



AgEcon SEARCH
RESEARCH IN AGRICULTURAL & APPLIED ECONOMICS

The World's Largest Open Access Agricultural & Applied Economics Digital Library

This document is discoverable and free to researchers across the globe due to the work of AgEcon Search.

Help ensure our sustainability.

Give to AgEcon Search

AgEcon Search
<http://ageconsearch.umn.edu>
aesearch@umn.edu

*Papers downloaded from **AgEcon Search** may be used for non-commercial purposes and personal study only. No other use, including posting to another Internet site, is permitted without permission from the copyright owner (not AgEcon Search), or as allowed under the provisions of Fair Use, U.S. Copyright Act, Title 17 U.S.C.*

EASTERN EUROPE

A Growing Market For U.S. Feed Grains

By :

Mary E. Ryan and James P. Houck



Department of Agricultural and Applied Economics

University of Minnesota
Institute of Agriculture, Forestry and Home Economics
St. Paul, Minnesota 55108

TABLE OF CONTENTS

ACKNOWLEDGEMENTS	iv
ABSTRACT	iv
INTRODUCTION	1
A SYNOPSIS OF EAST EUROPEAN GRAIN-LIVESTOCK SECTORS	2
ANALYTICAL FRAMEWORK	9
STATISTICAL ANALYSIS	14
East Germany	16
Poland	22
Czechoslovakia	23
Hungary	27
SUMMARY AND CONCLUSIONS	28
APPENDIX A. TABLE OF DATA	30
APPENDIX B. DATA SOURCES AND REFERENCES	32

ACKNOWLEDGEMENTS

The research reported in this publication is part of a joint project between the U.S. Department of Agriculture and the University of Minnesota. The Commodity Economics Division and the Foreign Demand and Competition Division of the Economic Research Service of the U.S.D.A. provided both financial assistance and technical advice. The work was done in the Department of Agricultural and Applied Economics at the University of Minnesota with additional financial support from the University's Agricultural Experiment Station.

Although the authors are responsible for the contents of this bulletin, the advice and helpful suggestions of Maury E. Bredahl, Kenneth E. Egertson, Willis L. Peterson, and other University and USDA colleagues are acknowledged.

Mary E. Ryan
Assistant Professor

James P. Houck
Professor

ABSTRACT

The economic factors influencing feed grain imports of several East European nations were analyzed for the 1961-74 period. Imports were significantly affected by international grain prices, domestic grain and livestock production, and government policies toward agriculture.

EASTERN EUROPE, A GROWING MARKET FOR U.S. FEED GRAINS

Seven nations of Eastern Europe imported 2.1 million metric tons of feed grains directly from the United States in 1975. In 1974, they imported 1.4 million metric tons. These exports constituted 15 percent of U.S. barley exports, 5 percent of U.S. corn exports, 6 percent of U.S. oats exports, and slightly over 3 percent of U.S. grain sorghum exports in 1974-75. Additional U.S. grains probably reached these nations through Western Europe or the Soviet Union. While they are now a relatively small market, many observers believe there is substantial growth potential for the future. Moreover, there is great general interest in Eastern Europe's political and economic performance.

The major objective of this study was to examine the factors that affect feed grain imports by the major importing countries in Eastern Europe. Changes in both the demands for feed grains and the supplies of domestic feedstuffs were investigated using standard statistical methods. Special attention was devoted to imports of corn and sorghum, the major U.S. feed grain exports. The results make it possible to estimate likely changes in imports when changes occur in related factors.

Although this study does not encompass all aspects of the feed-livestock sectors in each country, it does quantify some of the basic relationships. The study period covers the 1960s and early 1970s. Detailed attention was given to Czechoslovakia, East Germany, Poland, and Hungary, the principal feed grain importers in those years. The seven-nation group, to which some

of the descriptive data refer, also includes Romania, Yugoslavia, and Bulgaria.

A Synopsis of East European Grain-Livestock Sectors

Three recent USDA reports present detailed accounts of feed and livestock production, trade, and policies in Eastern Europe.^{1/} They document past consumption, production, and trade patterns and project future changes based chiefly on past trends. Grain and livestock sectors expanded between the mid-1950s and 1970 for the region as a whole. The expansion was linked to "changes in institutional and economic factors which have led to an improved economic climate." Some of the changes described are: decentralization of production and marketing decisions, increased investments in agriculture, and greater reliance on financial incentives. The studies concluded that continued emphasis on increasing livestock output to meet rising consumer demand for livestock products is likely.

National five-year plans for 1971-75 stressed expansion of livestock industries. To accommodate that expansion, regional grain imports from all origins increased.^{2/} Continued development of East European livestock industries will necessitate larger supplies of feedstuffs. Growth of domestic feed output will contribute to these larger supplies, but it is unlikely that national livestock production goals can be met without substantial imports. These nations are looking increasingly to the West for their grain imports. Their chief post World War II supplier, the

^{1/} See references [2], [12], and [13], listed in Appendix B.

^{2/} International trade by East European nations is conducted by government agencies. The institutional mechanisms are concisely described in [6].

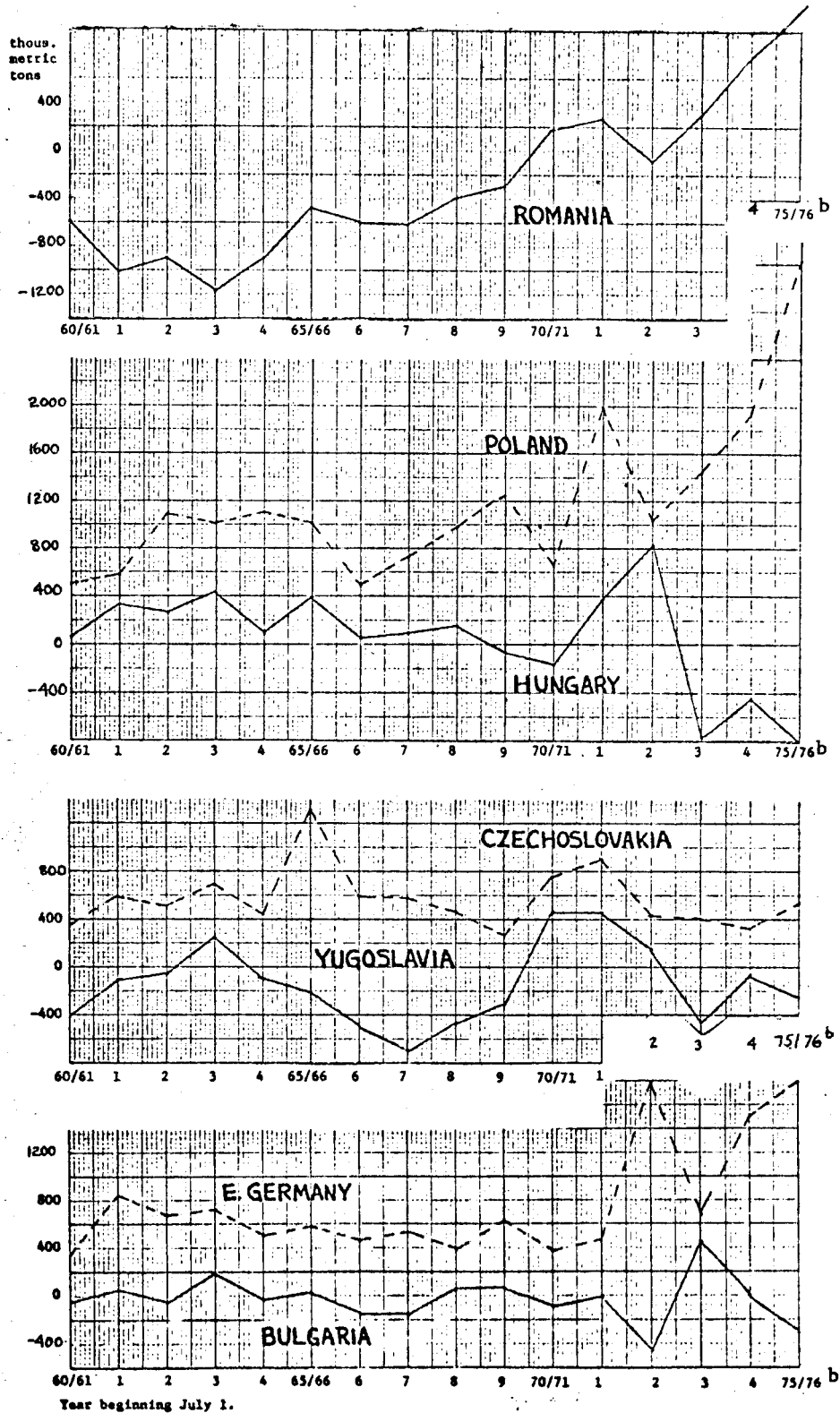
Soviet Union, no longer has exportable surpluses available on a regular basis. Meanwhile, East-West trade barriers generally have been lowered.^{3/}

Net imports of coarse grains by the seven East European nations for 1960-75 are shown in figure 1 to permit inter-country comparisons.^{4/} Czechoslovakia, East Germany, and Poland were net importers in each of the 16 years. Romania became a net importer in the 1970s after moving rather steadily away from a substantial net export position. In the 1970s, imports by East Germany and Poland grew considerably in contrast to the 1960s when there were no obvious trends in imports by those two countries. Hungary was a net coarse grain exporter in 5 of the 16 years and is likely to continue exporting more grain than it imports. Yugoslavia was a net exporter more frequently than it was a net importer. Bulgaria was nearly in balance--neither importing nor exporting substantial quantities of coarse grains. Considerable variation in imports from year to year is apparent for all countries. The figure also suggests that there is no common pattern of trade in coarse grains among the East European nations. There is some evidence, however, of intraregional trade, especially in 1972 and later years when opposite movements in net imports appear between some countries. (The graphical evidence does not, of course, mean that there was in fact trade among countries whose imports and exports offset one another. Actual trade may have occurred with third countries.)

