35,598.0	33,590.0		69,188.0
	model	28,320.3	31,269.3	59,589.6	12,947.5	48,139.8	72,537.1

[1]Actual and predicted food grain and feed grain production levels are not strictly comparable. No distinction is made between food grain produced for human consumption and for livestock consumption in the published data as was the case in this model.

Source (actual): Organization for Economic Co-Operation and Development, op. cit.

Table IV-28.--1968 transfer levels: food grain

Exporter \ Importer		France	Italy	Germany-Benelux	EFTA	Eastern Europe	Africa & Mid East	Other Asia
		1,000 metric tons						
France	actual		179.8	1,097.0	612.4	418.2	1,843.9	768.0
	model	5,195.9	268.9	2,407.8	690.6	1,104.9	966.8	414.3
Italy	actual	0		11.8		0	242.4	
	model	0	8,155.4	0		0	274.9	
Germany-Benelux	actual	7.6	0		383.6	100.6	382.5	176.7
	model	0	0	4,169.4	160.4	160.4	320.7	106.9
United States	actual	345.3	213.7	1,041.9				
	model	167.6	89.6	469.7				
Canada	actual	50.9	358.3	673.6				
	model	111.7	179.2	626.4				
Latin America	actual	46.0	437.9	59.8				
	model	111.7	268.9	156.6				
Africa & Mid East	actual	0						
	model	0						

Source (actual): Organization for Economic Co-Operation and Development, op. cit.
United Nations, op. cit.

Table IV-29.--1968 transfer levels: feed grain

Exporter \ Importer		France	Italy	Germany-Benelux	EFTA	Other Europe
		1,000 metric tons				
France	actual		143.0	2,133.2	948.7	552.0
	model	19,758.2	95.2	1,248.5	1,159.4	927.6
Italy	actual	2.6		1.5		
	model	1,145.3	5,618.6	249.7		
Germany-Benelux	actual	0	2.8		73.5	
	model	0	91.9	17,307.3	538.1	
EFTA	actual			653.2		
	model			499.4		
United States	actual	380.3	2,136.9	4,479.1		
	model	653.3	1,619.0	1,747.4		
Latin America	actual	53.7	2,523.3	1,085.7		
	model	217.7	2,000.0	499.4		
Africa & Mid East	actual	39.3		203.6		
	model	0		0		
Australia, New Zealand, South Africa	actual		440.9	292.5		
	model		95.2	3,418.7		

Source (actual): Organization for Economic Co-Operation and Development, op. cit.
United Nations, op. cit.

percent of both Italian and German-Benelux demand. The model's poultry production relative to actual production in France is also up -- by over sixteen percent. This added French production is then shipped to both Italy and Germany-Benelux.

As in the 1964 model the increased beef production in France requires substantially more feeder calves than are produced in France. About two-thirds of both Italian and German-Benelux feeder calves were shipped to France. Again since a large portion of France's demand for feeder calves is supplied via imports this model predicts a milk surplus only a third as large as that actually existing in France in 1968. A self-sufficiency position, with no milk surpluses, is predicted for both Italy and Germany-Benelux. Since French beef production replaced Italian and German-Benelux production, their imports of feeder calves fell substantially.

France's increased meat production caused corresponding repercussions in the feed grain section of the model. The increased demand for feed grain in France is met by over a 2.6 million metric ton increase in production and over a 1.5 million metric ton increase in imports (two-thirds of which were from Italy). The corresponding decrease in demand for feed grain in Italy and Germany-Benelux meant a drop in imports for the two. Italy's imports from both the United States and Latin America fell by over 500 thousand metric ton. Not only did Germany-Benelux's imports fall by over 500 thousand metric ton but the composition of the remaining imports changed. There were reductions in German-Benelux imports from the United States, France and Latin America while at the same time a significant increase in imports from Australia, New Zealand, South Africa.

The model also shows at least a twenty-five percent increase in German-Benelux imports of food grain. With two exceptions the transfer

pattern for food grain is reasonable. Germany-Benelux imports food grain from France at the expense of the United States. The excess production of France is shipped to Germany-Benelux and Eastern Europe in the model rather than Africa and the Mid East and Germany-Benelux.

To summarize the grain sector, the model shows a shifting away from food grain and toward feed grain production in the European Economic Community (especially in Germany-Benelux). As a result of this shift the European Economic Community's net imports of grain fell. A goodly portion of this drop in imports was at the expense of United States exports to Germany-Benelux and Italy. Again, as in 1964, the model shows feed grain production in France and Germany-Benelux to be composed chiefly of denatured food grain.

Theil's Inequality Coefficient -- the 1968 Model

In order to calculate the inequality coefficients the 1968 quantity data were weighted on the basis of the 1960-1968 average world price for the different grain-livestock prices (Table IV-16). These are the same weights used in computing the coefficients for 1964. Results for 1968 are presented in Table IV-30.

If we again ranked the sections of the model as to their relative 'goodness of fit' the poultry transfer section would have the best fit. Falling into a 'second best fit' grouping come the total grain transfer, the production, the total model, pork transfer and total transfer activities. Next come the egg, beef and veal and feed grain transfer activities. A final grouping consists of the food grain and feeder calves transfer activities.

Table IV-30.--'Goodness of fit' criteria -- the 1968 model

	Theil's inequality coefficient	The sign test (α=0.05)	Regression: $p_i = \beta_o + \beta_1 a_i$				
			$\hat{\beta}_o$	$\hat{\sigma}_{\beta_o}$	$\hat{\beta}_1$	$\hat{\sigma}_{\beta_1}$	$\hat{\sigma}_{p_i a_i}$
Production activities:							
All	0.17	accept	1,372.40	1,801.07	0.84	0.10	6,132.06
Transfer activities:							
Food grain	0.65	accept	34.72	62.72	0.81	0.17	243.19
Feed grain	0.40	accept	447.97	189.54	0.38	0.15	691.34
Total grain	0.12	accept	-86.97	183.38	1.15	0.04	971.36
Feeder calves	0.73	accept	1,358.95	671.26	-0.92	0.77	1,615.22
Beef and veal	0.38	accept	783.32	596.71	0.55	0.15	2,364.08
Pork	0.19	accept	633.11	432.18	0.67	0.05	1,133.17
Eggs	0.37	accept	241.98	144.36	0.81	0.05	364.61
Poultry	0.08	accept	169.55	105.63	0.88	0.05	258.67
All transfer	0.23	accept	235.34	132.24	0.84	0.04	1,438.27
The complete model	0.18	accept	298.52	240.22	0.88	0.03	2,796.92

The ranking is again consistent with where the major deviations occur between the 1968 predicted results and the 1968 actual results -- the transfer of beef and the resulting effects on grain and feeder calves. The inequality coefficient shows that the 1968 model is better than the 1964 model (0.18 to 0.29). At the same time however the coefficients for the separate sections of the model tend to be larger. This is in large part due to the fact that Theil's inequality coefficient measures relative error. The 1968 model does as good as a job as the 1964 model does in predicting the major activities. However, the error on the minor activities in 1968 tended to be larger than in 1964. This caused the coefficients to increase somewhat in size.

The Sign Test -- the 1968 Model

Again the hypothesis that the distribution of the predicted quantities equaled the distribution of the actual quantities was tested for the sections of the 1968 model by sign tests. This hypothesis was accepted at the 0.05 level for all parts of the model (Table IV-30).

Regression -- the 1968 Model

The results of regressions of predicted values on actual values of different sets of activities are presented in Table IV-30. As before, the regressions are based on dollar value data rather than the quantity data in Tables IV-17 to IV-29. The 1960-1968 average world prices (Table IV-16) were used to convert the data to value terms.

The hypothesis that the intercept equaled zero was accepted for all groupings of activities except feed grain transfer on the basis of a t-test at the 0.05 significance level. With the same type of test the hypothesis that the slopes of the regression equation equaled one was

accepted for the production, the food grain transfer and the poultry transfer activities. This hypothesis was rejected for the other activity divisions. Since the slope coefficients (with the exception of total grain transfer) are all less than one, this implies that the predictions of the 1968 model tend to underestimate actual activity levels.[13]

Rejection of the hypothesis that the slopes of the regression equations equal one is not inconsistent with the results of the sign test. It does, however, emphasize some of the shortcomings of the sign test. The sign test is only concerned with whether you overestimate or underestimate. It is not concerned with the size of either the aboslute error or the relative error -- just the sign of the error. In the 1968 case the model did not predict the large valued transfer activities with as much accuracy as it did in 1964. More often than not it tended to underestimate these values. This phenomenon would cause the slope of a regression equation to be less without affecting appreciably the number of overestimations and underestimations. One large underestimation could cause the regression test to be rejected without changing the results of a sign test.

Conclusions

One objective of this research was, using only easily available input data, to develop the simplest model possible that was able to simulate the grain-livestock economy of the European Economic Community. Given

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[13]The negative sign on the feeder calves transfer activities can be explained by the Italy-France and Germany-Benelux-France transfers. The divergence between actual and predicted is so great for these two activities that they completely dominate the regression coefficients; resulting in an equation with a negative slope.

this objective and the results of the objective 'goodness of fit' tests on the 1964 and 1968 models it seems reasonable to conclude that this model is a 'good' first approximation of the world. While it may be possible to further improve the model's 'goodness of fit' it could only be done by expanding the size and complexity of the model and/or by utilizing better, more detailed input data. This takes us further away from the objective of a simple model. Besides, some of the data required by a better model are not presently available.

The differences between actual and predicted values can be accounted for by any of a combination of three factors. The first hinges on the characteristics of a linear model. Activities enter a linear model one at a time. In this model the activity producing the most revenue enters first. Its level increases until some sort of maximum restriction stops it from increasing more. Then a second activity enters. Thus in many cases whether a given activity enters the model is an 'either-or' decision. An example of this would be the model of Chapter III without restirction twelve. Without this minimum historical percent transferred over any given route only one purchase or sale activity would enter the model. This restriction allows one to overcome some of the linear properties of the model. It is this type of problem that is causing so little feed grain to be produced in France and Germany-Benelux. It is more profitable to produce food grain for feed purposes than it is feed grain. It is an 'either-or' decision in the model. This linear model also does not allow for diminishing returns on the production activities (or transfer activities for that matter). With sufficiently detailed data concerning the shape of the production function (and therefore the total revenue curve) step functions could be included for all activities.

This will move the decision as to what activity to include away from an 'either-or' type decision. It does this by moving the linear model a step closer to a non-linear model.

This brings us to a second factor. The differences between actual and predicted values is also a function of the accuracy and availability of the input data in the model. Whenever two alternative activities are good substitutes errors in the data affecting these activities (be it in the objective function or in the coefficients of the restrictions) can cause activities to enter at different rates and times. Data for inter-country models tend to be inadequate and incomplete. This coupled to the necessity for comparable data for all countries causes the collection of even minimum input data to be a problem of some magnitude. For this model improved transport costs and forage and grain conversion factors for livestock should improve the predictions. This is particularly true for transportation costs within Europe.

This lack of comparable data will also account for the feeder calves transfer section of the model performing so poorly. The data aren't completely comparable. The predicted values are in terms of feeder calves while the actual values are in terms of live cattle. To the extent that live cattle transfers are not feeder calves, comparison between actual and predicted values in this section of the model are not completely valid.

A final reason for the models divergence from reality lies in the theoretical structure or framework of the model. If the framework of the model does not accurately represent the structure of the economy you are trying to simulate, the model will not predict reality. This final reason, coupled with the lack of data, is probably the major reason why

the 1964 model differed from reality. This model predicted a shifting of livestock production to the area which generates the greatest European Economic Community revenue-France. This shift is based on four relative factors: product prices, land availability, feed conversions and transport costs. These are the only four. The model does not consider the importance, cost and availability of other factors of production. Even if France is the 'best' producer, livestock production may not shift from Italy and Germany-Benelux. Whether production shifts or not depends upon the alternatives of the other factors of production. If livestock production is their best alternative, then this may offset the reasons for shifting. Livestock production would then stay in Italy and Germany-Benelux. Even if this phenomenon of shifting livestock production is occuring the model cannot adequately account for the inertia of the real world. Time is only superficially a component of the model. This same type of reasoning could also explain why the model shows food grain being utilized as feed grain.

A final reason for concluding that this model is, at least, a good first approximation of reality is a normative reason. The major deviations this model shows from reality are all in the direction that economic theory would tell us to expect them to be. If this optimizing model does in any sense represent how an 'efficient' economy should operate, and if the European Economic Community will over time move from a less efficient to a more efficient position; the errors in this model will decrease in importance over time. Therefore, as better, more accurate data are introduced into this model, not only will the model move closer to simulating the real world, but the real world will move closer to what the model says it should be doing.

CHAPTER V

Short Run Predictions - 1970

In the last chapter the model developed in Chapter III was accepted as being a valid predicting model. This chapter presents the results of predictions for 1970. Since the Michigan State University-United States Department of Agriculture study made projections to 1970 this same period was used for prediction here. The Michigan State University-United States Department of Agriculture study presented price projections for some commodities in terms of a range of prices; therefore, this study also presents predictions based on this same range of prices. The 1970 input data are presented in Appendix A.

The 1970 Model

The results for the 1970 predictions are presented in Tables V-1 to V-13. These tables give the results for both the low price, 1970(L), and the high price, 1970(H), projections. As the only differences in the two sets of predictions lie in the beef transfer activities the 1970(L) and 1970(H) are reported together for the other sections of the two models.

For veal, pork, eggs and poultry the model restricted production to a 100 percent self-sufficiency level. No exportable surpluses were allowed the Community for these products. Therefore, the production levels for these commodities are restricted to that level necessary to meet internal demand. Both models show Germany-Benelux essentially self-sufficient in poultry with a few imports from France. On the other hand twenty percent of the Italian poultry consumed comes from France. About twenty percent of both the eggs and the veal consumed in Italy and Germany-Benelux originates in France. France also supplies twenty percent

Table V-1.--1970(L) and 1970(H) production levels

	Food grain	Denatured food grain	Total food grain	Feed grain	Total feed grain equivalent	Total grain	Milk-beef-feeder calves	Feeder calves
	1,000 metric tons						1,000 head	
France	6,856.0	22,651.1	29,507.1	2,000.0	26,022.3	31,507.1	10,112.5	6,826.0
Italy	8,297.2	0	8,297.2	7,010.6	7,674.4	15,307.8	4,983.4	3,363.8
Germany-Benelux	8,081.1	8,591.8	16,672.9	4,471.0	13,709.3	21,143.9	8,989.9	6,068.1
European Economic Community	23,234.3	31,242.9	54,477.2	13,481.6	47,406.0	67,958.8	24,085.8	16,257.9

continued --

Table V-1 (cont'd.)

