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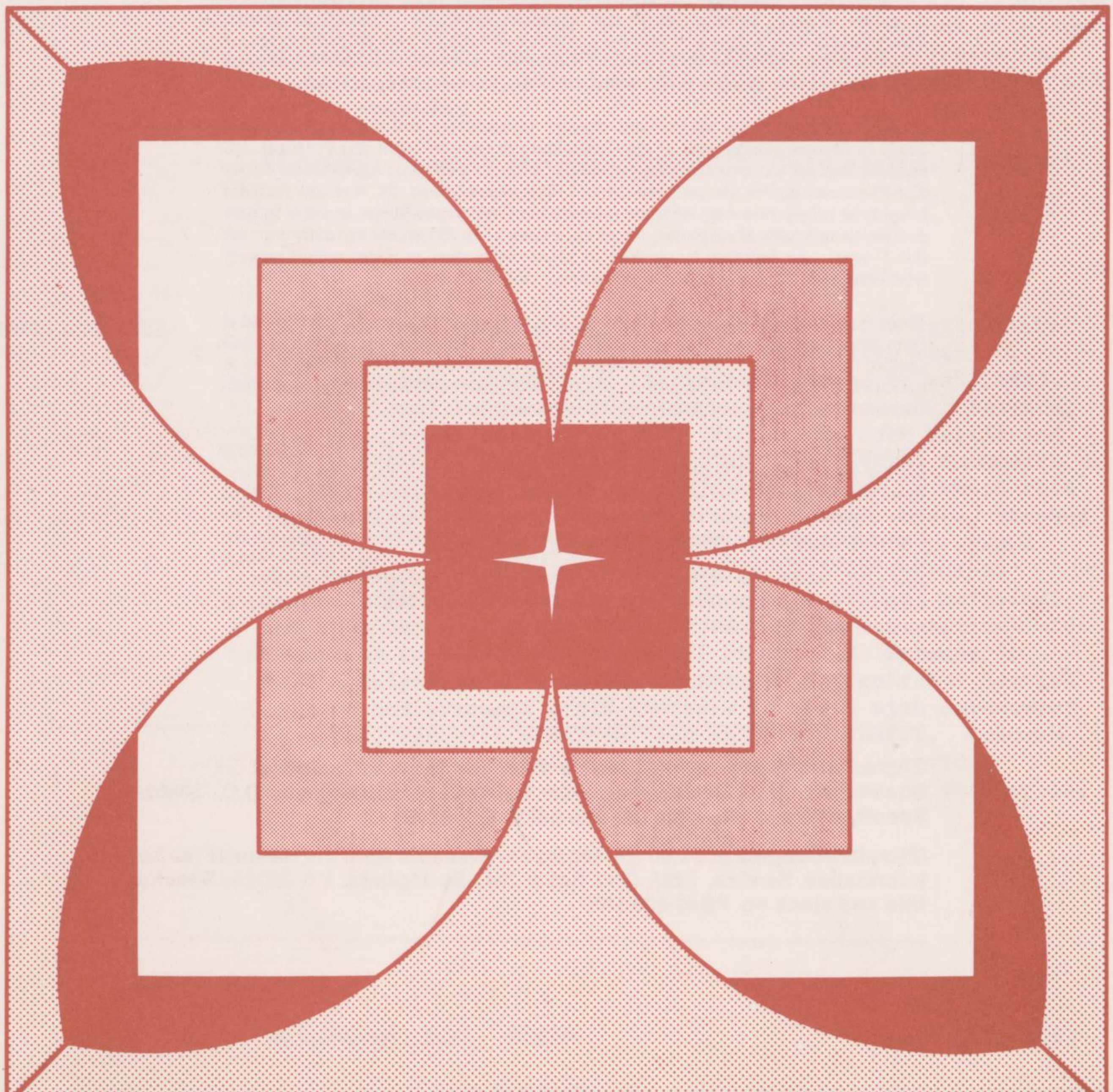
Foreign Agricultural Economic Report 180

Spain's Entry into the European Community

Effects on the Feed Grain and Livestock Sectors

E. Wesley F. Peterson, Albert Pelach Paniker, Harold M. Riley, Vernon L. Sorenson



Developments in the Common Agricultural Policy of the European Community

By Timothy E. Josling and Scott R. Pearson. International Economics Division, Economic Research Service, U.S. Department of Agriculture. Foreign Agricultural Economic Report No. 172.