Figures 2-5 show grain production and net imports, along with hog numbers for Czechoslovakia, East Germany, Hungary, and Poland. These are

^{3/} For a discussion of East-West trade relationships, see [5].

^{4/} Rye, barley, corn, oats, and sorghum are called "coarse grains." The term "feed grains" excludes rye.

Figure 1. Net imports of coarse grains by East European nations, 1960-75^a^a Negative values indicate net exports.^b Projected

Source: Data from For. Agr. Circulars, For. Agr. Service, U.S.D.A.

the key components of the feed-livestock sector in each country. Hogs consume more grain than any other class of livestock in the region. This is illustrated by the accompanying tabulation.

Grain fed to produce pork as a percentage of total
grain utilized as animal feed

	<u>1966-70</u>	<u>1975</u>	<u>1980</u>
Czechoslovakia	48%	51%	52%
East Germany	56	50	48
Hungary	42	42	41
Poland ^a	35	38	36

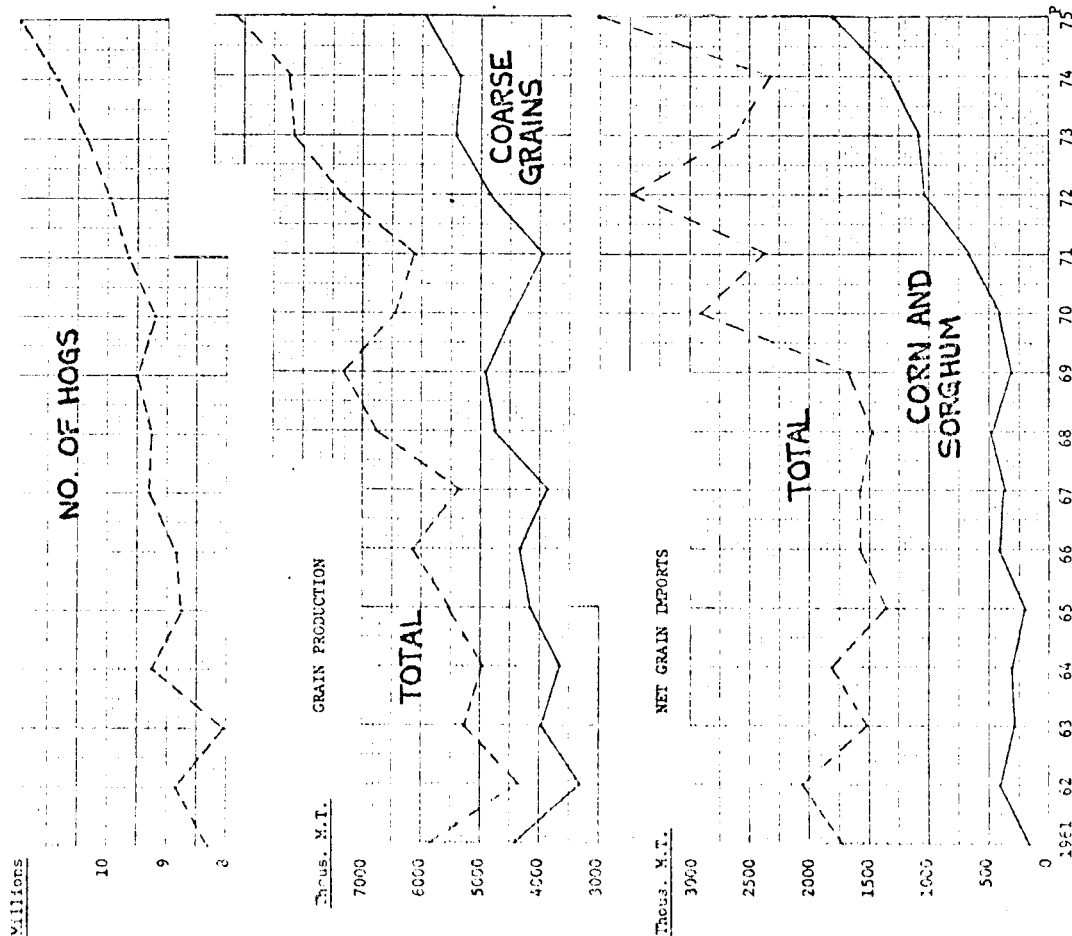
Source: Computed from data in [12], table 21.
Data for 1975 and 1980 are USDA estimates.

^aIn Poland, horses were the second largest grain-consuming animal group in 1966-70. By 1980 they are expected to remain an important, though smaller, component of the total.

According to modern livestock feeding practices, hogs and poultry consume relatively more grain than other classes of livestock. Since production periods for both are rather short, producers can adjust hog and poultry operations quickly as circumstances warrant. Hence, changes in grain utilization are linked closely to changes in hog and poultry industries in most countries. For this study, however, reliable poultry data were not available, so only hog data were employed.

In all four countries more hogs were on farms in the mid-1970s than in the early 1960s; but the expansion patterns differed greatly among countries. In East Germany, increases in hog numbers were rather steady. In Poland and Hungary, expansion was most rapid after about 1970. In

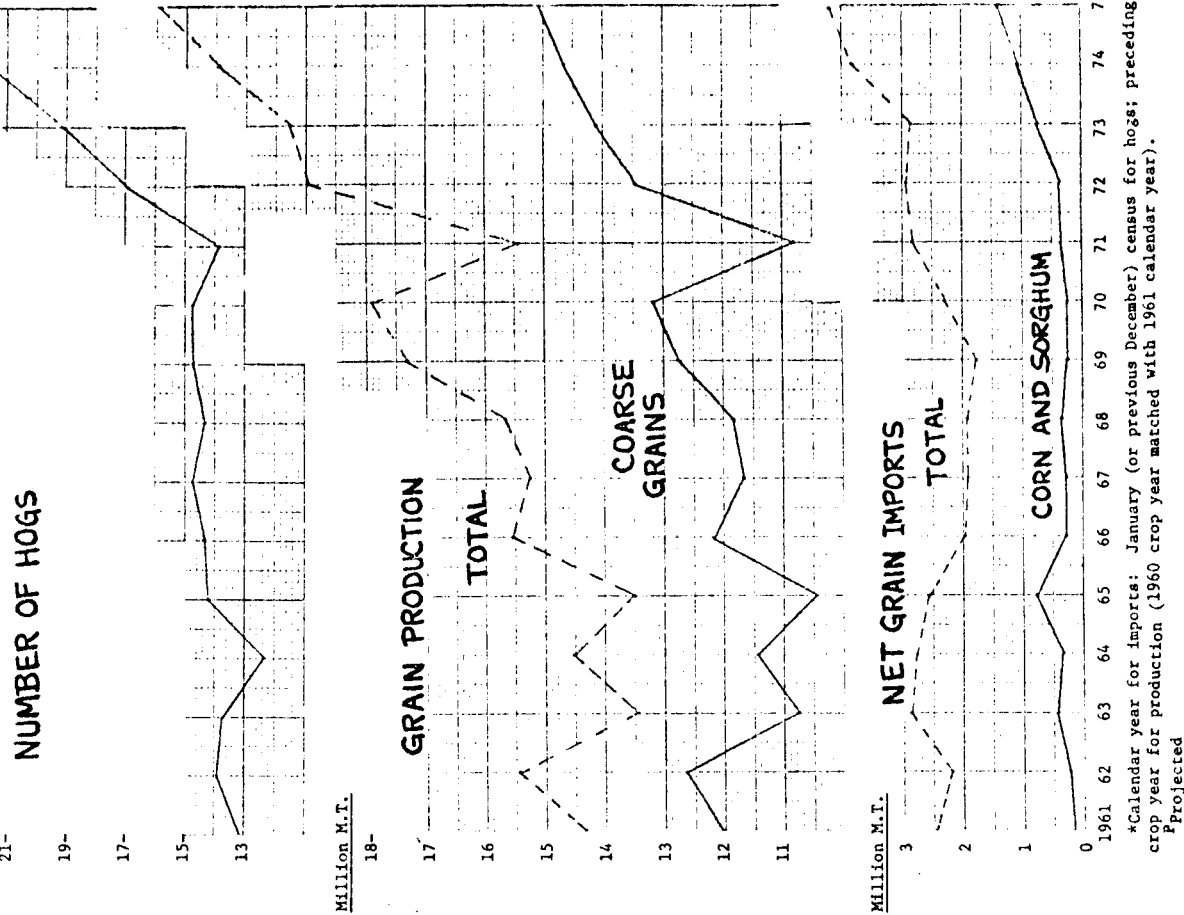
Figure 2. E. Germany: Hog numbers, grain production, and grain imports, 1961-1975*



*Calendar years for imports: January (or previous December) census for hogs; preceding crop year for production (1960 crop year matched 1961 calendar year).