	Beef (cull cows)	Beef (≥ 1 yr.)	Beef (≤ 1 yr.)	Total beef	Veal	Beef & veal	Pork	Eggs	Poultry
	1,000 metric tons								
France	596.6	1,888.5		2,485.2	553.8	3,039.0	1,980.7	1,046.6	866.7
Italy	299.0	0	0	299.0	134.0	433.0	403.8	505.6	416.8
Germany-Benelux	512.4	1.0		513.4	132.2	645.6	2,445.2	1,081.8	711.5
European Economic Community	1,408.0	1,889.5	0	3,297.6	820.0	4,117.6	4,829.7	2,634.0	1,995.0

Table V-2.--1970(L) and 1970(H) transfer levels: total grain

Importer / Exporter	France	Italy	Germany-Benelux	EFTA	Eastern Europe	Other Europe	Africa & Mid East	Other Asia
	1,000 metric tons							
France	25,418.0	262.2	2,099.7	1,575.3	411.4	780.7	685.6	274.2
Italy	1,682.3	13,293.5	0		0		331.9	
Germany-Benelux	0	92.9	19,942.0	379.5	80.8		484.9	161.6
EFTA			10,334.6					
United States	977.2	1,833.0	2,462.6					
Canada	58.2	246.1	558.5					
Latin America	2,499.1	2,093.2	616.8					
Africa & Mid East	0		0					
Australia, New Zealand, South Africa		196.3	283.5					

Table V-3.--1970(L) and 1970(H) transfer levels: food grain

Importer / Exporter	France	Italy	Germany-Benelux	EFTA	Eastern Europe	Africa & Mid East	Other Asia
	1,000 metric tons						
France	3,276.2	164.1	399.1	274.2	411.4	685.6	274.2
Italy	0	7,301.5	0		0	331.9	
Germany-Benelux	0	0	6,464.9	242.4	80.8	484.9	161.6
United States	232.7	164.1	478.8				
Canada	58.2	246.1	558.5				
Latin America	2,250.9	328.2	79.8				
Africa & Mid East	0						

Table V-4.--1970(L) and 1970(H) transfer levels: feed grain

Importer / Exporter	France	Italy	Germany-Benelux	EFTA	Other Europe
	1,000 metric tons				
France	22,141.8	98.1	1,700.6	1,301.1	780.7
Italy	1,682.3	5,992.0	0		
Germany-Benelux	0	92.9	13,479.3	137.1	
EFTA			10,334.6		
United States	744.6	1,668.9	1,983.8		
Latin America	248.2	1,765.0	567.0		
Africa & Mid East	0		0		
Australia, New Zealand, South Africa		196.3	283.5		

Table V-5.--1970(L) and 1970(H) transfer levels: feeder calves

Importer / Exporter	France	Italy	Germany-Benelux
	1,000 head		
France	6,780.5	45.4	0
Italy	2,182.7	1,181.1	0
Germany-Benelux	4,490.6	90.8	1,486.7
EFTA		121.1	227.5
Eastern Europe	0	75.7	35.0

Table V-6.--1970(L) transfer levels: beef and veal

Importer / Exporter	France	Italy	Germany-Benelux	All other countries
	1,000 metric tons			
France	1,609.5	44.1	1,385.4	0
Italy	144.7	288.3	0	0
Germany-Benelux	12.9	63.6	469.1	0
EFTA	0	74.2		
Eastern Europe	0	63.5		
Latin America	12.9	693.7	36.5	

Table V-7.--1970(H) transfer levels: beef and veal

Importer / Exporter	France	Italy	Germany-Benelux	All other countries
	1,000 metric tons			
France	1,754.2	518.9	765.9	0
Italy	0	433.0	0	0
Germany-Benelux	12.9	63.6	569.1	0
EFTA	0	74.2		
Eastern Europe	0	63.5		
Latin America	12.9	74.2	656.0	

Table V-8.--1970(L) transfer levels: beef

Importer / Exporter	France	Italy	Germany-Benelux	All other countries
	1,000 metric tons			
France	1,122.3	10.6	1,352.3	0
Italy	144.7	154.3	0	0
Germany-Benelux	12.9	63.6	436.9	0
EFTA	0	74.2		
Eastern Europe	0	63.5		
Latin America	12.9	693.7	36.5	

Table V-9.--1970(H) transfer levels: beef

Importer / Exporter	France	Italy	Germany-Benelux	All other countries
	1,000 metric tons			
France	1,267.0	485.4	732.8	0
Italy	0	299.0	0	0
Germany-Benelux	12.9	63.6	436.9	0
EFTA	0	74.2		
Eastern Europe	0	63.5		
Latin America	12.9	74.2	656.0	

Table V-10.1970(L) and 1970(H) transfer levels: veal

Importer / Exporter	France	Italy	Germany-Benelux
	1,000 metric tons		
France	487.2	33.5	33.1
Italy	0	134.0	0
Germany-Benelux	0	0	132.2

Table V-11.--1970(L) and 1970(H) transfer levels: pork

Importer / Exporter	France	Italy	Germany-Benelux
	1,000 metric tons		
France	1,333.9	65.6	581.2
Italy	0	403.8	0
Germany-Benelux	85.1	35.3	2,324.8

Table V-12.--1970(L) and 1970(H) transfer levels: eggs

Importer / Exporter	France	Italy	Germany-Benelux
	1,000 metric tons		
France	659.3	120.1	267.2
Italy	0	505.6	0
Germany-Benelux	6.7	6.3	1,068.8

Table V-13.--1970(L) and 1970(H) transfer levels: poultry

Importer / Exporter	France	Italy	Germany-Benelux
	1,000 metric tons		
France	748.0	104.2	14.5
Italy	0	416.8	0
Germany-Benelux	0	0	711.5

of Germany-Benelux's and thirteen percent of Italy's demand for pork. Italy, as well as France, imports some pork from Germany-Benelux too.

Beef production levels are the same in both the 1970(L) and 1970(H) models. In both cases France produces over three-fourths of the beef produced in the European Economic Community. With the low beef price projections France supplies Germany-Benelux with over seventy percent of the beef they consume. France finds it more profitable to export beef to Germany-Benelux in the 1970(L) model than to consume it domestically. After supplying Germany-Benelux they must import beef to meet their domestic demand. The 1970(L) model shows France importing beef from Italy, however, this is in reality transhipped beef from Latin America. This beef is shipped through Italy because of the lower variable import levy into Italy relative to that into France. This model also shows that over fifty percent of the beef consumed in Italy comes from Latin America, with another twenty percent from the European Free Trade Association, Germany-Benelux, Eastern Europe and France.

Under the high beef price predictions France supplies domestic consumers first, then Italian and finally German-Benelux consumers. Thus France does not import beef from Latin America in the 1970(H) model. Since France does supply Italy, Italian imports from Latin America drop drastically relative to the 1970(L) model. After supplying Italy, France's remaining excess production is shipped to Germany-Benelux. This, however, along with German-Benelux production, is not sufficient to meet their consumption needs. The remaining German-Benelux demand is met through Latin American imports. The exports of Latin America are the same for the 1970(L) and the 1970(H) model. The different beef prices just cause a rerouting of Latin American and French beef exports.

In as much as both models show France producing over three-fourths of the beef and only a little over forty percent of the feeder calves produced in the European Economic Community, France must import feeders. The main movement of feeder calves is from Germany-Benelux and Italy to France with them supplying thirty-three percent and sixteen percent respectively of the French demand. To do this required Germany-Benelux to ship over seventy percent and Italy over sixty percent of their feeder calf production to France. Since beef production in Italy and Germany-Benelux fell the demand for feeder calves in these two countries fell. Thus imports of feeder calves from Eastern Europe and the European Free Trade Area fell substantially from their 1968 levels.

While France imports a substantial number of feeder calves it only imports a little over ten percent of the feed grain used for livestock. It does import some feed grain from Italy (which it hadn't been doing in the past), the United States and Latin America. Germany-Benelux on the other hand produces somewhat less than half its needs. A third of its demand is supplied by imports from the European Free Trade Area, with the rest coming from the United States, France, Latin America and Australia, New Zealand, South Africa. To the extent that the European Free Trade Area cannot supply the indicated amounts of feed grain, feed grain transfers will be shifted to first Australia, New Zealand, South Africa, then in order Latin America, the United States and Africa and the Mid East.

With the exception of the European Free Trade Area the 1970 model shows external European Economic Community feed grain trade down from the 1968 levels. The model shows United States exports of feed grain down from actual 1968 levels by over a third. Exports to France are up by 95.8 percent but down to Italy by 21.9 percent and to Germany-Benelux by

55.7 percent. Since the European Free Trade Area and Australia, New Zealand, South Africa would, in all likelihood, not be able to supply Germany-Benelux with that amount of feed grain indicated by the model, United States exports to Germany-Benelux and therefore the European Economic Community would be larger than indicated. If the exports of the European Free Trade Area and Australia, New Zealand, South Africa were at a level equivalent to three-fourths of their total feed grain exports in 1968 then United States feed grain exports to the European Economic Community would increase about five percent rather then fall by a third. Under this assumption United States exports to Germany-Benelux would be up by about nine percent.

The 1970 model shows that the European Economic Community is a net importer of food grain. The exports of food grain would primarily be soft wheat while the imports would be hard wheat. Compared to the 1968 trade levels France has moved from a net exporter of 4,469.5 thousand metric ton to a net importer of 333.2 thousand metric ton of food grain. It reached this position by substantial reduction in its exports to Germany-Benelux, the European Free Trade Area and Africa and Mid East and a major increase in imports from Latin America. Italy remained a net importer in the 1970 model however, due to decreases in the level of imports from North America from the 1968 level, their net import position fell from 935.3 thousand metric ton to 570.6 thousand metric ton. The significant drop in United States food grain exports to Germany-Benelux caused them to move from a net import position of 1,833.1 thousand metric ton to one of 546.5 thousand metric ton.

Relative to 1968 this model shows the United States losing 45.3 percent of their European Economic Community food grain market. Their

exports to all three regions fell with the greatest decline being in the German-Benelux market.[1]

The European Economic Community was a net importer of grain in 1968. Not only does the model predict them to be a net importer in 1970 but it predicts that their net grain imports should rise by 87.2 percent. This increased demand for grain is met through an increase in grain imports (42.0 percent) and a decrease in grain exports (20.6 percent). However, the United States position, according to the model, in the European Economic Community total grain market deteriorates. In 1968 the United States exported 8,597.2 thousand metric ton of grain to the European Economic Community. This model shows exports of 5,272.8 thousand metric ton, a drop of 35.2 percent. Even allowing for the above postulated shift from European Free Trade Area exports of feed grain to United States exports to Germany-Benelux, the total grain exports of the United States to the European Economic Community will fall about five percent from their 1968 levels. The only place where the United States increases its exports is to France. This is because the increased feed grain exports offset the decrease in food grain exports.

Projected total grain production was down two percent from the 1968 levels. As was the case with the two postdictions the model shows total feed grain to be composed primarily of denatured food grain for both France and Germany-Benelux. The main reason for the decreased production in the European Economic Community involves a decline in the crop land available for grain production.

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[1]United States exports of food grain to France fell by 32.6 percent, to Italy by 23.2 percent and to Germany-Benelux by 54.1 percent relative to their 1968 levels.

A Second 1970 Model

Early in 1970 the production and consumption projections in the Michigan State University-United States Department of Agriculture were revised. The original projections were based on data through 1964. These new projections modified the earlier ones on the basis of the actual changes that occurred between 1964 and 1968. Since projected consumption levels for final products are inputs into the spatial model new predictions can be made. Again the predictions are made for both the low price projections, the 1970(L) update, and the high price projections, the 1970(H) update. These predictions are presented in Tables V-14 to V-26. Again the only differences in the predictions are in the beef transfer activities. Therefore, the 1970(L) update and the 1970(H) update results are presented together for the other sections of the models.

Since the only differences between the models in this section and the ones in the last section are changes in the levels of consumption (see Table A-39) we would expect the predictions for these two models to exhibit the same general patterns as the previous predictions. And, with a few exceptions, this is what happens.

The updated projections show an increase in the demand for poultry in the European Economic Community (the increase in Italy more than offsets the decreases elsewhere). Since the Community is a closed system this increased demand generates a corresponding increase in production -- particularly in Italy. The transfer pattern again shows France exporting poultry to Italy.

For eggs, pork and veal the updated demand projections are lower than the original projections. This again is manifested by lower production levels for the European Economic Community. The same is true for

Table V-14.--1970(L) update and 1970(H) update production levels

	Food grain	Denatured food grain	Total food grain	Feed grain	Total feed grain equivalent	Total grain	Milk-beef-feeder calves	Feeder calves
	1,000 metric tons						1,000 head	
France	5,836.5	23,670.7	29,507.2	2,000.0	26,838.0	31,507.2	9,260.5	6,250.8
Italy	9,097.2	0	9,097.2	5,890.6	6,618.4	14,987.8	4,983.4	3,363.8
Germany-Benelux	7,665.9	9,006.9	16,672.8	4,471.0	14,091.2	21,143.8	8,989.9	6,068.1
European Economic Community	22,599.6	32,677.6	55,277.2	12,361.6	47,547.6	67,638.8	23,233.8	15,682.7

continued --

Table V-14 (cont'd.)