Summary

The European Community (EC) must reduce expenditures for agricultural support programs to avert a budget crisis and maintain funds for other EC programs. Policymakers have a choice of keeping prices low directly or with producer taxes, or of limiting quantities covered by support measures. This study examines future price levels and possible changes in EC policy, and the possible timing of those changes.

Present trends of rising agricultural support expenditures will not leave adequate funds to finance enlargement of the Community to include Spain and Portugal. EC expenditures are close to exceeding revenues, with the Common Agricultural Policy (CAP) accounting for almost 70 percent of these expenditures. EC revenues increase roughly in proportion with national income, but CAP expenditures increase in proportion to agricultural surpluses, which have risen 15 to 20 percent annually over the last 5 years. An increase in revenue to solve the budget problem would require modifications of basic treaties, which appear politically infeasible.

Thus, expenditure increases must be contained. Budget costs cannot be controlled if farm prices are allowed to rise enough to cover inflation. Price increases much smaller than past increases would control budget expenditures, or a nominal rise in agricultural prices may be possible if coupled with policy changes restricting production or the quantities which qualify for support.

All alternatives which can reduce EC budget costs also reduce subsidized exports and the protection of EC agriculture, thus easing tensions with EC trading partners. Countries outside the EC which export the products in which the EC has a surplus have a direct interest in the outcome of the Community's internal debate. The United States will be particularly interested because the EC is the largest market for U.S. agricultural exports. Any policy changes or reductions in price increases which adequately control the EC budget, however, may also be too restrictive on farm income and perhaps lead individual EC governments to return to national agricultural support.

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SPAIN'S ENTRY INTO THE EUROPEAN COMMUNITY: EFFECTS ON THE FEED GRAIN AND LIVESTOCK SECTORS, by E. Wesley F. Peterson, Albert Pelach Paniker, Harold M. Riley, and Vernon L. Sorenson. International Economics Division, Economic Research Service, U.S. Department of Agriculture. Foreign Agricultural Economic Report No. 180.

ABSTRACT

Spain's expected entry into the European Community (EC) in the mideighties would raise internal feed grain prices, slowing growth in livestock production and feed grain use over a 5- to 10-year transition period. Accession would not cause major changes in U.S. exports of corn, sorghum, or soybeans. Effects on Spain's import needs will be small, and increased imports elsewhere in the EC will probably offset any reduction in Spain's imports from the United States. Eventual surpluses of barley, milk, and pork are possible. Spain's accession would do little to alleviate the EC's current farm surplus and budget problems.

KEYWORDS: Spain, European Community, feed grains, livestock

ACKNOWLEDGMENTS

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Washington, D.C. 20250 April 1983

FOREWORD

The European Community (EC), the largest market for U.S. agricultural exports, is undergoing its second enlargement. This process began when Greece joined the EC on January 1, 1981; it is expected to extend to Spain and Portugal by the mideighties.

The second enlargement may be of greater significance than the first, which occurred in January 1973 when Denmark, Ireland, and the United Kingdom joined the original six members (Belgium, France, Italy, Luxembourg, the Netherlands, and West Germany), because it will considerably increase the EC's economic and agricultural diversity. The second enlargement will occur within the context of a serious dialog on modifying the Common Agricultural Policy (CAP), necessitated by an impending budget crisis. The expansion of surplus agricultural production in the EC has led to large expenditures under the CAP for surplus disposal. Expenditures are on the verge of exceeding revenues available to the EC through resources provided by the basic treaties. Some modifications of the CAP appear inevitable.

To assess the implications of EC enlargement and modification of the CAP on U.S. agriculture, the Economic Research Service (ERS) initiated a research program in late 1979. This program included cooperative efforts between researchers at USDA and those at various U.S. universities. Stanford University researchers developed a framework for analyzing probable developments in the CAP, published by ERS in 1982 as Foreign Agricultural Economic Report 172. Michigan State University researchers analyzed the grains, oilseeds, and livestock sectors of the prospective member countries. As Spain is the largest of these three countries, greater effort was devoted to understanding its changes; the results are presented in this report. At the University of California, Berkeley, researchers are studying the effects of EC enlargement on trade in fruits, vegetables, and nuts. ERS has nearly completed a study on the EC market for U.S. agricultural exports and is also pursuing research on other impacts of EC enlargement.