^PProjected

Figure 3. Poland: Hog numbers, grain production and imports, 1961-1975*



*Calendar year for imports: January (or previous December) census for hogs; preceding crop year for production (1960 crop year matched with 1961 calendar year).

^PProjected

Figure 4. Czechoslovakia: Hog numbers, grain production, and grain imports, 1961-1975*

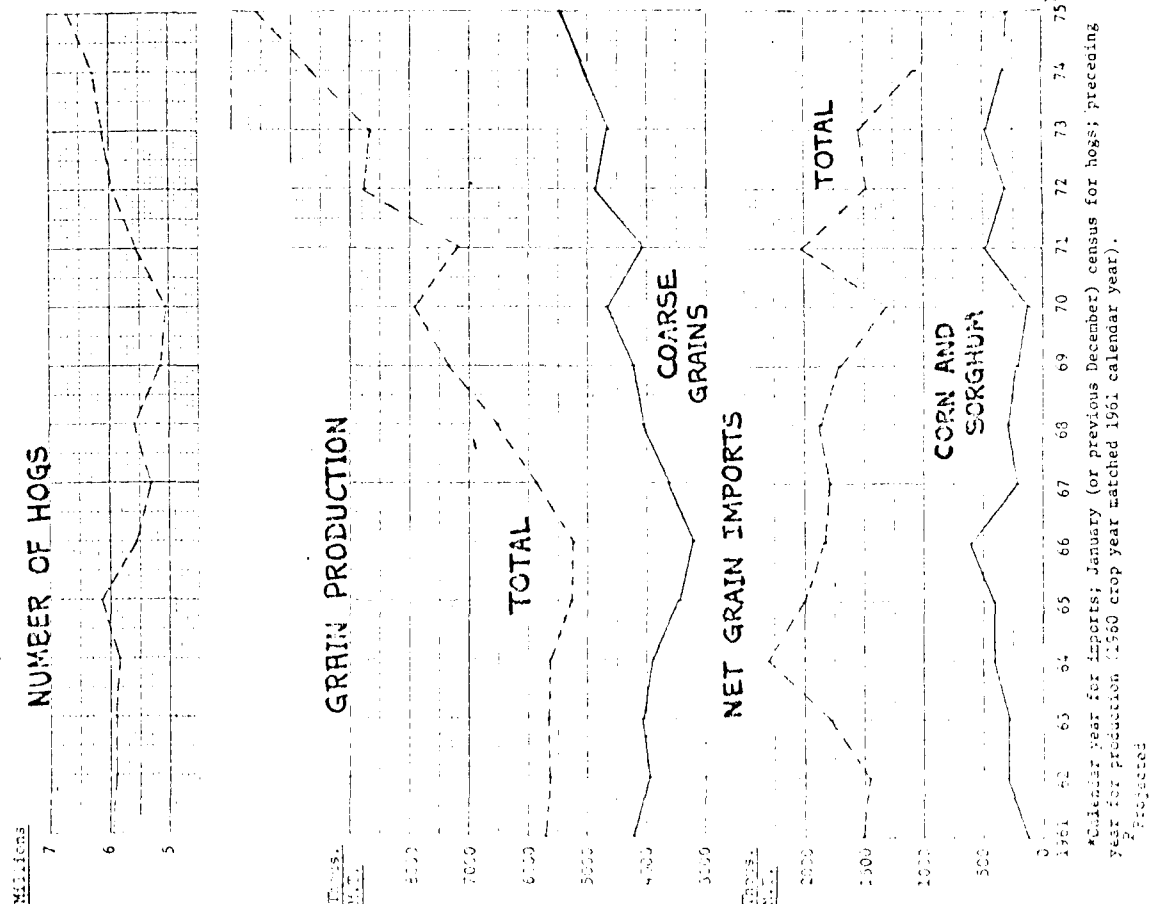
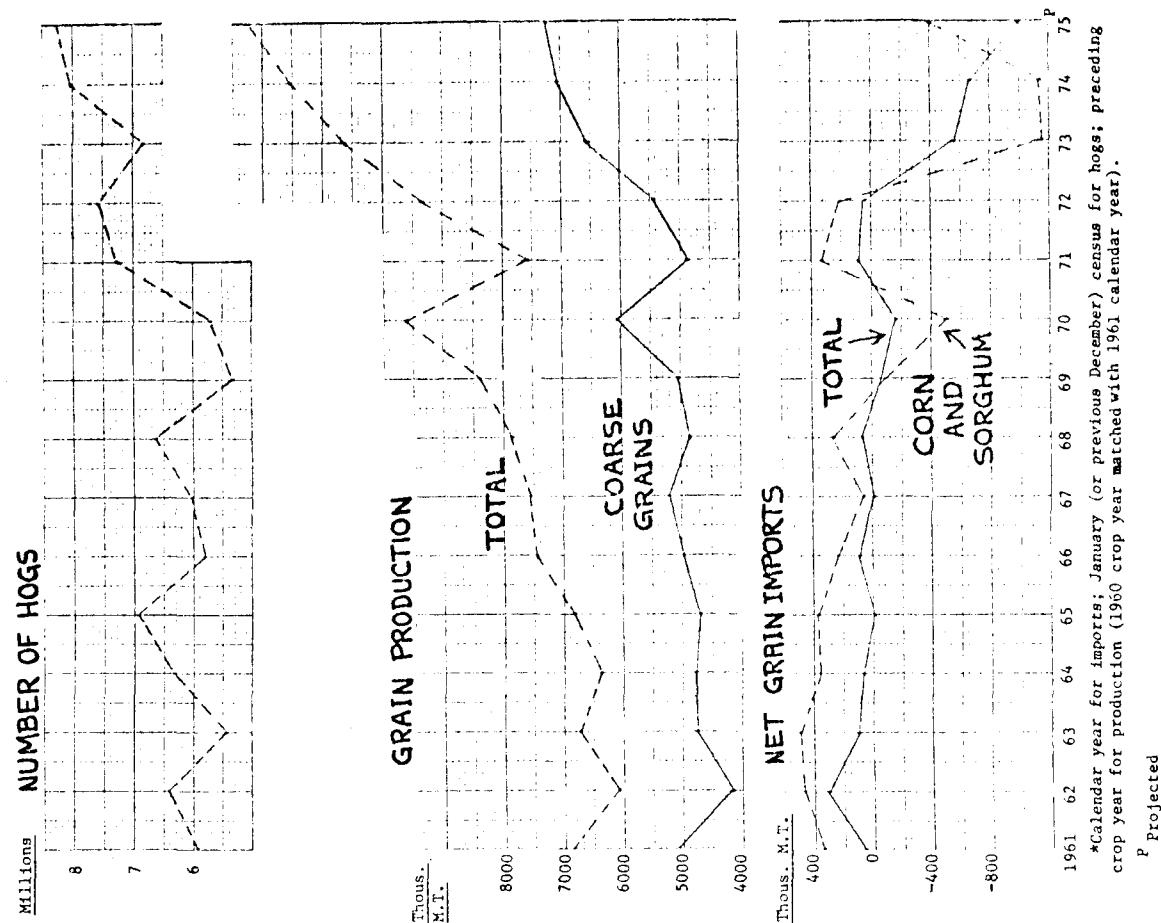


Figure 5. Hungary: Hog numbers, grain production, and grain imports, 1961-75*



Czechoslovakia, there was a decline until 1970, followed by quite steady growth.

The number of hogs to be fed each year is only a rough measure of annual feed requirements. It does not reflect changes in feed utilization that result from changes in marketing weights or in the time required to bring a hog to market weight. Pork production data do reflect these changes. However, pork production data alone give no indication of expansion or contraction of breeding stock. Since neither hog numbers nor pork production are complete indicators of feed requirements, both were examined in the statistical analyses of grain imports.

Import and production data for total grains include wheat and rye. Substantial quantities of these grains are consumed by animals in Eastern Europe. Furthermore, it is presumed that annual fluctuations in wheat and rye supplies would be reflected in changing feed use since food utilization of grains is generally rather stable.

In figures 2-5, wheat makes up the difference between total grain and coarse grain production. Wheat production and coarse grain production expanded in all countries with considerable variation from country to country. The common dip in 1971 (crop year 1970/71) reflected poor weather during the spring and summer growing season [7]. Output advances in the 1970s correspond with 1971-75 national five-year plans stressing improvements in the feed-livestock sectors. Earlier output fluctuations can be linked to both political and agronomic factors.

Combined net imports of corn and sorghum are shown separately since they are the two chief feed grains exported from the United States. East Germany and Poland have increased their imports of these grains while

Hungary has become a substantial exporter in more recent years. Some substitution between imports and production seems apparent for all countries. This relationship is investigated further in the statistical analysis.