	Beef (cull cows)	Beef (≥ 1 yr.)	Beef (≤ 1 yr.)	Total beef	Veal	Beef & veal	Pork	Eggs	Poultry
	1,000 metric tons								
France	546.4	2,101.1		2,647.4	454.7	3,102.1	1,881.9	976.0	885.9
Italy	299.0	0	0	299.0	140.4	439.4	441.6	402.4	596.0
Germany-Benelux	512.4	6.5		518.9	121.6	640.5	2,465.5	1,006.6	631.1
European Economic Community	1,357.8	2,107.6	0	3,465.3	716.7	4,182.0	4,789.0	2,385.0	2,113.0

Table V-15.--1970(L) update and 1970(H) update transfer levels: total grain

Importer / Exporter	France	Italy	Germany-Benelux	EFTA	Eastern Europe	Other Europe	Africa & Mid East	Other Asia
	1,000 metric tons							
France	25,622.9	281.9	2,054.7	1,575.4	350.2	805.1	583.6	233.5
Italy	393.6	14,230.3	0		0		363.9	
Germany-Benelux	0	97.5	19,985.6	370.9	76.7		460.0	153.3
EFTA			9,618.5					
United States	942.8	1,913.9	2,409.5					
Canada	53.6	269.9	529.8					
Latin America	2,625.8	2,193.6	634.5					
Africa & Mid East	0		0					
Australia, New Zealand, South Africa		203.9	279.4					

Table V-16.--1970(L) update and 1970(H) update transfer levels: food grain

Importer / Exporter	France	Italy	Germany-Benelux	EFTA	Eastern Europe	Africa & Mid East	Other Asia
	1,000 metric tons						
France	2,710.0	179.9	378.6	233.5	350.2	583.6	233.5
Italy	0	8,005.5	0		0	363.9	
Germany-Benelux	0	0	6,132.8	230.0	76.7	460.0	153.3
United States	214.4	179.9	454.2				
Canada	53.6	269.9	529.8				
Latin America	2,383.0	359.8	75.7				
Africa & Mid East	0						

Table V-17.--1970(L) update and 1970(H) update transfer levels: feed grain

Importer / Exporter	France	Italy	Germany-Benelux	EFTA	Other Europe
	1,000 metric tons				
France	22,912.9	102.0	1,676.1	1,341.9	805.1
Italy	393.6	6,224.8	0		
Germany-Benelux	0	97.5	13,852.8	140.9	
EFTA			9,618.5		
United States	728.4	1,734.0	1,955.3		
Latin America	242.8	1,833.8	558.8		
Africa & Mid East	0		0		
Australia, New Zealand, South Africa		203.9	279.4		

Table V-18.--1970(L) update and 1970(H) update transfer levels: feeder calves

Importer / Exporter	France	Italy	Germany-Benelux
	1,000 head		
France	6,203.2	47.6	0
Italy	2,126.3	1,237.5	0
Germany-Benelux	4,588.8	95.2	1,384.2
EFTA		126.9	211.8
Eastern Europe	0	79.3	32.6

Table V-19.--1970(L) update transfer levels: beef and veal

Importer / Exporter	France	Italy	Germany-Benelux	All other countries
	1,000 metric tons			
France	1,401.3	466.0	1,234.8	0
Italy	0	439.4	0	0
Germany-Benelux	10.3	66.6	563.6	0
EFTA	0	77.7		
Eastern Europe	0	66.5		
Latin America	10.3	169.8	33.6	

Table V-20.--1970(H) update transfer levels: beef and veal

Importer / Exporter	France	Italy	Germany-Benelux	All other countries
	1,000 metric tons			
France	1,401.3	558.0	1,142.8	0
Italy	0	439.4	0	0
Germany-Benelux	10.3	66.6	563.6	0
EFTA	0	77.5		
Eastern Europe	0	66.5		
Latin America	10.3	77.7	125.6	

Table V-21.--1970(L) update transfer levels: beef

Importer / Exporter	France	Italy	Germany-Benelux	All other countries
	1,000 metric tons			
France	1,012.1	430.9	1,204.4	0
Italy	0	299.0	0	0
Germany-Benelux	10.3	66.6	442.0	0
EFTA	0	77.7		
Eastern Europe	0	66.5		
Latin America	10.3	169.8	33.6	

Table V-22--1970(H) update transfer levels: beef

Importer / Exporter	France	Italy	Germany-Benelux	All other countries
	1,000 metric tons			
France	1,012.1	522.9	1,112.4	0
Italy	0	299.0	0	0
Germany-Benelux	10.3	66.6	442.0	0
EFTA	0	77.7		
Eastern Europe	0	66.5		
Latin America	10.3	77.7	125.6	

Table V-23.--1970(L) update and 1970(H) update transfer levels: veal

Importer / Exporter	France	Italy	Germany-Benelux
	1,000 metric tons		
France	389.2	35.1	30.4
Italy	0	140.4	0
Germany-Benelux	0	0	121.6

Table V-24.--1970(L) update and 1970(H) update transfer levels: pork

Importer / Exporter	France	Italy	Germany-Benelux
	1,000 metric tons		
France	1,223.0	71.8	587.2
Italy	0	441.6	0
Germany-Benelux	78.0	38.6	2,348.8

Table V-25.--1970(L) update and 1970(H) update transfer levels: eggs

Importer / Exporter	France	Italy	Germany-Benelux
	1,000 metric tons		
France	631.6	95.6	248.8
Italy	0	402.4	0
Germany-Benelux	6.4	5.0	995.2

Table V-26.--1970(L) update and 1970(H) update transfer levels: poultry

Importer / Exporter	France	Italy	Germany-Benelux
	1,000 metric tons		
France	724.0	149.0	12.9
Italy	0	596.0	0
Germany-Benelux	0	0	631.1

each country for these products except for Italy and Germany-Benelux for pork and Italy for veal where demand and production both increased. The transfer pattern was the same as before. France ships eggs and veal to Germany-Benelux and Italy and pork to Germany-Benelux.

The updated projections indicate that consumption of beef will be less than origianlly predicted for France and Germany-Benelux and more for Italy; the net result being a decrease in demand for beef in the European Economic Community. Given this changed demand the 1970 update models show an increase in European Economic Community beef production -- both in France and Germany-Benelux. No inconsistency exists here as the beef sector is not a completely closed internal system. Since veal production fell from the previously predicted levels in both countries more feeder calves became available for beef production. Under both price level projections this option was exercised at the expense of beef imports. With the low price projections France's added production was shipped to Italy at the expense of Latin American imports. Increases in German-Benelux production replaced some of their imports -- particularly from France. The decline in French demand also caused French imports of Latin American beef (via Italy) to fall.

Assuming the high price projections the results are similar with the earlier predictions with France first supplying domesitc, then Italian and finally German-Benelux consumers. Since French consumption was down and since these predictions show French production up, more beef is available for export to Germany-Benelux. These French exports replace a large part of Latin American exports of beef to Germany-Benelux.

The pattern of trade for feeder calves in the update models is very similar to that for the first 1970 models. France still produces a large part of its' beef from German-Benelux and Italian feeder calves. Since

veal demand increased in Italy fewer Italian feeder calves were available for export to France. This was more than offset, however, by the increased German-Benelux exports. Given this greater availability of imports coupled with France's decline in veal production French production of feeders fell from that level predicted in the 1970(L) and 1970(H) models.

The net effects of the higher production levels for beef in France and Germany-Benelux and the lower production levels of other livestock products relative to the first 1970 models leads to a decreased demand for feed grain. For France this is evidenced by a marked decline in imports from Italy; while for Germany-Benelux imports from European Free Trade Area fall. This decline in European Free Trade Area exports would in all likelihood be a decline in United States exports. As was the case before the European Free Trade Area and Australia, New Zealand, South Africa would not be able to supply Germany-Benelux with the predicted amount of feed grain. Therefore, any decline would in reality be a decline in United States exports, not European Free Trade Area exports. On balance there is a decline in United States exports to the European Economic Community by about fifteen percent from the 1970(L) and 1970(H) levels.

The updated demand for food grain was lower than the original projections in France and Germany-Benelux and higher in Italy. The changes in demand were met by corresponding changes in production levels in the three regions. As a result there was a relative shift in the production levels of food and feed grain. In France and Germany-Benelux food grain production fell, freeing more land for feed grain production. The reverse occurred in Italy.

Production Predictions -- A Comparison

Since both the Michigan State University-United States Department of Agriculture study and this study made predictions of production levels for 1970 we can compare the results of the two different methods of prediction. The four separate 1970 production predictions are given in Table V-27. In comparing the original Michigan State University-United States Department of Agriculture projections with this study's predictions we find that this study's predictions are about five percent higher. For the updated predictions this study's results are about five percent lower than those of the other study.

For the two original studies total grain production predictions are very close together. These two models production projections differ in the livestock areas. This study shows a shift in the regions comparative advantage of livestock production, with beef and pork production shifting from Italy and Germany-Benelux to France and egg production shifting from Germany-Benelux to France.

For the two updated studies, when trade is allowed for, you again get a shift in the regions comparative advantage in livestock production. This study's results show a shift of livestock production to France, particularly for beef, eggs and pork. This model also underestimates total European Economic Community pork production relative to the other model. There is no allowance for surplus pork to be produced in this model. This is a possibility in the Michigan State University-United States Department of Agriculture model. Total grain production predictions are less for this model than for the other model. This is due to the Michigan State University-United States Department of Agriculture updated projections being based, in part, on assumed higher grain yields

Table V-27.--1970 predicted production levels -- a comparison

		Total grain	Beef and veal	Pork	Eggs	Poultry
		1,000 metric tons				
France	MSU-USDA	30,646.0	1,940.0	1,440.2	650.0	730.0
	Kost	31,507.1	3,039.0	1,980.7	1,046.0	866.7
	MSU-USDA update	35,661.0	1,800.0	1,234.0	655.0	759.0
	Kost update	31,507.2	3,102.1	1,881.9	976.0	885.9
Italy	MSU-USDA	14,732.0	593.4	495.3	509.0	425.0
	Kost	15,307.8	433.0	403.8	505.6	416.8
	MSU-USDA update	15,650.0	648.0	468.0	492.0	674.0
	Kost update	14,987.8	439.4	441.6	402.4	596.0
Germany-Benelux	MSU-USDA	21,101.0	1,806.3	3,110.1	1,384.0	674.0
	Kost	21,143.9	645.6	2,445.2	1,081.8	711.5
	MSU-USDA update	23,773.0	1,818.0	3,538.0	1,322.0	646.0
	Kost update	21,143.8	640.5	2,465.5	1,006.6	631.1
European Economic Community	MSU-USDA	66,479.0	4,339.7	5,045.6	2,543.0	1,829.0
	Kost	67,958.8	4,117.6	4,829.7	2,634.0	1,995.0
	MSU-USDA update	75,090.0	4,266.0	5,240.0	2,469.0	2,079.0
	Kost update	67,638.8	4,182.0	4,789.0	2,385.0	2,113.0

Source (MSU-USDA): Vernon L. Sorenson, "EEC: Summary Statement of Recent Change and Updated Projections 1970-75", Working document for discussions held in London, May 18-22, 1970.
Sorenson and Hathaway, "The Grain-Livestock Economy and Trade Patterns of the European Economic Community With Projections to 1970 and 1975".

than in their original projections. The yield assumptions in both the original and update predictions of this model are the same. They are the same as those used in the original Michigan State University-United States Department of Agriculture study.

CHAPTER VI

Summary and Conclusions

In this study, I have attempted to develop an international trade model that will simulate the grain-livestock sector of the European Economic Community. The above objective was subjected to two interrelated restrictions. I wanted to develop the simplest possible model that would still simulate this grain-livestock sector. Because of this, the model was also limited to one that required only easily available data. Since the study concerned itself with trade my interests were directed toward spatial models. And given the above restrictions this interest was directed more toward the transportation model end of a continuum than toward the supply-demand spatial models.

The framework finally settled upon was a production-transfer spatial equilibrium model. This model included four types of activities. First, were transfer activities for food grain, feed grain, feeder calves, beef, veal, pork, eggs and poultry between France, Italy and Germany-Benelux. These commodities are not independent. With feed grain and feeder calves utilized in the production of some of the other products, production activities were also included in the model so that the derived demand relationships could be accounted for. The consumption levels for all final products were assumed given at predetermined levels. Since the European Economic Community is not a closed economic system external trade activities were allowed. These were in terms of purchase and sale activities rather than transfer activities. Had they been in terms of transfer activities it would have been necessary to back these with the production relationships as was done for the internal Community trade.

This would have required the development of a world trade system and was beyond the scope of this study. Food grain, feed grain, feeder calves and beef purchase activities were included. Sale activities for food grain, feed grain and beef were included. This allows European Economic Community countries to import and export these commodities. Thus the results of the model will be in terms of the quantities for the various products produced in the three European Economic Community regions and the quantities of these products traded between the European Economic Community regions and between them and their major trading partners.

The decision making criteria in the model was based on maximizing returns to the grain-livestock sector of the European Economic Community. Domestic pricing policies are included in the production revenues and the tariffs, variable import levies and variable export subsidies are incorporated into the transfer, purchase and sale activities.

The production activities have one basic input restriction -- land. It was assumed that the other factors of production would be available at least to the point where the land restriction became operative. Thus grain production is limited only by the amount of crop land available. Livestock production is limited by the amount of feed grain and forage land available. But internal feed grain production is limited in turn by the availability of crop land.

Purchase and transfer activity levels are limited in the final analysis by demand. And demand for final products is assumed fixed. Sale activities are limited by production which in turn is limited by land availability. Additional restrictions are placed on the transfer, purchase and sale activities. These are in terms of minimum percentages of consumption (production for sale activities) that must be shipped along

certain trade routes. The percentages are based on historical moving averages. They are included so that more than one purchase and sale activity will enter the optimal solution at the same time. Thus, in part, imports and exports are determined on the basis of past trends in imports and exports.

After a model has been developed the relevant question becomes does it simulate? Are the results a 'good' proxy for reality? Making a prediction, then comparing it with reality, is the only way in which any predictive model can be tested. This is most easily done by postdicting -- predicting a past period.

'Goodness of fit' tests for spatial models have not been developed. As long as one is concerned with predicting a single variable over time standard statistical procedures are available for testing the 'goodness of fit' of a prediction. With a spatial model many different variables are predicted simultaneously. If the spatial model can be replicated over time so that for each variable a series of predictions are made we can test the 'goodness of fit' of each variable over time. Many times it is not possible to make this larger number of predictions. In any case these tests do not allow for a test of the overall realiability of a model. These tests can tell us nothing about whether a model that predicts five variables with ninety percent accuracy is or is not better than one that predicts the same five variables, three with one hundred percent and two with seventy five percent accuracy. When a time dimension is not part of the spatial model only one prediction of each variable exists. With this sample size of one this question of a model's overall 'goodness of fit' is immediately confronted.

Some criteria are discussed in Chapter IV that attempt to confront this 'goodness of fit' problem. As a first approximation the rule of thumb that you focus in on key predicted variables is suggested. To the degree that some variables are more important than others it is more important to obtain predictive accuracy for these variables than it is for the other variables. A second test of a subjective nature, coined the Turing test, is suggested. This involves asking an 'expert' his opinion of the predictions. More objective than this is Theil's inequality coefficient. This is a type of correlation coefficient that ranges from zero (perfect predictions) to one (no correlation). This inequality coefficient however, only provides an objective measure of the 'goodness of fit' of a predictive model. It must still be decided how low the inequality coefficient should be before the model can be accepted as an adequate representation of the system being simulated.

Two actual tests of 'goodness of fit' are discussed. The first, the sign test, tests whether the predictions and the actual values of the variables are identically distributed. The sign test however does not take account of the magnitude of the error. It weights each error equally by considering only the sign of the error. The second test is a regression based test. With a perfect model a regression of predicted on actual values of the variables would yield an equation with a zero intercept and a unit slope. This 'goodness of fit' test then would involve testing whether the parameters of the regression are significantly different from zero and one. A problem exists here too. Regressions are concerned with absolute errors not relative errors.

No one of these suggested 'goodness of fit' criteria is without fault. However each are steps toward answering the question of how 'good'

the simulation is. Taken together they should provide more information on the 'goodness of fit' of a model. While they may not provide us with means by which we can accept a model as good, they do provide us with criteria by which we can reject a model. At worst they will provide criteria by which models can be rejected or alternatively tenatively accepted; i.e., reserve judgment on.

Two tests of this spatial model were conducted, one for 1964 and one for 1968. The test results are presented in Tables IV-15 and IV-30. As can be seen from these two tables the different tests sometimes give conflicting valuations as to the 'goodness of fit' of the two models. As was stated above this is due to each test measuring a different type of error. The 1964 and 1968 tests can both be summarized by saying that the model tends to overestimate as often as it tends to underestimate, however when it does underestimate it underestimates the variables of large magnitude.