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CONTENTS

SUMMARY

With expected entry into the European Community (EC) in the mideighties, Spain will harmonize its agricultural policies with the EC's Common Agricultural Policy. Accession will affect prices, production, and consumption of Spanish livestock products and grains. However, it will probably not cause major changes in U.S. exports of corn, sorghum, and soybeans. Larger Spanish imports of French corn would increase corn imports by other EC members. Spanish soybean import demand would not be affected by accession, but would be sensitive to changes in EC vegetable oil prices.

The results of a national simulation model, farm-level enterprise budgets, and analyses by area experts suggest that Spain's anticipated accession to the EC will affect its feed grain and livestock economy in the following ways:

- Higher feed grain prices will retard the current upward trend in livestock production and feed grain use following Spain's accession to the EC, but higher prices will not greatly affect Spanish demand for soybeans and soybean meal.

- The rapid rates of growth in poultry and egg production over the past decade will be slowed by higher feed costs. Increases in domestic consumption may not be sufficient to absorb Spanish production, but our analysis shows that any exports are likely to be small. Several other studies project Spain's production and exports of poultry meat and eggs to increase substantially.

- Pork production will rise following accession, but higher consumer prices will dampen consumption increases. If African Swine Fever is eradicated in Spain, surplus pork products could move into the export market by 1990.

- Milk production will increase, but consumption will probably stagnate or even decrease under the EC's Common Agricultural Policy. Our analysis indicates that Spain will remain self-sufficient in milk production and may even develop surpluses if the dairy sector continues its current trend toward larger, more modern farms. However, Spain will likely have difficulty in competing with northern EC countries in the production of manufactured dairy products.

- Beef production will increase, but less rapidly than if Spain remains outside the EC. Consumption will rise slowly following accession, and deficits will likely grow whether or not Spain joins the EC.

- Specialized lamb production is likely to expand following accession, but traditional sheep and goat production is projected to decline.

- Barley production will be encouraged by accession, but domestic use will grow more slowly. Barley surpluses of 2-4 million metric tons could occur by 1990.

- Corn production is unlikely to expand in the next decade, but corn consumption will continue to grow. Spain will need substantial imports, but fewer than if it remains outside the EC.

- Wheat production will decline with EC entry, but consumption will also fall so that Spain will likely be self-sufficient in bread-type wheats. Only small quantities of wheat will be fed to livestock. Higher EC prices will increase durum wheat production somewhat.

These conclusions relate to internal adjustments of Spain's feed grain and livestock sectors. As for the EC, Spanish accession is not expected to alleviate either the current problems of surplus agricultural production or the EC's budget difficulties. Complementarities between current EC surpluses and deficits in feed grain and livestock products and between projected surpluses and deficits for Spain as a member of the EC appear limited.

Spanish accession to the EC may alter U.S. trade in feed grains and oilseeds in the following ways:

- Total feed grain consumption is projected to grow more slowly if Spain joins the EC. Therefore, U.S. exports of corn and sorghum may expand less rapidly if Spain is integrated into the EC than if Spain remains outside. Nevertheless, Spanish imports of these products will likely increase so that the major effect on U.S. corn and sorghum exporters will be to slow growth in the Spanish market rather than to reduce exports.

- French exports of corn to Spain may displace some U.S. exports because transportation costs are lower and because the variable levy on French exports will be eliminated when Spain is integrated into the EC. However, as France is the only EC member with a corn surplus, any displacement of U.S. corn exports by French exports will likely be offset by increased needs elsewhere in the EC.

- Spanish imports of soybeans will probably not be affected by accession. Future U.S. soybean exports to Europe depend more on EC vegetable oil policies than on adjustments in Spanish production and consumption resulting from accession.

- Spanish accession to the EC, in and of itself, will not cause major changes in U.S. exports of grains and oilseeds. Most likely, Spanish feed grain and livestock sectors will adjust gradually over a 5- to 10-year transition period.

Exchange Rates

100 French francs	=	U.S. $23.505
100 Italian lire	=	U.S. $0.12035
100 Spanish pesetas	=	U.S. $1.490
100 European Currency Units	=	U.S. $137.065

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Spain's Entry into the European Community

Effects on the Feed Grain and Livestock Sectors

E. Wesley F. Peterson, Albert Pelach Paniker, Harold M. Riley, Vernon L. Sorenson *

INTRODUCTION

This report assesses the nature of the likely adjustments in Spain's feed grain and livestock sectors following its accession to the European Community (EC) and analyzes the implications for trade, particularly between Spain and the United States.