Although roughages are an important part of total feed supplies in Eastern Europe, they were not explicitly examined here since the focus is on grain imports. The growth of a modern livestock industry generally increases the demand for grains and high-protein meal relative to roughages. Shifts from roughages to grains most often occur steadily through time and can be accounted for indirectly in statistical analyses. From year to year, domestic grain and roughage output typically change together in response to weather fluctuations. Thus, the relationship between grain imports and domestic grain production also likely reflects the additional impact of changes in domestically-grown roughages. If a specific measure of the substitution between grains and roughages were desired, it would be necessary to consider roughages separately.

Figure 6 shows the commodity composition of grain imports and production by East Germany, Poland, Czechoslovakia, and Hungary. Hungary's production and import patterns are markedly dissimilar from the other three countries. Only in Hungary is corn the major grain crop. Hungarian grain imports are small relative to the other nations, with barley dominating. Patterns among the other nations have several similarities. Wheat is the chief import grain in the other three countries and is produced on a large scale by each.

Analytical Framework

In order to analyze feed grain imports in a systematic manner, a

common analytical framework was applied. In general, the annual quantity of any commodity imported by a country is the difference between the amount demanded (or used) and the amount supplied domestically from production and inventories. A typical algebraic expression of this relationship is

$$(1) \quad M = D - S = f(P, X_d, X_s)$$

where

M = the quantity of net imports

D = the amount demanded in the importing country

S = domestic supply in the importing country

P = price of the commodity

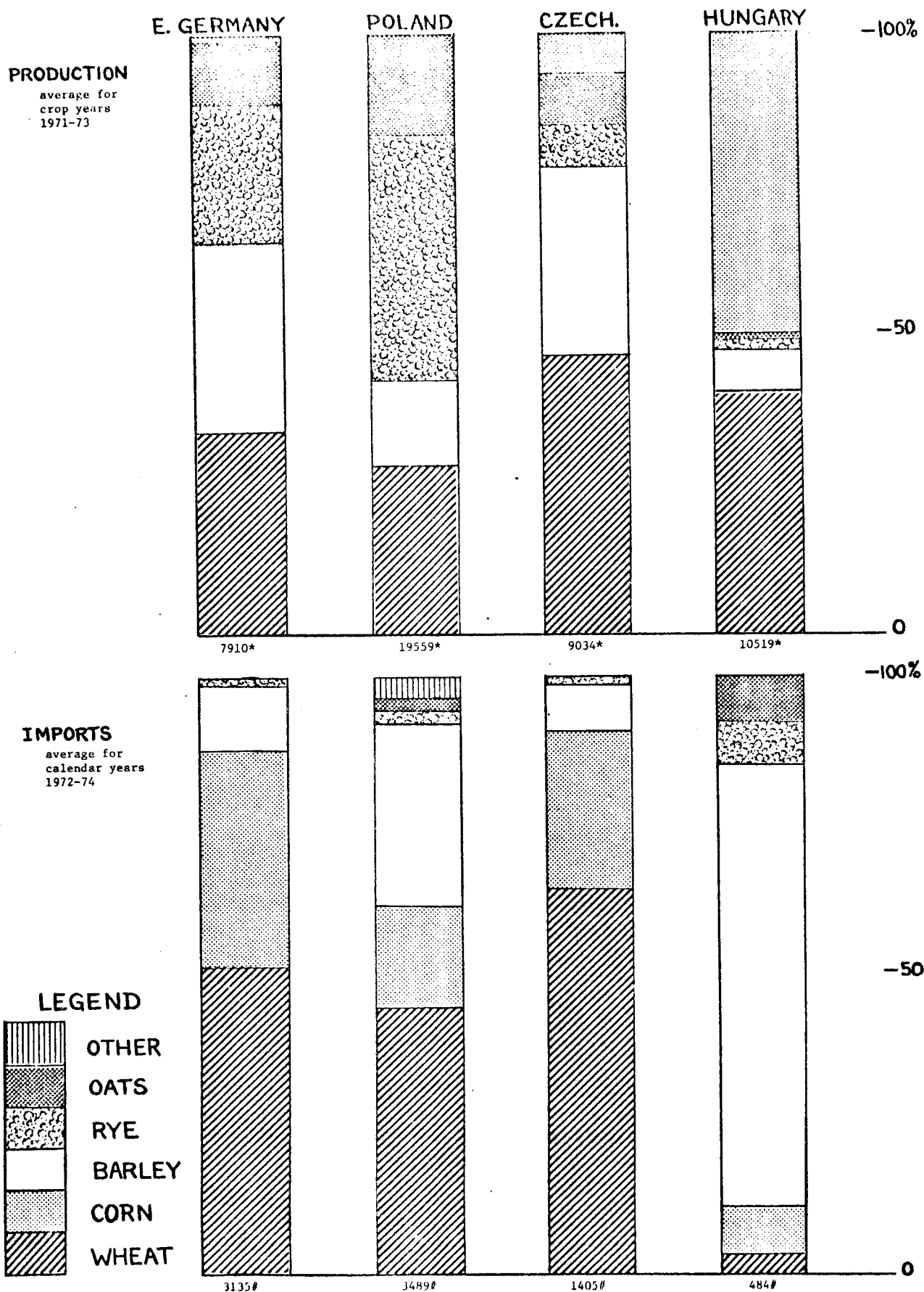
X_d = a collection of domestic demand shifters such as prices or quantities of substitutes, income, tastes and preferences, number and type of consumers

X_s = a collection of domestic supply shifters such as prices or quantities of alternative products or factors of production, environmental influences, policy decisions.

This basic framework is employed most often in studying the trade behavior of nations that rely on more-or-less open markets and decentralized economic decision making.

Some observers argue that the centrally-planned East European nations do not respond systematically to price and other economic variables because (1) they are not open market economies, and (2) their trading behavior is administratively-determined and heavily influenced by barter and special credit arrangements. Administratively-determined trade practices certainly are not unique to centrally-planned economies. Many other nations which

Figure 6. Average composition of grain production and imports by East Germany, Poland, Czechoslovakia, and Hungary



*Average annual imports, in thousand metric tons.

*Average annual production, in thousand metric tons.

rely chiefly on market forces for domestic price formation and resource allocation display formidable administrative barriers to international commerce. For all of these nations, centrally planned or not, important trade decisions are made by government officials. The same forces that influence trade when markets are allowed to function without restraint may also cause policymakers to take similar actions. So rational economic behavior (in the market sense) is not necessarily precluded when market forces are overridden by centralized decision making.

Jozef Wilczynski has written a lucid discussion of pricing policies and practices in East European countries and the USSR [14]. In Chapter 5, from which the following excerpts are drawn, he describes the early pricing systems that flowed from traditional Marxian philosophy. In general, prices were based on the cost of labor plus a social markup.

In each country there was a two-tier price system, viz. producers' (or wholesale) prices and retail (consumers') prices. Producers' prices were, as a rule, based on the 'average cost of production' of the branch of industry. But these costs did not include rent and capital charges. Moreover, these prices were fixed in advance before the desired combination of resources and the structure of production were worked out in the plan, and they remained fixed for long periods. . . .

Retail prices usually bore little relation to producers' prices, as the overriding objective in fixing the former was to ensure an equilibrium in the market for consumer goods by adjusting demand to the planned supply.

By the early 1960s planners and party leaders in these countries recognized the need to adopt new measures to stimulate their economies.

Widespread economic reforms were introduced that included major revisions in the principles underlying pricing policies. In Wilczynski's words:

It is now widely agreed amongst Socialist economists that for prices to be rational in the above sense [i.e. from the

standpoint of the efficiency of the allocation of resources and the requirements of intensive economic growth] (which coincides with the Capitalist concept of price rationality), the following conditions must be satisfied:

- (a) Prices must be either determined in free competitive markets where consumer's sovereignty prevails, or derived computationally from the optimal plan.
- (b) The contribution of all resources (i.e. in addition to labour) to production must be accepted as cost and reflected accordingly in prices.
- (c) Prices must be based on the costs of marginal enterprises in the industry producing a particular article.
- (d) There ought to be a closer correspondence between retail and producers' prices. If they must differ (over and above wholesale and retail margins), the rates of turnover taxes should be reasonably uniform, at least for broad classes of products.
- (e) Prices must be fairly flexible to indicate the conditions of supply and demand as reflected in conventional markets or in computationally simulated 'shadow markets'.
- (f) Domestic prices of internationally traded products (including their close substitutes) must be linked to those prevailing in world markets.

Now the economic systems in Eastern Europe generally are more flexible, more decentralized, and more market oriented than before 1960. Although prices are set to more closely represent supply and demand conditions, they still are determined administratively and thus do not rise or fall without a governmental decision.

Stemming from the above considerations, the working hypotheses of this study were that feed grain imports by East European nations responded (1) to changes in international prices; (2) to changes in domestic grain production and livestock numbers; and (3) to changes in domestic economic policies, where appropriate. Thus, the individual import demand relationships estimated in this study flow directly from the analytical model, equation (1).^{5/} Nevertheless, the application of this economic model to

^{5/} Insofar as international feed grain prices influence the domestic

East European nations is a special case. The results must be interpreted with caution. Some of the special circumstances to be considered are discussed with the statistical findings for each country.

Statistical Analysis

The variables employed in the statistical analysis are grouped into five categories. The first four categories correspond to the four general variables shown in equation (1): M , P , X_d , and X_s . The fifth category includes variables for policy changes and other factors not included in the first four groups.