On the basis of the 1964 and 1968 simulations the production-transfer model developed in Chapter III was tentatively accepted as providing a good simulation of the grain-livestock sector of the European Economic Community. This is the first step in developing a 'good' predictive model. Even if the model is a 'good' simulation of an existing situation it may not be a good predictive model. To also be a good predictive model the underlying structure of that which we are trying to simulate must remain stable from the simulated period to the predicted period. The empirical input data for the predicting model must be as good as that for the simulating model too.

In light of these two new restrictions the simulation model was tentatively accepted as a 'good' predictive model. Input data were then

developed in order that the model could be used to predict 1970 grain-livestock production and trade levels for the European Economic Community. These predictions are presented in Chapter V.

The 1970 predictions show France developing into the major agricultural center of the European Economic Community. It already is the major grain producer. To take advantage of their comparative advantage France utilizes this grain for livestock production. The predictions show France becoming both the major grain and livestock producer. This is particularly true for beef production. France produces a large part of the beef consumed in the European Economic Community and ships it to both Italy and Germany-Benelux. To support this expanded livestock production (primarily beef) the demand for feeder calves and feed grain in France increases. The demand for feeder calves is met through large imports of dairy calves from Germany-Benelux and Italy. This new demand for feed grain caused a shift from food grain to feed grain production in France, and to a certain extent in Italy which shipped some feed grain to France. The end result of the shift to France being the agricultural center is that the European Economic Community will become more self-sufficient in the future. Thus the United States cannot expect their grain exports to Europe to expand as much as they have in the past. In fact this model shows that United States grain exports to the European Economic Community will actually decline in the future.

The intent of this study was to develop a simple, short run predictive model for grain-livestock trade patterns for the European Economic Community. Within the rather severe limitations imposed on the predictive model the results show that this model does have the ability to predict. The 'goodness of fit' or accuracy of these predictions would, in

all likelihood, be even better as some of these restrictions are relaxed. While the 1964 model does an excellent job in predicting the pork production and transfer subsector of the economy the 1968 model is somewhat less accurate. In looking at the data we find that by 1968 some surplus pork was produced. Therefore restricting the European Economic Community to a self-sufficiency position in pork may not be appropriate. Better predictions might be obtained with a relaxing of this assumption.

As important as this model's ability to predict then, and possibly more so, is its' ability to highlight areas where we lack knowledge of the system we are trying to first simulate, then predict from. The model provides one with added insight into the two areas which can cause predictions to be in error -- the quality of the input data and the underlying structure of the model.

During the process of collecting input data for this model two major quality gaps were found. The first concerned transportation data. Very little effort has been directed toward the understanding of the European transportation system. Not only are no detailed transportation cost data available, but also little has been done concerning methods, routes, capacities and relative costs of the different transportation methods for the grain-livestock products. The same thing is true for data on feed-livestock conversion. Not much of the input-output type data is available for alternative production methods. This is particularly true for forage utilization.

Another area, that involves both data quality and structure, that causes inaccuracy of predictions concerns choosing the appropriate decision making criteria. This model uses a revenue maximization criteria. It may not be the appropriate criteria. Even if an optimizing

decision criteria is retained, a cost minimizing or a profit maximizing objective function may provide a structure that yields better predictions. Again a data problem exists. No detailed costs of production data are available for grain-livestock products. This data problem must be overcome before we can even consider these alternative decision criteria.

Relaxing some of the structural restrictions of the model, while increasing its' complexity, also gives some indication of being able to improve the predictability of the model. A pork surplus had developed by 1968. By relaxing the self-sufficiency restrictions for pork, and for veal, eggs and poultry for that matter, additional options are available to producers. By this type of change the option of surplus production is not assumed away.

Other expansions of the model might improve the model. One possible option is to expand along the product line. This sector as defined is not independent of other products. Milk and milk products are handled in a very cursory manner. Changes in the demand for, or supply of, these products do affect the results of this model. To the extent that dairy policy changes over time, predictions of the grain-livestock sector based on a constant dairy policy will be inaccurate. Disaggregation of the products included in the model may also improve predictability. To the extent that food grain isn't wheat, feed grain isn't corn, corn isn't barley, and French beef isn't the same as Italian beef excessive aggregation may introduce more errors than it eliminates.

The model may also be expanded by internalizing some of the countries that are now represented only by purchase and sale activities. To the extent that countries are internalized, this puts restrictions on the maximum amounts of a product that can be sold to or purchased from them.

Purchases would be limited by productive capacity. Sales by demand. The first step along this line should probably be to include the European Free Trade Area countries. Since a likely policy alternative for the European Economic Community is expansion to include these countries a model to predict the grain-livestock trade for the Community will not be accurate without including them. Due to the importance of this market to North America it might be of interest to internalize the United States and Canada. Ultimately it would be possible to develop a world trade model where all regions are included through production and transfer activities rather than purchase and sale activities.

Another area of the model where the results show that the model is predicting inaccurately concerns the use of denatured food grain for livestock feed. It is obvious that the model as stated does not include the right criteria for determining how much food grain will be denatured. This is an additional area where attention should be focused. If we knew more about denaturing policy we should be able to change the structure of this model and improve its' ability to predict.

This model assumes that production is a function of one factor of production -- land (two for livestock -- land and grain). Our theory tells us that this isn't true. With more information the production functions could be expanded to include other factors of production.

The main feature of linear programming models is their linearity. To the extent that the economy that we are trying to simulate is not linear, predictions from a linear model will not be accurate. Additional predictive accuracy may be gained by moving from the simplest linear model toward a non-linear model. This could be accomplished by expanding certain activities through the use of step functions. The most promising

candidates here would probably be the production functions and the transportation functions.

In summary, this model presents first order predictions of grain-livestock trade patterns for the European Economic Community. It also serves to give us some valuable insight into where future research efforts can be directed. Definitely, more research in this area will be needed.

BIBLIOGRAPHY

BIBLIOGRAPHY

Agricultural Economics Research Institute. "Supply and Demand, Imports and Exports of Selected Agricultural Products in the Netherlands, Forcast for 1970 and 1975". The Hague, 1967.

Bates, Thomas H. and Andrew Schmitz. "A Spatial Equilibrium Analysis of the World Sugar Economy". Giannini Foundation Monograph Number 23, California Agricultural Experiment Station, University of California, Berkeley, California, May 1969.

Bawden, D. Lee. "A Spatial Equilibrium Model of International Trade". Paper presented at annual meeting of Econometric Society, New York, N. Y., December 30, 1965.

_____. "A Spatial Price Equilibrium Model of International Trade". Journal of Farm Economics, 48 (November 1966), 862-74.

_____, James G. Kendrick, Carmen O. Nohre and Howard C. Williams. "A Model for Agricultural Trade Analysis". June 17, 1968. (Mimeographed).

Bjarnason, Harold Frederick. "An Economic Analysis of 1980 International Trade in Feed Grains". Unpublished Ph.D. dissertation, University of Wisconsin, Madison, Wisconsin, 1967.

Centre de Recherches et de Documentation sur la Consommation. "Production and Uses of Selected Farm Products in France, Projections to 1970 and 1975". Paris, France, December 1967.

Clarke, Robert H. and Richard J. Goodman. "Grain Marketing in the EEC: France-Germany". Great Plains Wheat, Inc., Rotterdam, September 1963. (Mimeographed).

Cohen, Kalman J. and Richard M. Cyert. "Computer Models in Dynamic Economics". The Quarterly Journal of Economics, 75 (February 1961), 112-27.

Commission of the European Communities. "Farm Prices 1970/1971". Information Memo P-31, June 16, 1969, Brussels.

Dean, Gerald W. and Normal R. Collins. "World Trade in Fresh Oranges: An Analysis of the Effects of European Economic Community Tariff Policies". Giannini Foundation Monograph Number 18, California Agricultural Experiment Station, University of California, Berkeley, California, January 1967.

Dorfman, Robert, Paul A. Samuelson and Robert M. Solow. Linear Programming and Economic Analysis. New York, New York: McGraw-Hill Book Company, Inc., 1958.

Epp, Donald J. "Changes in Regional Grain and Livestock Prices Under the European Economic Community Policies". Research Report No. 4, Institute of International Agriculture, Michigan State University, East Lansing, Michigan.

_____. Letter. October 22, 1968.

European Community Information Service. "Agriculture in the Common Market". Community Topics 21.

_____. "A Common Market for Agriculture". 1963.

_____. "The Common Agricultural Policy". Community Topics 28.

European Communities Joint Information Service. "Basic Facts of the Common Organization of the Market in Beef and Veal". October 1964.

European Economic Community. "Analyse des facteurs qui influent sur l'orientation de l'offre regionale de cereales et de produits transformes derives des cereales". Estudes Serie Agriculture 17, Bruxelles.

_____. Official Spokesman of the Commission. "A Farm Policy for Europe". January 1962.

_____. Statistical Office of the European Communities. "Basic Statistics of the Community", various issues.

_____. Office Statistique Des Communautes Europeennes. "Production Vegetale", various issues.

Fennell, Rosemary and A. Power. "Problems of the Organization of the Meat Market in the E.E.C.". International Journal of Agrarian Affairs. III (June 1963), 254-76.

Fox, Karl A. "The Use of Economic Models in Appraising Foreign Trade Policies". Journal of Farm Economics. 36 (December 1954), 944-58.

Fox, Roger William. "Some Possible Production and Trade Effects of the EEC's Common Agricultural Policy for Grains". Unpublished Ph.D. dissertation, Michigan State University, East Lansing, Michigan, 1965.

Freund, John E. Mathematical Statistics. Englewood Cliffs, New Jersey: Prentice-Hall, Inc., 1962.

General Agreement on Tariffs and Trade. "Trade in Agricultural Products, Report of Committee II on the Consultation with the European Economic Community". Geneva, 1962.

_____. "Trade in Agricultural Products, Reports of Committee II on Consultations with the European Economic Community, the United States of America and the United Kingdom". Geneva, 1965.

Heady, Earl O. and Wilfred Candler. Linear Programming Methods. Ames, Iowa: Iowa State University Press, 1958.

IFO-Institut Fur Wirtschaftsforschung. "Aggregation of Future Demand and Supply for Agricultural Products in the European Economic Community 1970-1975". By H. Schmidt and L. Grunewald. Studien Zur Agrarwirtschaft, Heft 5, Abteilung Landwirtschaft, Munchen, 1969.

_____. "Long-Term Development of Demand and Supply for Agricultural Products in the Federal Republic of Germany". Studien Zur Agrarwirtschaft, Haft 1, Abteilung Landwirtschaft, Munchen, 1967.

International Wheat Council. "World Wheat Statistics". London, various issues.

Jensen, Finn B. and Ingo Walter. The Common Market, Economic Integration in Europe. Philadelphia, Pennsylvania: J. B. Lippencott Company, 1965.

Kartographisches Institut Und Verlag. "Europe Road Map 1:3000000". Frankfurt/M.

King, Richard, ed. Interregional Competition Research Methods. The Agricultural Policy Institute Series 10, School of Agriculture and Life Sciences, North Carolina State of the University of North Carolina, Raleigh, North Carolina, 1963.

Lindgren, Bernard W. Statistical Theory. New York, New York: The Macmillan Company, 1962.

Mangum, Fred A., Jr. "The Grain-Livestock Economy of Italy With Projections to 1970 and 1975". Research Report No. 2, Institute of International Agriculture, Michigan State University, East Lansing, Michigan.

Ministry of Agriculture and Fisheries of the Netherlands, Statistics and Documentation Section. "Selected Agri-Figures of the E.E.C.". July 1968.

Naylor, Thomas H. and J. M. Finger. "Verification of Computer Simulation Models". Management Science, 14 (October 1967), B-92-101.

Organization for Economic Co-Operation and Development. "Agricultural Statistics: 1955-1968". Paris, 1969.

_____. "Food Consumption Statistics, 1954-1966". Paris, 1968.

_____. "The Market for Beef and Veal and its Factors". Paris, 1967.

_____. "Trade By Commodities: Detailed Analysis by Products". Foreign Trade Series C, Paris, various issues.

Petit, Michel J. and Jean-Baptiste Viallon. "The Grain-Livestock Economy of France With Projections to 1970 and 1975". Research Report No. 3, Institute of International Agriculture, Michigan State University, East Lansing, Michigan.

Rossmiller, George E. "The Grain-Livestock Economy of West Germany With Projections to 1970 and 1975". Research Report No. 1, Institute of International Agriculture, Michigan State University, East Lansing, Michigan.

Samuelson, Paul A. "Spatial Price Equilibrium and Linear Programming". American Economic Review, XLII (June 1952), 283-303.

Sorenson, Vernon L. "EEC: Summary Statement of Recent Change and Updated Projections 1970-75". London, May 18-22, 1970 (Mimeographed).

_____. Interview, May 15, 1970.

_____ and Dale E. Hathaway. "The Grain-Livestock Economy and Trade Patterns of the European Economy Community With Projections to 1970 and 1975". Research Report No. 5, Institute of International Agriculture, Michigan State University, East Lansing, Michigan.

Takayama, T. and G. G. Judge. "An Intertemporal Price Equilibrium Model". Journal of Farm Economics, 46 (May 1964), 477-84.

_____. "Spatial Equilibrium and Quadratic Programming". Journal of Farm Economics, 46 (February 1964), 67-93.

Theil, H. Economic Forecasts and Policy. Amsterdam: North-Holland Publishing Company, 1961.

Turing, A. M. "Computing Machinery and Intelligence". Mind, (October 1950), 433-60.

United Nations, Food and Agriculture Organization. Production Yearbook. Rome, various issues.

_____. "Technical Conversion Factors for Agricultural Commodities". Rome, 1960.

_____. Trade Yearbook. Rome, various issues.

_____, Statistical Office of the United Nations, Department of Economic and Social Affairs. "Commodity Trade Statistics". Statistical Papers, Series D, various issues.

_____. Statistical Yearbook, various issues.

United States Department of Agriculture, Agricultural Research Service. "Consumption of Feed by Livestock, 1909-56" by Ralph D. Jennings. Production Research Report No. 21. Washington, D. C.: Government Printing Office, November 1958.

_____, Economic Research Service. "Agricultural Policies in Europe and the Soviet Union". Foreign Agricultural Economic Report No. 46. Washington, D. C.: Government Printing Office, July 1968.

_____. "Conversion Factors and Weights and Measures for Agricultural Commodities and Their Products". Statistical Bulletin No. 362. Washington, D. C.: Government Printing Office, 1965.

_____. "The European Agricultural Guidance and Guarantee Fund" by Byron L. Berntson. Foreign 144. Washington, D. C.: Government Printing Office, no date.

_____. "The European Community's Common Agricultural Policy: Implications for U.S. Trade" by B. L. Berntson, O. H. Goolsby and C. O. Nohre. Foreign Agricultural Economic Report No. 55. Washington, D. C.: Government Printing Office, October 1969.

_____. "European Economic Community Agricultural Trade Statistics, 1961-67". Foreign 247. Washington, D. C.: Government Printing Office, February 1969.

_____. "The Grain-Livestock Economy of the European Economic Community: A Compendium of Basic Statistics". Statistical Bulletin No. 351. Washington, D. C.: Government Printing Office, November 1964.

_____. "The Grain-Livestock Economy of the European Economic Community: A Historical Review, 1951-63". Foreign Agricultural Economics Report No. 31. Washington, D. C.: Government Printing Office, July 1966.

_____. "Growth in Demand for Feed Grains in the EEC, Projection to 1970 and 1975 in Relation to Consumption of Meat and Livestock Products" by Donald W. Regier. Foreign 158. Washington, D. C.: Government Printing Office, July 1967.

_____. "The Uniform Grain Price in the European Economic Community" by Hans G. Hirsch. Foreign 110. Washington, D. C.: Government Printing Office, March 1965.

_____. Foreign Agricultural Service. "Grain Developments in the Common Market". FAS-M-202. Washington, D. C.: Government Printing Office, December 1968.

_____. "Outlets for French Grain" by L. Schertz and R. Cannon. Washington, D. C.: Mimeographed, February 8, 1965, revised March 21, 1965.

United States Department of State. "Denaturing of Wheat and Rye" by Ernest Koenig. Airgram from US Mission to the European Communities, Brussels to Department of State/Washington, pass Agriculture, July 19, 1968.

_____. "New Common Market Financial Regulation and Prospects for British Entry" by Martin J. Hillenbrand. Information Memorandum. Washington, D. C.: January 14, 1970.

Walsh, A. E. and John Paxton. The Structure and Development of the Common Market. London: Hutchinson & Co., Ltd., 1968.

Weightman, Paul W. H. "Concentrated Feedingstuffs for Livestock in the Netherlands, 1960-61 to 1965-66 (Livestock Feed Balance)". Agricultural Economics Research 239, Department of Agricultural Economics, Cornell University, Ithaca, New York, January 1968.

_____. Letter, January 1968.

Appendix A

Appendix A

The input data developed for the various models are presented in Tables A-1 to A-47. In as many cases as possible the input data were based on data from easily available secondary data sources. A combination of the lack of data and the lack of intercountry comparability of data meant that much of the data were not available in the form in which it was required by the model. Listed under each table in this appendix are the basic sources used in developing this input data. The specific computation procedure used to arrive at any of these data can be obtained from the author.

Food grain prices for the European Economic Community countries are based on wheat prices except in the case of Germany-Benelux where a volume weighted average of wheat and rye prices was used. A volume weighted average of barley, oats, maize and rye (except Germany-Benelux) prices gave the feed grain price. The price of the joint product milk-beef-feeder calves was composed of three parts: that received for milk, for cull cow beef and for feeder calves. All meat prices are in terms of carcass weight prices. Purchase prices are based on f.o.b. prices calculated from export quantities and values and for 1970 were calculated on the basis of a 1960-1968 trend.

Transportation costs, where no better data were available, were based on average cost per kilometer and the distance transported. The rates were assumed equal for food grain and feed grain and for beef and veal. The transport cost for live feeder calves was assumed to be the same as that for live hogs. These transportation costs were calculated for 1964. The 1968 and 1970 costs were developed on the basis of the 1964 costs and an index of transport costs. The index of transport

costs for 1970 was calculated from a trend equation on the 1960-1968 period.

The variable import levies, the variable export subsidies and the import duties were calculated on the basis of the policies discussed in Chapter II.

The minimum percentage of a commodity transferred between countries was based on a moving average for the most recent four year period for grains and eggs and the most recent two year period for feeder calves and for all the meat products. The percentages used in the 1970 models were based on 1967-1968 averages.

Table A-1.--Food grain prices ($/100 kg.)

Exporter	Importer / Year	France	Italy	Germany-Benelux
France	1964	8.09		
	1968	8.98		
	1970(L)	9.37		
	1970(H)	9.37		
Italy	1964		11.11	
	1968		10.85	
	1970(L)		10.63	
	1970(H)		10.63	
Germany-Benelux	1964			10.48
	1968			9.39
	1970(L)			9.52
	1970(H)			9.52
United States	1964	6.59	6.59	6.59
	1968	6.15	6.15	6.15
	1970(L)	6.25	6.25	6.25
	1970(H)	6.25	6.25	6.25
Canada	1964	6.94	6.94	6.94
	1968	6.90	6.90	6.90
	1970(L)	7.15	7.15	7.15
	1970(H)	7.15	7.15	7.15

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Table A-1 (cont'd.)

Exporter	Importer / Year	France	Italy	Germany-Benelux
Latin America	1964	6.53	6.53	6.53
	1968	5.81	5.81	5.81
	1970(L)	5.73	5.73	5.73
	1970(H)	5.73	5.73	5.73
Africa & Mid East	1964	6.79		
	1968	9.07		
	1970(L)	8.79		
	1970(H)	8.79		

Source: Epp, "Changes in Regional Grain and Livestock Prices Under the European Economic Community Policies."

Mangum, "The Grain-Livestock Economy of Italy With Projections to 1970 and 1975."

Organization for Economic Co-Operation and Development, "Agricultural Statistics: 1955-1968," Paris, 1969.

Petit and Viallon, "The Grain-Livestock Economy of France With Projections to 1970 and 1975."

Rossmiller, "The Grain-Livestock Economy of West Germany With Projections to 1970 and 1975."

Sorenson and Hathaway, "The Grain-Livestock Economy and Trade Patterns of the European Economic Community With Projections to 1970 and 1975."

United Nations, Food and Agriculture Organization, Trade Yearbook, various issues.

Exporter	Year	France	Italy	Germany-Benelux
Latin America	1964	[illegible]	[illegible]	[illegible]
	1968	[illegible].81	[illegible].81	[illegible].81
	1970(L)	[illegible]	[illegible]	[illegible]
	1970(H)	[illegible]	[illegible]	[illegible]
Africa & Mid East	1964	6.79		
	1968	[illegible]		
	1970(L)	8.79		
	1970(H)	8.79		

Source: Epp, "Changes in Regional Grain and Livestock Prices [illegible]

Table A-2.--Feed grain prices ($/100 kg.)

Exporter	Importer / Year	France	Italy	Germany-Benelux
France	1964	7.25		
	1968	7.25		
	1970(L)	8.90		
	1970(H)	8.90		
Italy	1964		7.93	
	1968		8.34	
	1970(L)		8.71	
	1970(H)		8.71	
Germany-Benelux	1964			9.18
	1968			8.08
	1970(L)			8.51
	1970(H)			8.51
EFTA	1964			6.56
	1968			5.50
	1970(L)			5.73
	1970(H)			5.73
United States	1964	5.33	5.33	5.33
	1968	5.01	5.01	5.01
	1970(L)	5.63	5.63	5.63
	1970(H)	5.63	5.63	5.63
Latin America	1964	4.81	4.81	4.81
	1968	5.22	5.22	5.22
	1970(L)	5.38	5.38	5.38
	1970(H)	5.38	5.38	5.38

--Continued

Table A-2 (cont'd.)

Exporter \ Importer	Year	France	Italy	Germany-Benelux
Africa & Mid East	1964	5.82		5.29
	1968	6.56		6.21
	1970(L)	6.04		6.57
	1970(H)			6.57
Australia, New Zealand, South Africa	1964		4.95	4.95
	1968		5.04	5.04
	1970(L)		5.66	5.66
	1970(H)		5.66	5.66

Source: Epp, op. cit.

Institute Fur Wirtschaftsforschung, "Long-Term Development of Demand and Supply for Agricultural Products in the Federal Republic of Germany," Studien Zur Agrarwirtschaft, Heft 1, Abteilung Landwirtschaft, Munchen 1967.

Mangum, op. cit.

Organization for Economic Co-Operation and Development, "Agricultural Statistics: 1955-1968."

Organization for Economic Co-Operation and Development, "Food Consumption Statistics, 1954-1966," Paris, 1968.

Petit and Viallon, op. cit.

Sorenson and Hathaway, op. cit.

United Nations, Statistical Office of the United Nations, Department of Economics and Social Affairs, "Commodity Trade Statistics," Statistical Papers, Series D, various issues.

United Nations, Food and Agriculture Organization, Production Yearbook, various issues.

United Nations, Trade Yearbook.

Table A-3.--Milk-beef-feeder calf prices ($/head)

Exporter	Importer / Year	France	Italy	Germany-Benelux
France	1964	309.30		
	1968	360.93		
	1970(L)	386.51		
	1970(H)	386.51		
Italy	1964		384.63	
	1968		453.58	
	1970(L)		409.04	
	1970(H)		409.04	
Germany-Benelux	1964			517.43
	1968			558.51
	1970(L)			566.83
	1970(H)			566.83

Source: Epp, op. cit.

Mangum, op. cit.

Organization for Economic Co-Operation and Development, "Agricultural Statistics: 1955-1968."

Petit and Viallon, op. cit.

Rossmiller, op. cit.

United Nations, Production Yearbook.

United Nations, Food and Agriculture Organization, "Technical Conversion Factors for Agricultural Commodities," Rome, 1960.

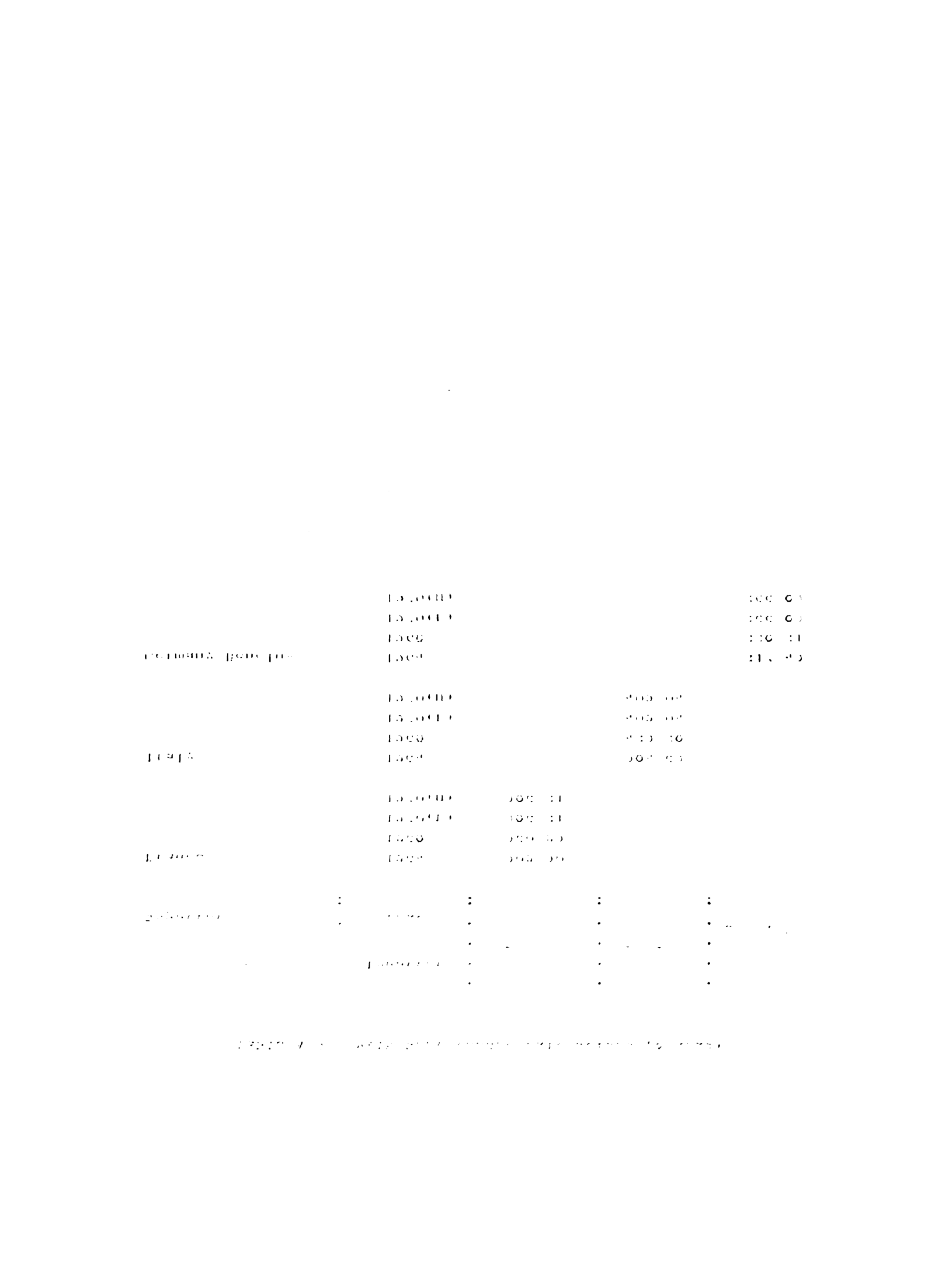

Table A-4.--Feeder calf prices ($/head)

Exporter	Importer / Year	France	Italy	Germany-Benelux
EFTA	1964		321.90	246.71
	1968		297.10	272.14
	1970(L)		304.06	295.50
	1970(H)		304.06	295.50
Eastern Europe	1964	275.68	275.68	275.68
	1968	274.10	274.10	274.10
	1970(L)	291.82	291.82	291.82
	1970(H)	291.82	291.82	291.82

Source: Epp, op. cit.

Petit and Viallon, op. cit.

H. Schmidt and L. Grunewald, "Aggregation of Future Demand and Supply for Agricultural Products in the European Economic Community 1970-1975," Studien Zur Agrarwirtschaft, Haft 5, IFO-Institut Fur Wirtschaftsforschung Abteilung Landwirtschaft, Munchen 1969.

United Nations, "Commodity Trade Statistics."

United Nations, "Technical Conversion Factors for Agricultural Commodities."

United Nations, Trade Yearbook.

[illegible]

Exporter	Year	Importer	[illegible]	Total	[illegible]
Fiji	1964				
	1968				
	1970(I)				
	1970(II)				
[illegible]	1964			[illegible]	
	1968			[illegible]	
	1970(I)			[illegible]	
	1970(II)			[illegible]	

Table A-5.--Beef prices ($/100 kg.)

Exporter \ Importer	Year	France	Italy[1]		Germany-Benelux
France	1964	102.68			
	1968	115.45			
	1970(L)	117.17			
	1970(H)	135.67			
Italy	1964		123.46	105.38	
	1968		121.33	108.06	
	1970(L)		121.77	104.08	
	1970(H)		141.02	120.52	
Germany-Benelux	1964				101.48
	1968				110.45
	1970(L)				131.73
	1970(H)				152.54
EFTA	1964	93.64	98.55		
	1968	98.66	82.83		
	1970(L)	99.00	97.79		
	1970(H)	99.00	97.79		

--Continued

Table A-5 (cont'd.)

Exporter / Importer	Year	France	Italy[1]	Germany-Benelux
Eastern Europe	1964	78.10	88.37	
	1968	96.56	76.85	
	1970(L)	107.76	106.53	
	1970(H)	107.76	106.53	
Latin America	1964	53.29	53.29	53.29
	1968	63.07	63.07	63.07
	1970(L)	69.35	69.35	69.35
	1970(H)	69.35	69.35	69.35

[1]The double column for Italy consecutively represents prices for beef fed more than one year and beef fed less than one year.