Five different measures of M (feed grain imports) were examined in preliminary analyses for each of the four countries. They were (1) net imports of corn, (2) net imports of corn and sorghum, (3) net imports of the four feed grains, (4) net imports of all coarse grains, and (5) net imports of all grains. Estimates using either net imports of corn or net imports of corn plus sorghum as M were superior to the others.

Corn and sorghum are probably the closest substitutes among the main feed grains. Imports of either respond to the same set of factors. Some substitution between the two may have been induced by U.S. trade policy

grain and livestock sectors of these countries, the price responsiveness of their grain imports to international grain prices is understated in this specification. Conceptually, a model employing quantities instead of prices as demand shifters reflects some of the price effects through simultaneous adjustments in other quantity variables. For example, if grain prices fall relative to livestock prices, producers may expand their herds, feed more grain to livestock already on grain rations, and place additional animals on grain rations. In this specification, employing livestock numbers, only the latter two impacts of a price change are reflected by the price variable. But if livestock numbers and other quantity variables depend importantly on previous prices, then this understatement is diminished.

in the mid-sixties. Grain sorghum exports to many traditional corn buyers were encouraged through attractive export and freight subsidies and special credit terms. Several East European countries imported substantial quantities of U.S. grain sorghum during that period. Recently, their sorghum imports have been small and sporadic. The estimates using net imports of corn and sorghum as the dependent variable implied that these two grains were perfect substitutes for one another. When sorghum imports were entered as an independent variable in the estimations of corn imports (Poland and Czechoslovakia), an apparent rate of substitution was generated by the statistical procedure. For both countries, a one-ton increase in sorghum imports was associated with a greater than one-ton decrease in corn imports. Since large quantities of sorghum were imported only when the U.S. offered special trade inducements, this probably is not indicative of future substitution rates.

Various prices of corn were employed as measures of P . For each country, except East Germany, an implicit import price was computed by dividing the total value of corn imports by the total quantity of corn imports. In addition, quoted prices of corn imported into the United Kingdom and average prices received for corn by U.S. farmers were entered in some specifications. The latter two were considered representative of world corn prices. No results are reported that contain the U.S. farm price of corn. One of the other price variables provided better statistical results.

Pork production was taken as the principal demand shifter, X_d . As incomes have risen in these countries, consumers have desired more meat. Because prices are fixed administratively, market forces do not necessarily

reflect such a demand increase back to producers through higher prices. Nonetheless, increased demand for meat becomes evident as meat supplies vanish from retail shops and consumers vocalize discontent. Meat shortages have created political pressures on government planners to stimulate meat production increases.

Domestic production and imports of other feed grains were used as principal domestic supply shifters, X_s . Substitution between corn and sorghum imports and wheat production and imports also was investigated. Analyses including wheat had less explanatory power than others. Thus, no reported results contain wheat variables. The estimated substitution relations among grains differed from country to country because of differences in production and feeding practices.

In each country, except Hungary, a variable designed to capture the impact of a major government policy change during the period was found to be important.

The import demand relations for each country were estimated by ordinary least squares regression analysis. The study period encompassed calendar years 1961-74. One estimated equation for corn and one for corn plus sorghum imports are reported for each country. Some of the other specifications investigated are mentioned in the text. Overall, the estimates are reasonable and quite closely capture historical import patterns. Table 1 gives variable identifications. The data and data sources are in the appendix.

East Germany. Two estimated import demand relationships for East Germany are shown in equations (2) and (3). The same independent variables appear in each. The dependent variable in equation (2) is net corn

Table 1. Variable Identification

Dependent Variables

CORNNM = net imports of corn, thousand metric tons (TMT), calendar year
 CSGNM = net imports of corn and sorghum,^a TMT, calendar year

Independent Variables

BORNM = net imports of barley + oats + rye, TMT, calendar year
 CGP = corn + oats + barley + rye production in importing country, TMT, crop year
 CORNP = corn production in importing country, TMT, crop year
 DV1^b = 1 in 1961-70, 0 in 1971-74 for East Germany and Poland;
 1 in 1961-66, 0 in 1967-74 for Czechoslovakia
 DV2^b = 0 in 1961-70, 1 in 1971-74 for East Germany and Poland;
 0 in 1961-66, 1 in 1967-74 for Czechoslovakia
 PCCZ = Czechoslovakia, implicit import price^c of corn, \$/MT, calendar year
 PCPOL = Poland, implicit import price^c of corn, \$/MT, calendar year
 PCUK = United Kingdom import price of corn \$/MT, calendar year average
 PIGS = number of hogs, from census in December or January, in thousands
 PRKP = pork production, TMT, liveweight, calendar year
 SGNM = net imports of sorghum,^a TMT, calendar year
 YEAR = linear trend; 61, 62, 63, . . . 74

Other Statistics

D.W. = Durbin-Watson statistic to test serial correlation
 R² = coefficient of multiple correlation, squared
 S = standard error of the estimate

^aSorghum includes millet and other grains not specified.

^bWhere DV1 or DV2 is prefixed to another variable, the two variables are multiplied together.

^cImplicit import price is the total value of imports divided by the total quantity of imports.

imports. In equation (3) it is net imports of corn plus sorghum. Very little sorghum is imported by East Germany so the two equations are quite similar. Actual and estimated values of corn imports based on equation (2) are depicted in figure 7.

$$\begin{aligned}
 (2) \quad \text{CORNNM} &= -606.61 - 7.68 \text{ DV2PCUK} + .10 \text{ PIGS} + 1.05 \text{ DV2PIGS} \\
 &\quad (2.1) \quad (2.0) \quad (3.4) \\
 &\quad - 9,361.48 \text{ DV2} \\
 &\quad (3.3) \\
 R^2 &= .97 \quad S = 72.13 \quad \text{D.W.} = 2.11
 \end{aligned}$$

$$\begin{aligned}
 (3) \quad \text{CSGNM} &= -696.75 - 7.12 \text{ DV2PCUK} + .12 \text{ PIGS} + .97 \text{ DV2PIGS} \\
 &\quad (1.7) \quad (1.9) \quad (2.6) \\
 &\quad - 8,697.78 \text{ DV2} \\
 &\quad (2.6) \\
 R^2 &= .96 \quad S = 86.43 \quad \text{D.W.} = 2.58 \\
 &\quad (\text{t-values are in parentheses})
 \end{aligned}$$

In both equations, a dummy variable allows for possibly different effects before and after the start of the 1971-75 five-year plan stressing livestock expansion. The dummy variable, DV2, in combinations with the price variable, PCUK, and with PIGS indicates that imports were more responsive to changes in these variables in 1971-74 than in 1961-70. To show the relationship in the two time periods separately, equation (2) can be rewritten. For 1971-74 the coefficient for the dummy variable DV2 is added to the intercept value and the two pig variables are summed. Therefore,

$$\text{in 1961-70: } \text{CORNNM} = -606.61 + .10 \text{ PIGS},$$

$$\text{and in 1971-74: } \text{CORNNM} = -9968.09 + 1.15 \text{ PIGS} - 7.68 \text{ PCUK}.$$

Without the dummy variable, the number of pigs was the only significant variable related to imports. Alone it accounted for 80 percent of the variation in imports of corn (or corn plus sorghum) for the entire 15-year study period. Thus, the dummy variable captures effects of the policy change in 1971 and contributes substantially to the analysis.

A negative net relation exists between the U.K. price of corn and East German imports during 1971-74. A 10 percent increase in the price was associated with a 7.6 percent decline in corn imports.^{6/} The U.K. price was used because an implicit import price of corn was not calculated for East Germany.^{7/} When PCUK was entered for the entire study period, its regression coefficient and t-value were reduced, compared to equation (2). When the two periods were treated separately, the estimated coefficient for 1961-70 was negative but nonsignificant. These results suggest that this

^{6/} The percentage changes reported here and elsewhere are elasticities calculated at the means of the data for the appropriate periods. For East Germany, the price relationship was for 1971-74. Thus the elasticity was calculated as

$$e = b \frac{\overline{PCUK}}{\overline{CORNNM}} = -7.68 \left(\frac{101.0}{1025.25} \right) = -.76$$

where b is the regression coefficient, \overline{PCUK} is the mean of the U.K. corn price in 1971-74, and \overline{CORNNM} is the mean of annual East German corn imports in 1971-74.

In interpreting elasticities calculated in this study, recall that price responsiveness may be underestimated (cf. fn. 5). Also, single equation estimates do not reflect the simultaneity of real markets.

^{7/} Commerce between East and West Germany has not been reported as international trade for political reasons. Thus, East German import statistics do not include commodities arriving from West Germany. It was possible to obtain import quantities adjusted for intra-German trade but no attempt was made to adjust the value of imports because reliable data were not available.

importing nation became more price sensitive as imports became a larger part of the grain supply. In 1974, imports of corn were 1.3 million metric tons while production of barley, oats, rye and corn in crop year 1973-74 was 5.4 million tons. Thus, East German corn imports in 1974 were about 25 percent as large as domestic coarse grain production. In 1961, this proportion was only 4 percent.

As expected, imports of corn (or corn plus sorghum) increased as pig numbers increased. According to these estimates, imports grew about ten times faster per pig after 1971. This implies a recent shift toward corn and away from other feeds. The PIGS coefficient for 1971-74 suggests a very high feeding rate for imported corn.^{8/} These results, however, are plausible since hog numbers probably serve as a proxy for other grain-consuming animal units. Moreover, the hog data come from a mid-winter census that may understate the total number of hogs fed throughout the year. When more years of data become available, this relationship with animal units can be reexamined. Poultry and dairy cows might be considered along with hogs as demand shifters for imported corn.

No significant competitive relationships were found between imports of corn (or corn plus sorghums) and other imported grains or between corn imports and domestic grain production. As mentioned, substitution of corn for other grains may be reflected by the larger coefficient on PIGS after 1971. A shift to corn and a reduction in wheat feeding occurred during the 1971-75 five-year plan as livestock production expanded.

^{8/}Currently in the United States, one hog is fed 12 to 14 bushels of corn to bring it to market weight in 5 to 6 months. That amounts to about 0.75 ton per pig unit on an annual basis. The PIGS coefficient in equation (2) for 1971-74 indicates a 1.15 ton increase in annual corn imports per additional pig in East Germany.

Figure 7. E. Germany: net imports of corn, actual and estimated values, 1961-74

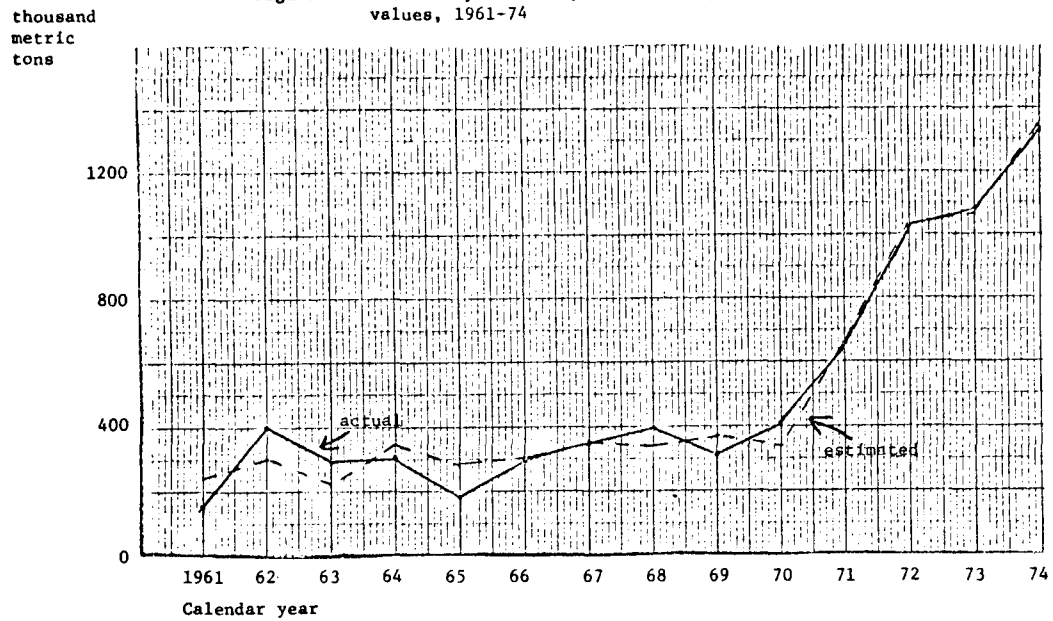
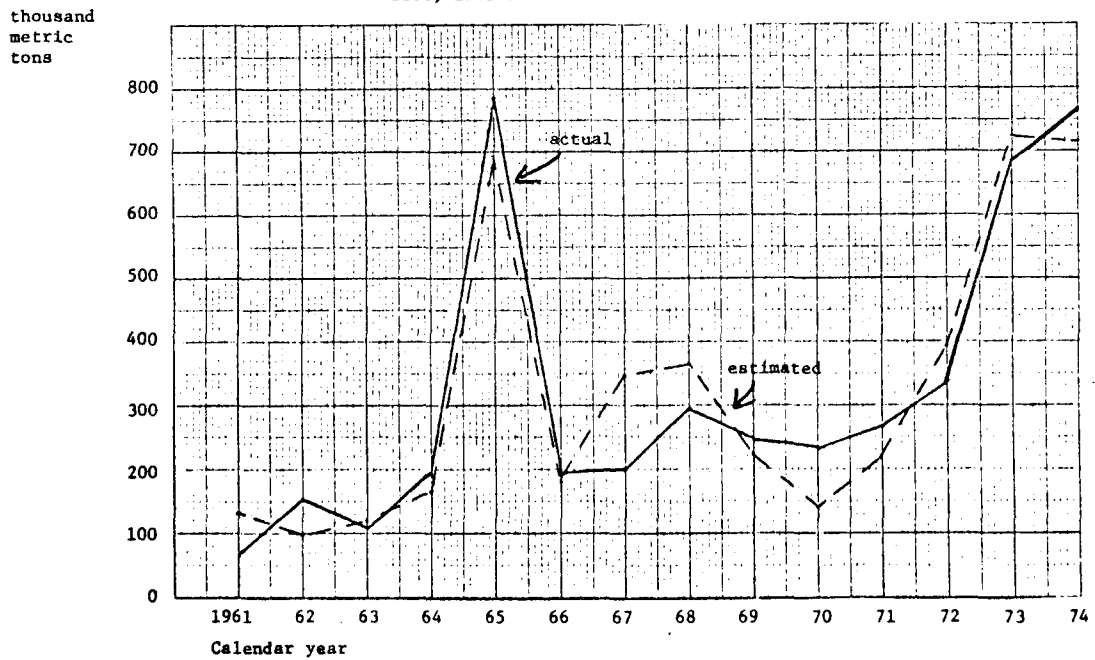


Figure 8. Poland: net imports of corn, actual and estimated values, 1961-74



Net imports of the four feed grains, the five coarse grains, and all grains (coarse grains plus wheat) also were regressed against the same independent variables in equation (2). The R^2 's are .89, .78 and .67 respectively. These independent variables provide fairly good estimates of feed grain or coarse grain imports, but they are best as explanatory variables for corn imports.

Poland. Estimated import demand relationships for Poland are given in equations (4) and (5), and the historical comparisons for equation (4) are shown in figure 8.

$$(4) \quad \text{CORNNM} = 2035.17 - 1.53 \text{ SGNM} - .22 \text{ CGP} + .06 \text{ PIGS} + .17 \text{ DV2PIGS}$$

(4.8) (5.8) (1.6) (3.3)

$$- 2600.10 \text{ DV2}$$

(3.4)

$$R^2 = .92 \quad S = 87.23 \quad \text{D.W.} = 1.58$$

$$(5) \quad \text{CSGNM} = 1777.51 - 4.82 \text{ DV1PCPOL} - .18 \text{ CGP} + .07 \text{ PIGS} + .13 \text{ DV2PIGS}$$

(1.1) (4.6) (1.5) (2.8)

$$- 2266.75 \text{ DV2}$$

(3.0)

$$R^2 = .92 \quad S = 94.40 \quad \text{D.W.} = 1.67$$

(t-values are in parentheses)

Dummy variables were employed to capture effects of policy changes in 1971, as with East Germany. This reflected the emphasis on livestock production in the five-year plan beginning in 1971. In both equations, DV2 changes the intercept for 1971-74 and also adjusts the pig variable for those four years. Some alternative versions of equation (4) were estimated adding price variables. No significant price response emerged. The price

coefficient in equation (5) indicates a rather tenuous negative relationship but only in 1961-70.

Sorghum imports are competitive with corn in equation (4). Coarse grain production appears as an import substitute in both equations. Neither substitution rate was a one-to-one. The relatively small coefficient for CGP is reasonable since a nation is not likely to import one ton of a specific grain to offset a one-ton reduction in domestic output of all coarse grains.

The response of imports to changes in pig numbers was positive and, as expected, was greater after the 1971 policy change. The magnitude of the relationship was much less than in East Germany, as the following manipulation of equation (4) illustrates:

$$\text{in 1961-70: } \text{CORN NM} = 2035.17 - 1.52 \text{ SGNM} - .22 \text{ CGP} + .06 \text{ PIGS}$$

$$\text{and in 1971-74: } \text{CORN NM} = -564.93 - 1.52 \text{ SGNM} - .22 \text{ CGP} + .23 \text{ PIGS}$$

The difference in the estimated coefficients on PIGS between East Germany and Poland likely stems from differences in the two countries' grain-livestock sectors. Poland produces more grain relative to hogs, so is less dependent on imports. Polish hogs are fed substantial amounts of potatoes, thus lowering grain requirements. Many hogs in Poland are raised by small farmers who probably have little access to imported corn.

Pig numbers and domestic coarse grain production also were important explanatory variables in equations using net imports of total feed grains and total coarse grains as dependent variables. But the R^2 's of the aggregated grain equations were smaller than for equations (4) and (5).