Source: Epp, op. cit.

Mangum, op. cit.

Organization for Economic Co-Operation and Development, "Agricultural Statistics: 1955-1968."

Petit and Viallon, op. cit.

Rossmiller, op. cit.

United Nations, "Commodity Trade Statistics."

United Nations, "Technical Conversion Factors for Agricultural Commodities."

United Nations, Trade Yearbook.

Table A-6.--Veal prices ($/100 kg.)

Exporter \ Importer	Year	France	Italy	Germany-Benelux
France	1964	151.00		
	1968	173.73		
	1970(L)	143.97		
	1970(H)	166.71		
Italy	1964		147.77	
	1968		170.69	
	1970(L)		146.97	
	1970(H)		170.19	
Germany-Benelux	1964			129.73
	1968			158.95
	1970(L)			158.41
	1970(H)			183.45

Source: Epp, op. cit.

Mangum, op. cit.

Organization for Economic Co-Operation and Development, "Agricultural Statistics: 1955-1968."

Petit and Viallon, op. cit.

Rossmiller, op. cit.

United Nations, "Technical Conversion Factors for Agricultural Commodities."

Table A-7.--Pork prices ($/100 kg.)

Exporter	Importer / Year	France	Italy	Germany-Benelux
France	1964	76.71		
	1968	78.51		
	1970(L)	78.09		
	1970(H)	78.09		
Italy	1964		74.07	
	1968		82.17	
	1970(L)		80.60	
	1970(H)		80.60	
Germany-Benelux	1964			83.11
	1968			72.27
	1970(L)			76.77
	1970(H)			76.77

Source: Epp, op. cit.

Mangum, op. cit.

Organization for Economic Co-Operation and Development, "Agricultural Statistics: 1955-1968."

Petit and Viallon, op. cit.

Rossmiller, op. cit.

United Nations, "Technical Conversion Factors for Agricultural Commodities."

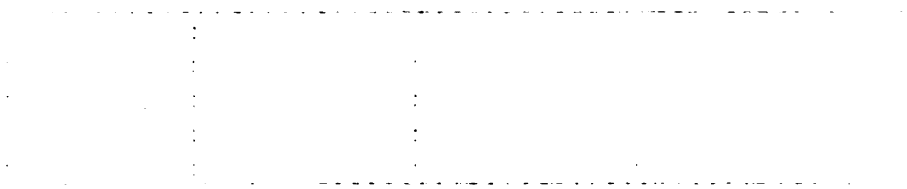

Table A-8.--Egg prices ($/100 kg.)

Exporter \ Importer	Year	France	Italy	Germany-Benelux
France	1964	64.53		
	1968	53.74		
	1970(L)	57.29		
	1970(H)	57.29		
Italy	1964		69.65	
	1968		64.46	
	1970(L)		55.55	
	1970(H)		55.55	
Germany-Benelux	1964			87.30
	1968			73.63
	1970(L)			50.39
	1970(H)			50.39

Source: Epp, op. cit.

Mangum, op. cit.

Organization for Economic Co-Operation and Development, "Agricultural Statistics: 1955-1968."

Petit and Viallon, op. cit.

Rossmiller, op. cit.

Table A-9.--Poultry prices ($/100 kg.)

Exporter	Importer / Year	France	Italy	Germany-Benelux
France	1964	89.90		
	1968	66.00		
	1970(L)	53.81		
	1970(H)	53.81		
Italy	1964		61.12	
	1968		70.27	
	1970(L)		51.09	
	1970(H)		51.09	
Germany-Benelux	1964			66.85
	1968			55.28
	1970(L)			54.02
	1970(H)			54.02

Source: Epp, op. cit.

Mangum, op. cit.

Organization for Economic Co-Operation and Development, "Agricultural Statistics: 1955-1968."

Petit and Viallon, op. cit.

Rossmiller, op. cit.

United Nations, "Technical Conversion Factors for Agricultural Commodities."

Table A-10.--Denaturing costs ($/100 kg.)

	1964	1968	1970
France	2.30	1.58	1.27
Italy	2.30	1.58	1.27
Germany-Benelux	2.30	1.58	1.27

Source: Epp, op. cit.

Ernest Koenig, "Denaturing of Wheat and Rye," Department of State Airgram, from U.S. Mission to the European Communities, Brussels to Department of State/Washington, Pass Agriculture.

L. Schertz and R. Cannon, "Outlets for French Grain," Grain and Feed Division, Foreign Agriculture Service, United States Department of Agriculture, 2/8/65, Rev. 3/21/65.

Table A-11.--Food grain transportation costs ($/100 kg.)

Exporter \ Importer	Year	France	Italy	Germany-Benelux
France	1964		3.04	2.05
	1968		3.01	2.03
	1970		3.22	2.17
Italy	1964	3.04		2.23
	1968	3.01		2.21
	1970	3.22		2.36
Germany-Benelux	1964	1.85	1.98	
	1968	1.83	1.96	
	1970	1.96	2.10	
United States	1964	2.46	1.69	1.85
	1968	2.86	1.97	2.15
	1970	2.59	1.78	1.95
Canada	1964	2.17	1.76	1.77
	1968	2.52	2.05	2.06
	1970	2.28	1.85	1.86
Latin America	1964	2.13	2.03	2.31
	1968	1.42	1.36	1.55
	1970	1.73	1.65	1.88
Africa & Mid East	1964	1.64		
	1968	1.62		
	1970	1.74		

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Table A-11 (cont'd.)

Exporter	Importer: Year	EFTA	Eastern Europe	Africa & Mid East	Other Asia
France	1964	1.29	4.45	1.69	2.08
	1968	1.28	4.41	1.67	2.06
	1970	1.37	4.71	1.79	2.20
Italy	1964		2.70	1.69	
	1968		2.67	1.67	
	1970		2.86	1.79	
Germany-Benelux	1964	1.18	3.52	2.29	1.94
	1968	1.17	3.48	2.27	1.92
	1970	1.25	3.73	2.43	2.05

Source: D. Lee Bawden, James G. Kendrick, Carmen O. Nohre and Howard C. Williams, "A Model for Agricultural Trade Analysis," Unpublished Paper, June 17, 1968.

Harold Frederick Bjarnason, "An Economic Analysis of 1980 International Trade in Feed Grains," Unpublished Ph.D. Thesis, University of Wisconsin, 1967.

Epp, op. cit.

Donald J. Epp, Letter, October 22, 1968.

European Economic Community, "Analyse Des Facteurs Qui Influent Sur L'orientation De L'offre Régionale De Céréales Et De Produits Transformés Dérivés De Céréales," Estudes Série Agriculture 17, Bruxelles.

Roger William Fox, "Some Possible Production and Trade Effects of the EEC's Common Agricultural Policy for Grains," Unpublished Ph.D. Thesis, Michigan State University, 1965.

International Wheat Council, "World Wheat Statistics," London, various issues.

Kartographisches Institut Und Verlag, "Europe Road Map, 1:3000000," Frankfurt/M.

United Nations, Statistical Office of the United Nations, Department of Economic and Social Affairs, Statistical Yearbook, various issues.

Table A-12.--Feed grain transportation costs ($/100 kg.)

Exporter \ Importer	Year	France	Italy	Germany-Benelux	EFTA	Other Europe
France	1964		3.04	2.05	1.29	1.20
	1968		3.01	2.03	1.28	1.19
	1970		3.22	2.17	1.37	1.27
Italy	1964	3.04		2.23		
	1968	3.01		2.21		
	1970	3.22		2.36		
Germany-Benelux	1964	1.85	1.98		1.14	
	1968	1.83	1.96		1.13	
	1970	1.96	2.10		1.21	
EFTA	1964			1.42		
	1968			1.57		
	1970			1.67		
United States	1964	2.09	1.87	2.04		
	1968	2.43	2.17	2.37		
	1970	2.20	1.97	2.15		

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Table A-12 (cont'd.)

Exporter / Importer	Year	France	Italy	Germany-Benelux	EFTA	Other Europe
Latin America	1964	2.43	2.03	2.72		
	1968	1.63	1.36	1.82		
	1970	1.98	1.65	2.21		
Africa & Mid East	1964	1.64		2.29		
	1968	1.62		2.27		
	1970	1.74		2.43		
Australia, New Zealand, South Africa ...	1964		2.53	2.53		
	1968		1.73	1.73		
	1970		1.81	1.81		

Source: Bawden, Kendrick, Nohre and Williams, op. cit.

Bjarnason, op. cit.

Epp, op. cit.

Epp, Letter.

European Economic Community, "Analyse Des Facteurs Qui Influent Sur L'orientation De L'offre Régionale De Céréales Et De Produits Transformés Dérivés Des Céréales."

Fox, op. cit.

International Wheat Council, "World Wheat Statistics."

Kartographisches Institut Und Verlag, "Europe Road Map, 1:3000000," Frankfurt/M.

United Nations, Statistical Yearbook.

Table A-13.--Feeder calf transportation costs ($/head)

Exporter	Importer / Year	France	Italy	Germany-Benelux
France	1964	2.16	4.87	4.17
	1968	2.14	4.82	4.13
	1970	2.29	5.16	4.42
Italy	1964	4.16		4.60
	1968	4.12		4.55
	1970	4.41		4.87
Germany-Benelux	1964	3.27	3.68	
	1968	3.24	3.64	
	1970	3.46	3.90	
EFTA	1964		3.27	3.70
	1968		3.24	3.66
	1970		3.46	3.92
Eastern Europe	1964	6.46	4.72	5.94
	1968	6.40	4.67	5.88
	1970	6.84	5.00	6.29

Source: European Economic Community, "Analyse Des Facteurs Qui Influent Sur L'orientation De L'offre Régionale De Céréales Et De Produits Transformés Dérivés Des Céréales."

International Wheat Council, "World Wheat Statistics."

Kartographisches Institut Und Verlag, "Europe Road Map, 1:3000000," Frankfurt/M.

United Nations, Statistical Yearbook.

Table A-14.--Beef transportation costs ($/100 kg.)

Exporter \ Importer	Year	France	Italy	Germany-Benelux
France	1964	1.54	2.78	2.63
	1968	1.52	2.75	2.60
	1970	1.63	2.94	2.79
Italy	1964	2.69		2.84
	1968	2.66		2.81
	1970	2.85		3.01
Germany-Benelux	1964	2.33	2.82	
	1968	2.31	2.79	
	1970	2.47	2.99	
EFTA	1964	6.47	3.66	
	1968	7.16	3.62	
	1970	7.59	3.84	
Eastern Europe	1964	3.95	2.91	
	1968	3.91	2.88	
	1970	4.18	3.08	
Latin America	1964	7.67	7.67	7.83
	1968	5.13	5.13	5.24
	1970	6.24	6.24	6.37

Source: Bawden, Kendrick, Nohre and Williams, op. cit.

Epp, op. cit.

European Economic Community, "Analyse Des Facteurs Qui Influent Sur L'orientation De L'offre Régionale De Céréales Et De Produits Transformés Dérivés Des Céréales."

International Wheat Council, "World Wheat Statistics."

Kartographisches Institut Und Verlag, "Europe Road Map, 1:3000000," Frankfurt/M.

United Nations, Statistical Yearbook.

Table A-15.--Veal transportation costs ($/100 kg.)

Exporter \ Importer	Year	France	Italy	Germany-Benelux
France	1964	1.54	2.78	2.63
	1968	1.63	2.94	2.60
	1970	1.52	2.75	2.79
Italy	1964	2.69		2.84
	1968	2.85		2.81
	1970	2.66		3.01
Germany-Benelux	1964	2.33	2.82	
	1968	2.47	2.79	
	1970	2.31	2.99	

Source: Bawden, Kendrick, Nohre, and Williams, op. cit.

Epp, op. cit.

European Economic Community, "Analyse Des Facteurs Qui Influent Sur L'orientation De L'offre Régionale De Céréales Et De Produits Transformés Dérivés Des Céréales."

International Wheat Council, "World Wheat Statistics."

Kartographisches Institut Und Verlag, "Europe Road Map, 1:3000000," Frankfurt/M.

United Nations, Statistical Yearbook.

Table A-16.--Pork transportation costs ($/100 kg.)

Exporter	Importer / Year	France	Italy	Germany-Benelux
France	1964	1.65	3.63	3.02
	1968	1.75	3.84	3.20
	1970	1.63	3.59	2.99
Italy	1964	3.09		3.47
	1968	3.27		3.67
	1970	3.06		3.44
Germany-Benelux	1964	2.52	3.45	
	1968	2.67	3.65	
	1970	2.49	3.42	

Source: Epp, op. cit.

European Economic Community, "Analyse Des Facteurs Qui Influent Sur L'orientation De L'offre Régionale De Céréales Et De Produits Transformés Dérivés Des Céréales."

International Wheat Council, "World Wheat Statistics."

Kartographisches Institut Und Verlag, "Europe Road Map, 1:3000000," Frankfurt/M.

United Nations, Statistical Yearbook.

Table A-17.--Egg transportation costs ($/100 kg.)

Exporter \ Importer	Year	France	Italy	Germany-Benelux
France	1964	2.09	2.25	1.87
	1968	2.21	2.38	1.98
	1970	2.07	2.23	1.85
Italy	1964	2.92		3.30
	1968	3.09		3.49
	1970	2.89		3.27
Germany-Benelux	1964	2.35	2.28	
	1968	2.49	2.41	
	1970	2.33	2.26	

Source: Epp, op. cit.

European Economic Community, "Analyse Des Facteurs Qui Influent Sur L'orientation De L'offre Régionale De Céréales Et De Produits Transformés Dérivés Des Céréales."

International Wheat Council, "World Wheat Statistics."

Kartographisches Institut Und Verlag, "Europe Road Map, 1:3000000," Frankfurt/M.

United Nations, Statistical Yearbook.

Table A-18.--Poultry transportation costs ($/100 kg.)

Exporter	Importer / Year	France	Italy	Germany-Benelux
France	1964	2.19	2.36	1.95
	1968	2.32	2.50	2.07
	1970	2.17	2.34	1.93
Italy	1964	3.09		3.49
	1968	3.27		3.70
	1970	3.06		3.46
Germany-Benelux	1964	2.47	3.47	
	1968	2.62	3.67	
	1970	2.45	3.44	

Source: Epp, op. cit.

European Economic Community, "Analyse Des Facteurs Qui Influent Sur L'orientation De L'offre Régionale De Céréales Et De Produits Transformés Dérivés Des Céréales."

International Wheat Council, "World Wheat Statistics."

Kartographisches Institut Und Verlag, "Europe Road Map, 1:3000000," Frankfurt/M.

United Nations, Statistical Yearbook.

Table A-19.--Food grain variable import levies (+) and variable export subsidies (-) ($/100 kg.)