Czechoslovakia. Estimated import demand relationships for corn and

corn plus sorghum are given in equations (6) and (7). Actual and estimated imports from equation (6) are depicted in figure 9. The independent variables in equation (6) are the same as in (7) with the exception of SGNM, sorghum imports.

$$\begin{aligned}
 (6) \quad \text{CORN NM} = & -3604.53 - 1.67 \text{ DV2PCCZ} - 1.77 \text{ SGNM} - .28 \text{ BORN NM} - .39 \text{ CGP} \\
 & \quad \quad \quad (2.0) \quad \quad \quad (8.8) \quad \quad \quad (2.9) \quad \quad \quad (7.8) \\
 & + .13 \text{ PIGS} - 303.04 \text{ DV2} + 76.69 \text{ YEAR} \\
 & \quad \quad \quad (2.7) \quad \quad \quad (3.5) \quad \quad \quad (9.3) \\
 R^2 = & .96 \quad \quad S = 36.71 \quad \quad \text{D.W.} = 2.52
 \end{aligned}$$

$$\begin{aligned}
 (7) \quad \text{CSGNM} = & -3032.92 - 2.03 \text{ DV2PCCZ} - .29 \text{ BORN NM} - .26 \text{ CGP} + .16 \text{ PIGS} \\
 & \quad \quad \quad (1.4) \quad \quad \quad (1.7) \quad \quad \quad (4.2) \quad \quad \quad (1.9) \\
 & - 136.25 \text{ DV2} + 55.98 \text{ YEAR} \\
 & \quad \quad \quad (1.1) \quad \quad \quad (5.3) \\
 R^2 = & .89 \quad \quad S = 62.78 \quad \quad \text{D.W.} = 3.30 \\
 & \quad \quad \quad (\text{t-values are in parentheses})
 \end{aligned}$$

As with East Germany and Poland, a government policy change proved to be important in explaining changes in imports. But it was a different type of policy change. In January 1967, economic reforms were introduced to alter government management of Czechoslovakian agriculture. Centralized decision making was reduced, and the role of prices and other financial instruments was enhanced. Individual farms were given the freedom to make their own annual plans based on contracts negotiated with state purchasing agencies. At the end of 1967, prices for agricultural output were about 20 percent above 1965 levels without concurrent increases in retail food prices [1]. Presumably these reforms contributed to the changes in grain output shown in figure 4. Before 1967, coarse grain production was declining. The downward trend was reversed in 1967. Since then, domestic output

has grown. This policy-induced change also was accounted for with dummy variables. For Czechoslovakia, the study period was split at 1967 by means of DV2 to shift the constant term and to bring in the price variable in the latter years.

The dummy variable allowed prices to enter into the computations only in 1967-74. A modestly significant negative relationship emerged. It indicates that at the means a 10 percent price change in those years is associated with a 4 percent opposite change in imports. When prices were entered in both periods but allowed to generate different coefficients, the price relationship for 1961-66 was positive and significant. Because no rationale was found to explain such a relationship, prices were omitted in the first period.

To illustrate the importance of the policy-related dummy variables to the Czechoslovakian analysis, equation (6) was reestimated omitting DV2 and DV2PCCZ and adding PCCZ for all 15 years. The R^2 dropped to .69, the t-value on the price variable fell to 0.8, and the significance of all independent variables except PIGS was reduced.

Three of the variables in equation (6) and two in (7) reflect substitution between corn imports and other grains. One ton of imported barley, oats, or rye substituted for about 0.3 tons of corn plus sorghum, according to these estimates. In the corn equation, sorghum imports appeared with the expected negative sign, but with a coefficient greater than 1.0. Domestic coarse grain production also was found to have a significant negative relationship with imports. The estimated substitution of one ton of domestic production for 0.3 to 0.4 tons of imported grain is reasonable.

Figure 9. Czechoslovakia: net imports of corn, actual and estimated values, 1961-74

thousand
metric
tons

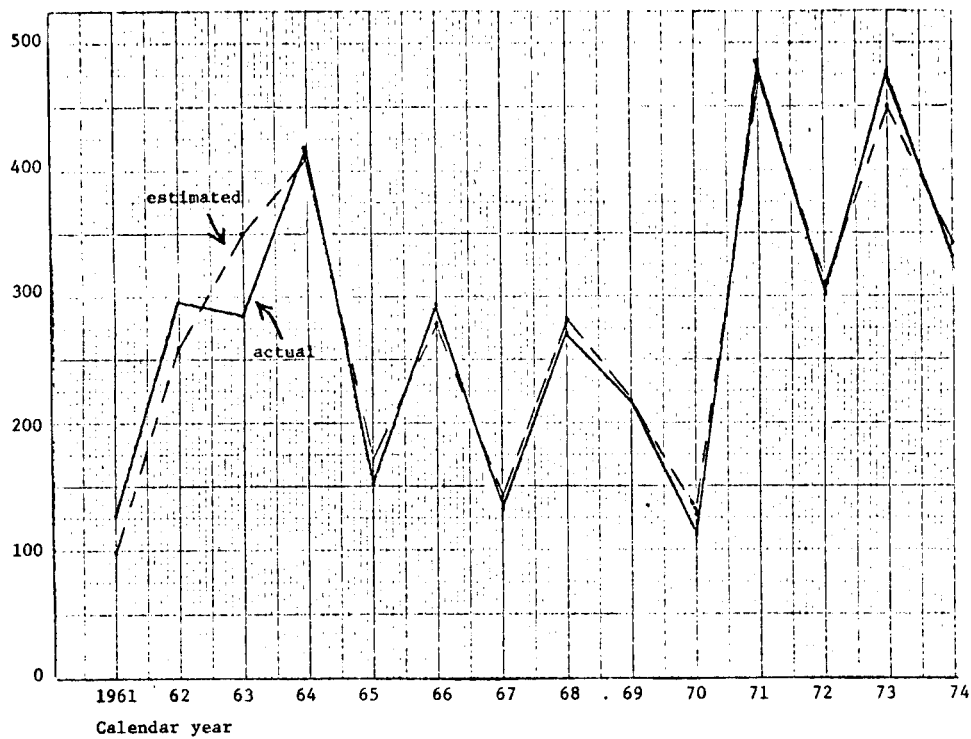
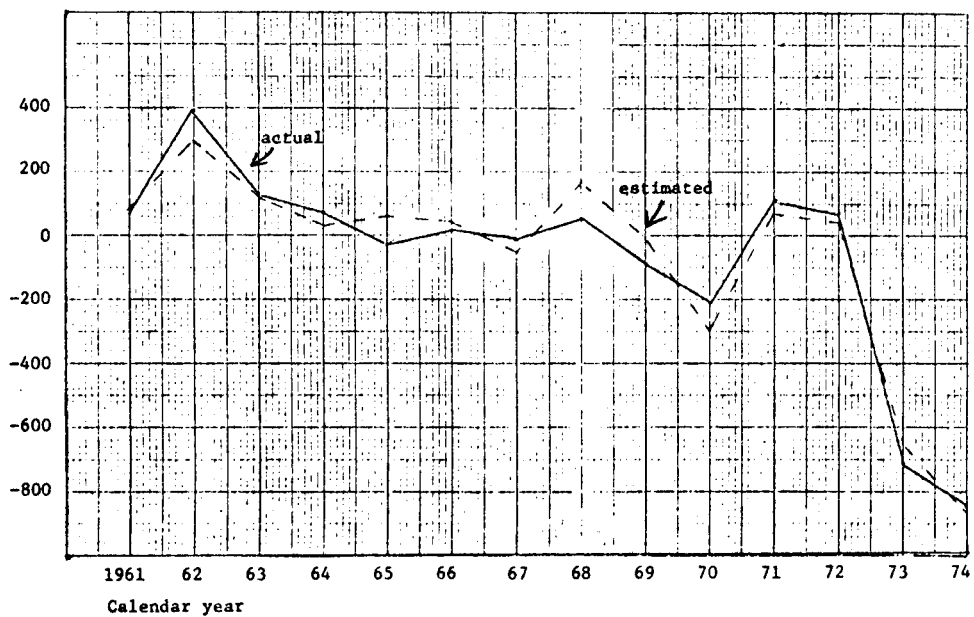


Figure 10. Hungary: net imports of corn, actual and estimated values, 1961-74

thousand
metric
tons



Hog numbers and a linear trend also appear in these equations. The relationship between hog numbers and imports is the same as that discussed for the other nations. The significant, positive coefficient on the trend suggests a secular increase in imports apart from changes in the other variables.

Estimates of net imports of the aggregated grain variables also indicated substitution with domestic coarse grain production and positive relationships with changes in hog numbers. The linear trend variable added explanatory power to these equations. These alternative estimations were inferior to equations (6) and (7).

Hungary. Hungary became a net exporter of grains in the 1970s and is likely to continue in that position. Equations (8) and (9) were estimated with net imports as the dependent variable. To interpret them as net export relationships, just reverse the signs on the estimated regression coefficients. The two equations are nearly identical because sorghum is a very small component of Hungarian trade. The historical performance of equation (8) is shown in figure 10.

$$(8) \quad \text{CORN NM} = 791.87 - 7.60 \text{ PCUK} - .24 \text{ CRNP} + .88 \text{ PRKP}$$

(5.2)
(4.8)
(3.8)

$$R^2 = .96 \quad S = 74.53 \quad \text{D.W.} = 2.05$$

$$(9) \quad \text{CSGNM} = 825.86 - 7.46 \text{ PCUK} - .25 \text{ CRNP} + .89 \text{ PRKP}$$

(5.2)
(5.2)
(3.9)

$$R^2 = .96 \quad S = 72.47 \quad \text{D.W.} = 2.35$$

(t-values are in parentheses)

The specification is simple and requires little explanation. The U.K. corn import price was used because the implicit corn import prices

for Hungary were not reasonable when compared with other price series. A 1 percent increase in the U.K. corn price was associated, at the means, with a 7 to 8 percent decrease (increase) in net imports (exports).