Exporter	Importer / Year	France	Italy	Germany-Benelux	EFTA
France	1964		3.17	3.70	-1.52
	1968				-2.46
	1970(L)				-2.81
	1970(H)				-2.81
Italy	1964	-3.20		.78	
	1968				
	1970(L)				
	1970(H)				
Germany-Benelux	1964	-2.39	.78		-3.91
	1968				-2.87
	1970(L)				-2.96
	1970(H)				-2.96
United States	1964	3.45	4.79	5.32	
	1968	4.10	4.33	4.01	
	1970(L)	4.08	4.30	3.98	
	1970(H)	4.08	4.30	3.98	
Canada	1964	3.45	4.79	5.32	
	1968	4.10	4.33	4.01	
	1970(L)	4.08	4.30	3.98	
	1970(H)	4.08	4.30	3.98	
Latin America	1964	3.45	4.79	5.32	
	1968	4.10	4.33	4.01	
	1970(L)	4.08	4.30	3.98	
	1970(H)	4.08	4.30	3.98	
Africa & Mid East	1964	3.45			
	1968	4.10			
	1970(L)	4.08			
	1970(H)	4.08			

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Table A-19 (cont'd.)

Exporter	Importer: Year	Eastern Europe	Africa & Mid East	Other Asia
France	1964	-1.52	-1.52	-1.52
	1968	-2.46	-2.46	-2.46
	1970(L)	-2.81	-2.81	-2.81
	1970(H)	-2.81	-2.81	-2.81
Italy	1964	-4.54	-4.54	
	1968	-4.33	-4.33	
	1970(L)	-4.07	-4.07	
	1970(H)	-4.07	-4.07	
Germany-Benelux	1964	-3.91	-3.91	-3.91
	1968	-2.87	-2.87	-2.87
	1970(L)	-2.96	-2.96	-2.96
	1970(H)	-2.96	-2.96	-2.96

Source: Foreign Agricultural Service, United States Department of Agriculture, "Grain Developments in the Common Market," FAS-M-202, December 1968.

Hans G. Hirsch, "The Uniform Grain Price in the European Economic Community," ERS-Foreign 110, United States Department of Agriculture, March 1965.

Table A-20.--Feed grain variable import levies (+) and variable export subsidies (-) ($/100 kg.)

Exporter \ Importer	Year	France	Italy	Germany-Benelux	EFTA	Other Europe
France	1964		-.68	2.95	-1.66	-1.66
	1968				-1.10	-1.10
	1970(L)				-2.47	-2.47
	1970(H)				-2.47	-2.47
Italy	1964	.96		2.27		
	1968					
	1970(L)					
	1970(H)					
Germany-Benelux	1964	-1.93	-1.25		-3.59	
	1968				-1.93	
	1970(L)				-2.08	
	1970(H)				-2.08	
EFTA	1964			4.71		
	1968			3.20		
	1970(L)			3.35		
	1970(H)			3.35		
United States	1964	3.40	1.37	4.71		
	1968	3.22	2.50	3.20		
	1970(L)	3.46	2.67	3.35		
	1970(H)	3.46	2.67	3.35		
Latin America	1964	3.40	1.37	4.71		
	1968	3.22	2.50	3.20		
	1970(L)	3.46	2.67	3.35		
	1970(H)	3.46	2.67	3.35		

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Table A-20 (cont'd.)

Exporter \ Importer	Year	France	Italy	Germany-Benelux	EFTA	Other Europe
Africa & Mid East	1964	3.40		4.71		
	1968	3.22		3.20		
	1970(L)	3.46		3.35		
	1970(H)	3.46		3.35		
Australia, New Zealand, South Africa	1964		1.37	4.71		
	1968		2.50	3.20		
	1970(L)		2.67	3.35		
	1970(H)		2.67	3.35		

Source: Hirsch, op. cit.

United Nations, "Commodity Trade Statistics."

United States Department of Agriculture, "Grain Developments in the Common Market."

Table A-21.--Feeder calf variable import levies (+) and variable export subsidies (-) ($/head)

Exporter	Importer / Year	France	Italy	Germany-Benelux
France	1964			
	1968			
	1970(L)			
	1970(H)			
Italy	1964			
	1968			
	1970(L)			
	1970(H)			
Germany-Benelux	1964			
	1968			
	1970(L)			
	1970(H)			

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Table A-21 (cont'd.)

Exporter \ Importer	Year	France	Italy	Germany-Benelux
EFTA	1964			
	1968		21.04	6.56
	1970(L)		19.46	3.66
	1970(H)			
Eastern Europe	1964			
	1968	2.44	15.16	5.98
	1970(L)	2.75	16.47	4.17
	1970(H)			

Source: Commission of the European Communities, "Farm Prices 1970/1971," Information Memo, P-31, June 16, 1969, Brussels.

Epp, op. cit.

European Community Information Service, "The Common Agricultural Policy," Community Topics 28.

Rosemary Fennell and A. Power, "Problems of the Organization of the Meat Market in the E.E.C.," International Journal of Agrarian Affairs, Vol. III, No. 5, June 1963.

General Agreement on Tariffs and Trade, "Trade in Agricultural Products, Reports of Committee II on Consultations with the European Economic Community, the United States of America and the United Kingdom," Geneva, 1965.

Ministry of Agriculture and Fisheries of the Netherlands, Statistics and Documentation Section, "Selected Agri-Figures of the E.E.C."

Table A-22.--Beef variable import levies (+) and variable export subsidies (-) ($/100 kg.)

Exporter \ Importer	Year	France	Italy	Germany-Benelux
France	1964			
	1968			
	1970(L)			
	1970(H)			
Italy	1964			
	1968			
	1970(L)			
	1970(H)			
Germany-Benelux	1964			
	1968			
	1970(L)			
	1970(H)			
EFTA	1964			
	1968	7.96	14.90	
	1970(L)	7.55	.98	
	1970(H)			

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Table A-22 (cont'd.)

Exporter	Importer / Year	France	Italy	Germany-Benelux
Eastern Europe	1964			
	1968	10.48	20.31	
	1970(L)	4.91	4.27	
	1970(H)			
Latin America	1964			42.45
	1968	50.67	32.72	53.52
	1970(L)	43.13	18.04	34.49
	1970(H)			

Source: B. L. Berntson, O. H. Goolsby and C. O. Nohre, "The European Community's Common Agricultural Policy: Implications for U.S. Trade."

Commission of the European Communities, "Farm Prices 1970/1971."

European Community Information Service, "The Common Agricultural Policy."

Fennell and Power, op. cit.

General Agreement on Tariffs and Trade, "Trade in Agricultural Products, Reports of Committee II on Consultations with the European Economic Community, the United States of America and the United Kingdom."

Ministry of Agriculture and Fisheries of the Netherlands, "Selected Agri-Figures of the E.E.C."

Table A-23.--Pork variable import levies ($/100 kg.)

Exporter \ Importer	Year	France	Italy	Germany-Benelux
France	1964		2.86	3.38
Italy	1964			5.57
Germany-Benelux	1964	8.11	5.25	

Source: Fennell and Power, op. cit.

Table A-24.--Egg variable import levies ($/100 kg.)

Exporter \ Importer	Year	France	Italy	Germany-Benelux
France	1964		2.36	10.61
Italy	1964	9.48		13.34
Germany-Benelux	1964	6.60	2.36	

Source: General Agreement on Tariffs and Trade, "Trade in Agricultural Products, Report of Committee II on the Consultation with the European Economic Community."

Table A-25.--Poultry variable import levies ($/100 kg.)

Exporter \ Importer	Year	France	Italy	Germany-Benelux
France	1964		6.76	15.84
Italy	1964	16.32		15.45
Germany-Benelux	1964	16.41	6.45	

Source: General Agreement on Tariffs and Trade, "Trade in Agricultural Products, Report of Committee II on the Consultation with the European Economic Community."

Table A-26.--Feeder calf import duties ($/head)

Exporter \ Importer	Year	France	Italy	Germany-Benelux
France	1964		6.45	7.02
	1968			
	1970(L)			
	1970(H)			
Italy	1964	19.08		7.47
	1968			
	1970(L)			
	1970(H)			

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Table A-26 (cont'd.)

Exporter \ Importer	Year	France	Italy	Germany-Benelux
Germany-Benelux ...	1964	15.50	5.58	
	1968			
	1970(L)			
	1970(H)			
EFTA	1964		19.16	11.91
	1968		20.95	11.25
	1970(L)		20.51	11.14
	1970(H)		20.51	11.14
Eastern Europe	1964	28.77	16.41	13.30
	1968	15.77	19.33	11.33
	1970(L)	15.81	19.69	11.00
	1970(H)	15.81	19.69	11.00

Source: Commission of the European Communities, "Farm Prices 1970/1971."

Epp, op. cit.

European Community Information Service, "The Common Agricultural Policy."

Fennell and Power, op. cit.

General Agreement on Tariffs and Trade, "Trade in Agricultural Products, Reports of Committee II on Consultations with the European Economic Community, the United States of America and the United Kingdom."

Ministry of Agriculture and Fisheries of the Netherlands, "Selected Agri-Figures of the E.E.C."

Table A-27.--Beef import duties ($/100 kg.)

Exporter \ Importer	Year	France	Italy	Germany-Benelux
France	1964		5.65	11.29
	1968			
	1970(L)			
	1970(H)			
Italy	1964	23.83		13.58
	1968			
	1970(L)			
	1970(H)			
Germany-Benelux	1964	19.59	5.58	
	1968			
	1970(L)			
	1970(H)			
EFTA	1964	28.56	12.81	
	1968	19.73	16.57	
	1970(L)	19.80	19.56	
	1970(H)	19.80	19.56	

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Table A-27 (cont'd.)

Exporter \ Importer	Year	France	Italy	Germany-Benelux
Eastern Europe	1964	23.82	11.49	
	1968	19.31	15.37	
	1970(L)	21.55	21.31	
	1970(H)	21.55	21.31	
Latin America	1964	16.25	6.93	10.66
	1968	12.61	12.61	12.61
	1970(L)	13.87	13.87	13.87
	1970(H)	13.87	13.87	13.87

Source: Berntson, Goolsby and Nohre, op. cit.

Commission of the European Communities, "Farm Prices 1970/1971."

European Community Information Service, "The Common Agricultural Policy."

Fennell and Power, op. cit.

General Agreement on Tariffs and Trade, "Trade in Agricultural Products, Reports of Committee II on Consultations with the European Economic Community, the United States of America and the United Kingdom."

Table A-28.--Veal import duties ($/100 kg.)

Exporter \ Importer	Year	France	Italy	Germany-Benelux
France	1964		8.31	16.61
Italy	1964	28.52		16.25
Germany-Benelux	1964	25.04	7.14	

Source: Fennell and Power, op. cit.

General Agreement on Tariffs and Trade, "Trade in Agricultural Products, Reports of Committee II on Consultations with the European Economic Community, the United States of America and the United Kingdom."

Table A-29.--Food grain dummy costs
($, all years)

Exporter \ Importer	France	Italy	Germany-Benelux	EFTA	Eastern Europe	Other Europe	United States	Canada	Latin America	Africa & Mid East	Other Asia	Australia, New Zealand South Africa
France	-10					10,000	10,000	10,000	10,000			10,000
Italy		-10	10,000	10,000		10,000	10,000	10,000	10,000		10,000	10,000
Germany-Benelux		10,000	-10			10,000	10,000	10,000	10,000			10,000
EFTA	10,000	10,000	10,000									
Eastern Europe	10,000	10,000	10,000									
Other Europe	10,000	10,000	10,000									
United States												
Canada												
Latin America												
Africa & Mid East		10,000	10,000									
Other Asia	10,000	10,000	10,000									
Australia, New Zealand, South Africa	10,000	10,000	10,000									

Table A-30.--Feed grain dummy costs
($, all years)

Exporter \ Importer	France	Italy	Germany-Benelux	EFTA	Eastern Europe	Other Europe	United States	Canada	Latin America	Africa & Mid East	Other Asia	Australia, New Zealand, South Africa
France	-10				10,000		10,000	10,000	10,000	10,000	10,000	10,000
Italy		-10	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000
Germany-Benelux		10,000	-10		10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000
EFTA	10,000	10,000										
Eastern Europe	10,000	10,000	10,000									
Other Europe	10,000	10,000	10,000									
United States												
Canada	10,000	10,000	10,000									
Latin America												
Africa & Mid East		10,000										
Other Asia	10,000	10,000	10,000									
Australia, New Zealand, South Africa	10,000											

Table A-31.--Feeder calf dummy costs ($, all years)

Exporter \ Importer	France	Italy	Germany-Benelux
France	-10		
Italy		-10	10,000
Germany-Benelux		10,000	-10
EFTA	10,000		
Eastern Europe			
Other Europe	10,000	10,000	10,000
United States	10,000	10,000	10,000
Canada	10,000	10,000	10,000
Latin America	10,000	10,000	10,000
Africa & Mid East	10,000	10,000	10,000
Other Asia	10,000	10,000	10,000
Australia, New Zealand, South Africa	10,000	10,000	10,000

Table A-32.--Beef dummy costs ($, all years)

Exporter \ Importer	France	Italy	Germany-Benelux	All other countries
France	-10			10,000
Italy		-10	10,000	10,000
Germany-Benelux		10,000	-10	10,000
EFTA			10,000	
Eastern Europe			10,000	
Other Europe	10,000	10,000	10,000	
United States	10,000	10,000	10,000	
Canada	10,000	10,000	10,000	
Latin America				
Africa & Mid East	10,000	10,000	10,000	
Other Asia	10,000	10,000	10,000	
Australia, New Zealand, South Africa	10,000	10,000	10,000	

Table A-33.--Veal, pork, eggs and poultry dummy costs ($, all years)

Exporter \ Importer	France	Italy	Germany-Benelux
France	-10		
Italy		-10	10,000
Germany-Benelux		10,000	-10

Table A-34.--Land area (ha.)

	Year	Forage land	Crop land
France	1964	19,334,000	9,188,000
	1968	18,937,000	9,282,000
	1970	18,860,000	8,862,000
Italy	1964	9,373,000	6,250,000
	1968	9,372,000	5,950,000
	1970	9,372,000	5,588,000
Germany-Benelux	1964	5,723,000	6,024,000
	1968	5,354,000	6,038,000
	1970	5,249,000	5,965,000

Source: European Economic Community, Office Statistique Des Communautés Européennes, Production Végétale, various issues.

Sorenson and Hathaway, op. cit.

Table A-35.--Land conversion factors

	Year	Forage land conversion factors	
		To the joint product milk-beef feeder calves (ha./head)	To beef fed more than one year (ha./100 kg.)
France	1964	.95	.50
	1968	.86	.45
	1970	.88	.46
Italy	1964	1.21	.65
	1968	1.14	.61
	1970	1.14	.61
Germany-Benelux	1964	.63	.34
	1968	.58	.32
	1970	.56	.31

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Table A-35 (cont'd.)

	Year	Forage land conversion factors	
		To beef fed less than one year (ha./100 kg.)	To veal (ha./100 kg.)
France	1964		.26
	1968		.22
	1970		.23
Italy	1964	.52	.27
	1968	.49	.26
	1970	.49	.26
Germany-Benelux	1964		.23
	1968		.19
	1970		.16

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Table A-35 (cont'd.)

	Year	Crop land conversion factors	
		To food grain (ha./100 kg.)	To feed grain (ha./100 kg.)
France	1964	.032	.040
	1968	.027	.029
	1970	.028	.030
Italy	1964	.049	.036
	1968	.043	.032
	1970	.042	.030
Germany-Benelux	1964	.029	.031
	1968	.026	.028
	1970	.028	.029

Source: European Economic Community, Office Statistique Des Communautés Européennes, Production Végétale, various issues.

Ralph D. Jennings, "Consumption of Feed by Livestock, 1909-56," Production Research Report No. 21, United States Department of Agriculture.

Organization for Economic Co-Operation and Development, "Agricultural Statistics: 1955-1968."

Sorenson and Hathaway, op. cit.

United Nations, "Technical Conversion Factors for Agricultural Commodities."

United States Department of Agriculture, Economic Research Service, "The Grain-Livestock Economy of the European Economic Community: A Historical Review, 1951-63," Foreign Agricultural Economics Report No. 31.

Table A-36.--Percent of farm fed food grain

	1964	1968	1970
France	20	20	20
Italy	8	8	8
Germany-Benelux	8	8	8

Source: Robert H. Clarke and Richard J. Goodman, "Grain Marketing in the EEC: France-Germany" Great Plains Wheat, Inc. (mimeographed), September 1963.

United States Department of Agriculture, "Grain Developments in the Common Market."

Table A-37.--Production restrictions

	Year	Feed grain	The joint product milk-beef-feeder calves	
		Minimum (100 kg.)	Minimum (head)	Maximum (head)
France	1964	16,970,000	8,432,875	11,135,959
	1968	18,840,000	8,877,111	12,915,963
	1970	20,000,000	9,126,907	12,259,362
Italy	1964	15,140,000	4,522,043	4,522,043[1]
	1968	13,180,000	4,949,490	4,949,490[1]
	1970	12,940,000	4,983,389	4,983,389[1]
Germany-Benelux	1964	28,730,000	7,841,499	8,504,184
	1968	47,830,000	7,488,301	8,717,764
	1970	44,710,000	7,774,392	8,989,851

[1]This number is M_i^5 since $M_i^5 > N_i^5$.

Source: Organization for Economic Co-Operation and Development, "Agricultural Statistics: 1955-1968."

Rossmiller, op. cit.

Vernon L. Sorenson, "EEC: Summary Statement of Recent Change and Updated Projections 1970-75," Working document for discussions held in London, May 18-22, 1970.

Sorenson and Hathaway, op. cit.

Table A-38.--Consumption levels

	Year	Food grain	Feed grain for industrial and seed purposes	Beef
		(100 kg.)	(100 kg.)	(100 kg.)
France	1964	59,750,000	16,970,000	10,135,000
	1968	55,870,000	18,840,000	10,045,000
	1970	58,180,000	20,000,000	12,929,000
	1970(update)	53,610,000	20,000,000	10,328,000
Italy	1964	88,530,000	15,140,000	7,115,000
	1968	89,620,000	13,180,000	9,776,000
	1970	82,040,000	12,940,000	10,598,000
	1970(update)	89,950,000	12,940,000	11,105,000
Germany-Benelux	1964	82,890,000	28,730,000	15,581,000
	1968	78,300,000	47,830,000	16,390,000
	1970	79,810,000	44,710,000	18,257,000
	1970(update)	75,710,000	44,710,000	16,800,000

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Table A-38 (cont'd.)

	Year	Veal	Pork	Eggs	Poultry
		(100 kg.)	(100 kg.)	(100 kg.)	(100 kg.)
France ...	1964	3,819,000	11,773,000	5,570,000	5,720,000
	1968	3,785,000	12,080,000	6,090,000	6,240,000
	1970	4,872,000	14,190,000	6,660,000	7,480,000
	1970(update)	3,892,000	13,010,000	6,380,000	7,240,000
Italy	1964	1,274,000	4,041,000	5,140,000	3,580,000
	1968	1,614,000	4,850,000	4,910,000	5,380,000
	1970	1,675,000	5,047,000	6,320,000	5,210,000
	1970(update)	1,755,000	5,520,000	5,030,000	7,450,000
Germany-Benelux	1964	1,599,000	25,150,000	10,660,000	4,820,000
	1968	1,550,000	27,500,000	11,640,000	5,610,000
	1970	1,653,000	29,060,000	13,360,000	7,260,000
	1970(update)	1,520,000	29,360,000	12,440,000	6,440,000

Source: Centre De Recherches Et De Documentation Sur La Consommation, "Production and Uses of Selected Farm Products in France, Projections to 1970 and 1975," Paris, France, December 1967.

Institute Fur Wirtschaftsforschung, "Long-Term Development of Demand and Supply for Agricultural Products in the Federal Republic of Germany," Studien Zur Agrarwirtschaft, Heft 1, Abteilung Landsirtschaft, Munchen 1967.

Donald W. Regier, "Growth In Demand For Feed Grains in the EEC, Projection to 1970 and 1975 in Relation to Consumption of Meat and Livestock Products," Economic Research Service, United States Department of Agriculture, ERS-Foreign 158, July 1967.

Vernon L. Sorenson, "EEC: Summary Statement of Recent Change and Updated Projections 1970-75."

Sorenson and Hathaway, op. cit.

Table A-39.--Livestock conversion factors

	Year	Feed grain		
		To the joint product milk-beef-feeder calves (100 kg./head)	To beef fed more than one year (kg./kg.)	To beef fed less than one year (kg./kg.)
France	1964	2.94	1.85	
	1968	4.17	2.28	
	1970	4.79	2.50	
Italy ...	1964	5.01	1.34	.69
	1968	5.86	1.49	.85
	1970	6.28	1.56	.93
Germany-Benelux	1964	8.64	1.73	
	1968	10.21	1.91	
	1970	11.01	2.00	

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Table A-39 (cont'd.)

	Year	Feed grain			
		To veal (kg./kg.)	To pork (kg./kg.)	To eggs (kg./kg.)	To poultry (kg./kg.)
France	1964	.69	3.47	3.50	2.97
	1968	1.29	3.35	3.37	2.84
	1970	1.59	3.29	3.30	2.77
Italy	1964	2.46	5.92	3.02	3.00
	1968	3.42	5.41	3.15	2.85
	1970	3.90	5.15	3.23	2.77
Germany-Benelux	1964	1.77	3.22	3.70	2.97
	1968	1.96	3.13	3.43	2.79
	1970	2.05	3.36	3.30	2.70

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Table A-39 (cont'd.)

	Year	Milk-beef-feeder calves	
		To feeder calves (head/head)	To beef: cull dairy cows (100 kg./head)
France	1964	.675	.58
	1968	.675	.59
	1970	.675	.59
Italy ...	1964	.675	.61
	1968	.675	.61
	1970	.675	.60
Germany-Benelux	1964	.675	.55
	1968	.675	.56
	1970	.675	.57

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Table A-39 (cont'd.)

	Year	Feeder calves		
		To beef fed more than one year (head/100 kg.)	To beef fed less than one year (head/100 kg.)	To veal (head/100 kg.)
France	1964	.35		1.39
	1968	.34		1.31
	1970	.34		1.27
Italy	1964	.33	.46	1.13
	1968	.33	.46	1.13
	1970	.33	.46	1.13
Germany-Benelux	1964	.37		1.53
	1968	.36		1.39
	1970	.36		1.32

Source: Agricultural Economics Research Institute, "Supply and Demand, Imports and Exports of Selected Agricultural Products in the Netherlands, Forecast For 1970 and 1975," The Hague, 1967.

Centre De Recherches Et De Documentation Sur La Consommation, "Production and Uses of Selected Farm Products in France, Projections to 1970 and 1975."

Epp, op. cit.

Institute Fur Wirtschaftsforschung, "Long-Term Development of Demand and Supply for Agricultural Products in the Federal Republic of Germany."

Mangum, op. cit.

Petit and Viallon, op. cit.

Rossmiller, op. cit.

United Nations, "Technical Conversion Factors for Agricultural Commodities."

Paul W. H. Weightman, "Concentrated Feedingstuffs for Livestock in the Netherlands, 1960-61 to 1965-66 (Livestock Feed Balance)," Agricultural Economics Research 239, Department of Agricultural Economics, Cornell University, January 1968.

Paul W. H. Weightman, Letter, January 1968.

Table A-40.--Minimum percent of food grain transferred

Exporter	Importer / Year	France	Italy	Germany-Benelux	EFTA	Eastern Europe	Africa & Mid East	Other Asia
France	1964			5	3	2	4	4
	1968		3	3	5	8	7	3
	1970		2	5	4	6	10	4
Italy	1964						2	
	1968						3	
	1970						4	
Germany-Benelux	1964				4	4	4	4
	1968				3	3	6	2
	1970				3	1	6	2

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Table A-40 (cont'd.)

Exporter \ Importer	Year	France	Italy	Germany-Benelux	EFTA	Eastern Europe	Africa & Mid East	Other Asia
United States	1964	1	5	10				
	1968	3	1	6				
	1970	4	2	6				
Canada	1964	2	2	15				
	1968	2	2	8				
	1970	1	3	7				
Latin America	1964	1	1	4				
	1968	2	3	2				
	1970	1	4	1				
Africa & Mid East	1964	2						
	1968							
	1970							

Source: European Economic Community, Statistical Office of the European Communities, "Basic Statistics of the Community," various issues.

Organization for Economic Co-Operation and Development, "Agricultural Statistics: 1955-1968."

Organization for Economic Co-Operation and Development, "Food Consumption Statistics, 1954-1966," Paris, 1968.

United Nations, "Commodity Trade Statistics."

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Table A-41.--Minimum percent of feed grain transferred

Exporter \ Importer	Year	France	Italy	Germany-Benelux	EFTA	Other Europe
France	1964		3	3	4	1
	1968		1	5	5	4
	1970		1	6	5	3
Italy	1964	2				
	1968	1		1		
	1970					
Germany-Benelux	1964	4	1		2	
	1968				3	
	1970				1	
EFTA	1964			2		
	1968			2		
	1970			3		
United States	1964	2	7	22		
	1968	3	17	7		
	1970	3	17	7		

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Table A-41 (cont'd.)

Exporter	Importer / Year	France	Italy	Germany-Benelux	EFTA	Other Europe
Latin America	1964	1	19	6		
	1968	1	21	2		
	1970	1	18	2		
Africa & Mid East	1964	1		1		
	1968					
	1970					
Australia, New Zealand, South Africa	1964		4	3		
	1968		1	1		
	1970		2	1		

Source: Organization for Economic Co-Operation and Development, "Agricultural Statistics: 1955-1968."

Organization for Economic Co-Operation and Development, "Food Consumption Statistics, 1954-1966."

United Nations, "Commodity Trade Statistics."

Table A-42.--Minimum percent of feeder calves transferred

Exporter \ Importer	Year	France	Italy	Germany-Benelux
France	1964		>3,<10	
	1968		>3,<10	
	1970		>3,<10	
Italy	1964			
	1968			
	1970			
Germany-Benelux	1964	1	3	
	1968	1	3	
	1970	1	3	
EFTA	1964		8	13
	1968		8	13
	1970		8	13
Eastern Europe	1964		5	2
	1968		5	2
	1970		5	2

Source: Vernon L. Sorenson, Interview, May 15, 1970.

United Nations, "Commodity Trade Statistics."

Table A-43.--Minimum percent of beef transferred

Exporter \ Importer	Year	France	Italy	Germany-Benelux
France	1964			4
	1968			4
	1970		1	6
Italy	1964			
	1968			
	1970			
Germany-Benelux	1964	1	2	
	1968		1	
	1970	1	6	
EFTA	1964		3	
	1968	1	9	
	1970		7	
Eastern Europe	1964		1	
	1968		6	
	1970		6	
Latin America	1964		2	3
	1968	1	11	2
	1970	1	7	2

Source: Organization for Economic Co-Operation and Development, "Agricultural Statistics: 1955-1968."

Organization for Economic Co-Operation and Development, "Food Consumption Statistics, 1954-1966."

Organization for Economic Co-Operation and Development, "The Market for Beef and Veal and Its Factors." Paris, 1967.

United Nations, "Commodity Trade Statistics."

Table A-44.--Minimum percent of veal transferred

Exporter \ Importer	Year	France	Italy	Germany-Benelux
France	1964	90		
	1968	85		
	1970	80		
Italy	1964		90	
	1968		85	
	1970		80	
Germany-Benelux	1964			90
	1968			85
	1970			80

Source: Organization for Economic Co-Operation and Development, "Agricultural Statistics: 1955-1968."

Organization for Economic Co-Operation and Development, "Food Consumption Statistics, 1954-1966."

Organization for Economic Co-Operation and Development, "The Market for Beef and Veal and Its Factors."

Sorenson, Interview.

United Nations, "Commodity Trade Statistics."

Table A-45.--Minimum percent of pork transferred

Exporter	Importer / Year	France	Italy	Germany-Benelux
France	1964	90		
	1968	85		
	1970	80		
Italy	1964		90	
	1968		85	
	1970		80	
Germany-Benelux	1964	2	1	90
	1968	4	6	85
	1970	6	7	80

Source: European Economic Community, "Basic Statistics of the Community."

Organization for Economic Co-Operation and Development, "Agricultural Statistics: 1955-1968."

Organization for Economic Co-Operation and Development, "Food Consumption Statistics, 1954-1966."

Sorenson, Interview.

United Nations, "Commodity Trade Statistics."

Table A-46.--Minimum percent of eggs transferred

Exporter	Importer / Year	France	Italy	Germany-Benelux
France	1964	90		
	1968	85		
	1970	80		
Italy	1964		90	
	1968		85	
	1970		80	
Germany-Benelux	1964	2	3	90
	1968	1	1	85
	1970	1	1	80

Source: European Economic Community, "Basic Statistics of the Community."

Organization for Economic Co-Operation and Development, "Agricultural Statistics: 1955-1968."

Organization for Economic Co-Operation and Development, "Food Consumption Statistics, 1954-1966."

Sorenson, Interview.

United Nations, "Commodity Trade Statistics."

Table A-47.--Minimum percent of poultry transferred

Exporter \ Importer	Year	France	Italy	Germany-Benelux
France	1964	90		2
	1968	85		2
	1970	80		2
Italy	1964		90	
	1968		85	
	1970		80	
Germany-Benelux	1964			90
	1968			85
	1970			80

Source: European Economic Community, "Basic Statistics of the Community."

Organization for Economic Co-Operation and Development, "Agricultural Statistics: 1955-1968."

Organization for Economic Co-Operation and Development, "Food Consumption Statistics, 1954-1966."

Sorenson, Interview.

United Nations, "Commodity Trade Statistics."