Hungary is the only significant corn producer among the East European countries analyzed in this study. As expected, a strong negative relationship emerged between production and imports. Pork production appears in these equations because it explained more of the variation in imports than did pig numbers. As pork production grew, imports increased.

Analyses for Hungary using combined net imports of all grains and the same explanatory variables produced results generally inferior to those obtained when only corn or corn plus sorghum was used.

Summary and Conclusions

Eastern Europe has grown in importance as a market for U.S. feed grains. Continued growth is expected. This study examines some of the basic relationships in the region's feed-livestock sectors during 1961-75. Then, with statistical methods, it analyzes import demand for feed grains in the principal importing nations.

The analysis applies an economic framework commonly employed in studying the trade behavior of nations relying predominantly upon open markets and decentralized decision making. Such an approach for these centrally planned countries can be justified by arguing that government policymakers typically take actions similar to those that would have resulted from market forces.

The findings generally support that argument and some specific hypotheses derived from it. Those hypotheses are that feed grain imports responded to changes in (1) international prices, (2) domestic grain

production and livestock numbers, and (3) domestic economic policies.

Net imports of corn and corn plus sorghum were estimated by ordinary least squares regression equations for East Germany, Poland, Czechoslovakia and Hungary. The estimated equations explain from 89 to 97 percent of the variation in imports of each nation. At least a modest measure of price responsiveness was obtained for all four countries. The price elasticity was especially large and highly significant in Hungary, where grain exports have recently developed. In all nations, pig numbers or pork production was the principal demand shifter. Substitution between imports and domestic grain production was found for all countries except East Germany. In Czechoslovakia, competition with other feed grain imports also emerged as a significant variable. A variable designed to capture effects of changes in government economic policies during the study period was important in each country except Hungary.

Appendix A. Table of Data

Year	East Germany					Poland				
	CORNNM	CSGNM	PIGS	CORNNM	CSGNM	SGNM	CGP	PCPOL	PIGS	PCUK
	TMT	TMT	thous.	TMT	TMT	TMT	TMT	\$/MT	thous.	\$/MT
1961	157.0	157.0	8,316.0	65.6	173.1	107.5	12,009.0	75.0	13,119.0	55.0
1962	402.7	402.7	8,864.0	150.7	219.5	68.8	12,668.0	66.8	13,917.0	54.0
1963	287.0	287.1	8,045.0	108.4	422.4	314.0	10,759.0	71.9	13,698.0	61.0
1964	309.0	309.7	9,288.0	195.3	319.3	124.0	11,447.0	59.1	12,328.0	61.0
1965	183.0	203.3	8,759.0	785.0	787.1	2.1	10,461.0	54.3	14,197.0	65.0
1966	295.0	406.1	8,878.0	198.6	299.7	101.1	12,203.0	60.6	14,367.0	65.0
1967	352.0	369.6	9,312.0	200.0	276.8	76.8	11,697.0	62.8	14,704.0	62.0
1968	394.0	493.4	9,254.0	295.0	327.0	32.0	11,821.0	52.5	14,384.0	56.0
1969	314.0	314.9	9,523.0	247.0	251.9	4.9	12,760.0	58.1	14,677.0	61.0
1970	411.0	411.0	9,237.0	231.0	236.0	5.0	13,189.0	69.6	14,755.0	71.0
1971	656.0	677.0	9,684.0	267.0	312.0	45.0	10,803.0	67.4	13,860.0	68.0
1972	1,031.0	1,031.0	9,995.0	338.0	358.0	20.0	13,485.0	66.7	16,950.0	66.0
1973	1,086.0	1,086.0	10,361.0	684.0	710.0	26.0	14,121.0	83.8	19,030.0	115.0
1974	1,328.0	1,328.0	10,850.0	765.0	1,084.0	319.0	14,660.0	134.8	21,450.0	155.0

TMT = thousand metric tons.

Variables are identified in Table 1. All data are from official USDA or FAO documents listed in Appendix B; from an unpublished USDA study on Czechoslovakia; and from ERS, USDA unpublished data obtained by telephone.

Appendix A. (continued)

Czechoslovakia											Hungary			
	CORN NM	CSGNM	SGNM	BORN M	CGP	PCCZ	PIGS	CORN NM	CSGNM	CRNP	PRKP			
Year	TMT	TMT	TMT	TMT	TMT	\$/MT	thous.	TMT	TMT	TMT	TMT			
1961	127.6	128.1	.5	252.5	4,232.0	63.9	5,962.0	66.7	66.6	3,504.0	620.5			
1962	296.8	296.9	.1	248.3	3,995.0	71.8	5,895.0	395.0	394.3	2,715.0	642.4			
1963	285.0	285.1	.1	141.2	4,044.0	61.5	5,897.0	136.4	135.4	3,240.0	646.3			
1964	419.5	419.7	.2	398.5	3,875.0	62.0	5,845.0	76.3	74.8	3,582.0	645.6			
1965	152.2	413.2	261.0	655.3	3,433.0	59.8	6,139.0	-21.7	-21.5	3,552.0	703.2			
1966	293.3	611.3	318.0	180.1	3,244.0	64.4	5,544.0	13.1	104.0	3,608.0	694.2			
1967	133.4	212.4	79.0	358.7	3,620.0	64.5	5,305.0	-16.1	-17.0	3,958.0	655.2			
1968	270.9	271.3	.4	218.2	4,014.0	59.7	5,601.0	56.4	80.7	3,580.0	750.0			
1969	216.7	217.1	.4	239.0	4,204.0	60.0	5,136.0	-95.8	-95.5	3,814.0	661.0			
1970	122.3	122.6	.3	162.7	4,650.0	59.6	5,037.0	-209.3	-213.0	4,820.0	691.0			
1971	486.5	486.4	-.1	315.5	4,023.0	59.6	5,530.0	112.1	108.4	4,072.0	886.0			
1972	302.2	302.5	.3	74.3	4,896.0	69.5	5,935.0	64.4	62.5	4,670.0	996.0			
1973	478.4	479.3	.9	102.6	4,653.0	94.1	6,090.0	-712.1	-719.3	5,540.0	867.0			
1974	332.0	334.0	2.0	56.9	5,011.0	141.0	6,270.0	-842.0	-842.0	5,910.0	1,068.0			

Appendix B

DATA SOURCES AND REFERENCES

- [1] Brainard, Lawrence J. "Policy Cycles in Socialist Economics: Examples from Czechoslovak Agriculture." U.S. Congress, Joint Economic Committee. Reorientation and Commercial Relations of the Economies of Eastern Europe. Joint Committee Print, 93d Cong., 2d sess., Aug. 16, 1974, pp. 214-228.
- [2] Collins, H. Christine. The Feed-Livestock Economy of Poland: Prospects to 1980. USDA, ERS, For. Agr. Econ. Report No. 99, Jan. 1975.
- [3] Food and Agriculture Organization of the United Nations. Production Yearbook. Various annual issues.
- [4] Food and Agriculture Organization of the United Nations. Trade Yearbook. Various annual issues.
- [5] Holt, Susan F. "East-West Trade: An American Dilemma." Exponent, Vol. 11, No. 1, Federal Reserve Bank of Minneapolis, March 1972.
- [6] Jones, James R., and W. R. Morrison. Import Demand for Soybeans and Soybean Products in Eastern Europe. Bull. No. 803, Agr. Expt. Sta., Univ. of Arkansas, Fayetteville, March 1976.
- [7] U.S. Department of Agriculture, Economic Research Service. The Agricultural Situation in Communist Areas. ERS-Foreign 314, April 1971.
- [8] _____. The Agricultural Situation in Eastern Europe: Production and Trade Statistics, 1970-75. For. Agr. Econ. Report No. 117, March 1976.
- [9] _____. The Agricultural Situation in Eastern Europe: Review of 1974 and Outlook for 1975. For. Agr. Econ. Report No. 102, April 1975.
- [10] _____. Agricultural Statistics of E. Europe and Soviet Union, 1950-70. ERS-For. 349, June 1973.
- [11] _____. The Agricultural Situation in Communist Areas, Review of 1972 and Outlook for 1973. ERS-For. 350, undated.

- [12] Urban, Francis, et al. The Feed-Livestock Economics of Eastern Europe: Prospects to 1980. USDA, ERS, For. Agr. Econ. Report No. 90, Oct. 1973.
- [13] Vankai, Thomas A. The Feed-Livestock Economy of East Germany: Prospects to 1980. USDA, ERS, For. Agr. Econ. Report No. 110, Sept. 1975.
- [14] Wilczynski, Jozef. Socialist Economic Development and Reforms. Praeger Publishers, New York, 1972.