To become a member of the EC, Spain must adopt the body of current EC legislation including the Common Agricultural Policy (CAP). Institution of the CAP in Spain will lead to a new set of relative prices and to changes in Spain's agricultural and trade policies. These changes will lead to adjustments in production and consumption within Spain, and thus, agricultural imports may be altered. Furthermore, eliminating trade barriers between Spain and the EC and harmonizing Spanish trade policies with those of the EC may change the direction of trade.

We have four specific objectives:

- o To describe the structure of the feed grain and livestock sectors in Spain and to synthesize information on organization, relevant policies, and trends in production, consumption, and trade;
- o To develop models and analytical tools to measure the response of producers and consumers to price and policy changes implied by accession to the EC;
- o To analyze the probable adjustments in the feed grain and livestock sectors in response to a new set of prices and policies, including projections of production, consumption, and trade to 1985 and 1990; and
- o To discuss the implications of these adjustments for U.S. feed grain and soybean exports to Spain and to the enlarged EC.

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*Peterson is on the staff of the École Superieure des Sciences Économiques et Commerciales, Cergy, France; Pelach Paniker is employed by the International Federation of Agricultural Producers, Paris, France; Riley and Sorenson are professors in the Department of Agricultural Economics at Michigan State University, East Lansing.

To accomplish these objectives, we have employed two analytical approaches. One approach involves developing a simulation model based on historical data designed to measure the aggregate response of producers and consumers to evolving prices and policies. We use this simulation model to project the levels of Spain's production and consumption and the implied degree of self-sufficiency for the relevant commodities to 1985 and 1990. The second approach uses farm budgets and an optimum feed-ration linear program to provide insights into the effects of imposing EC prices on costs and returns for a group of representative farms.

These two approaches are complementary; that is, they deal with the same feed grain and livestock industries. For both, production activities include beef, veal, milk, swine, poultry (meat and eggs), sheep and goats, wheat, barley, and corn. The aggregate model also includes production components for rye, oats, and sorghum as well as a food demand model. Soybeans and other feeds are also treated in the analysis. The two approaches lead to similar results.

The data used in the aggregate approach are taken primarily from published statistical series obtained through visits to Government offices in Spain. The information used to develop the farm-level models was collected in Spain from a wide variety of Government and private sources as well as from research institutions, producer associations, and other personal contacts.

This report is organized into four parts. First, we describe the characteristics of the Spanish feed grain and livestock economy and discuss the institutional and policy setting in Spain and the EC. Second, we describe the simulation model and present the results of the aggregate analysis. Third, we present the methodology and the results of the farm-level analysis. Fourth, we use the aggregate and farm-level analyses as well as assessments of the impact of accession drawn from other sources to develop a set of conclusions on the most likely impacts and their implications. The report also includes several appendixes for those interested in some of the more technical aspects of the study.

INSTITUTIONAL AND POLICY SETTINGS IN SPAIN AND THE EC

In 1977, following the election of the first democratic government since the Spanish Civil War, Spain officially requested admission to the EC. The Commission of the EC returned a favorable opinion on Spanish accession in 1978, but noted numerous prospective problems in Spain's integration into the EC. Although negotiations on accession were begun in early 1979, it is unlikely that accession will actually occur before 1984.

Since the inception of the EC, the issue of agricultural policy has been a difficult one. The attempt to harmonize diverse national policies has led to a complicated system which currently absorbs a disproportionate share of the EC's resources. Although agriculture in Spain is somewhat less developed than that in northern Europe, Spain is a major agricultural country with some sectors that will be particularly difficult to incorporate into the EC. Therefore, the accession negotiations related to agriculture are expected to be long and complicated.

This section describes the context within which these negotiations are taking place. After a brief overview of Spanish agriculture and the feed grain and livestock economy, we discuss in detail the characteristics and structure of each sector. The descriptions of the feed grain and livestock sectors will include comments on recent Spanish policy in these areas. We briefly review the CAP and highlight the policy changes required for Spain to join the EC.

Agriculture in Spain

The Spanish economy has grown rapidly since the early sixties. The agricultural sectors shared in this growth, although the level of development is still lower than in many other parts of Europe. In the seventies, economic growth slowed somewhat as Spain experienced high rates of inflation and unemployment common to most industrialized countries.

The impressive growth in Spain's agricultural output over the past 20 years is attributable to extensive technical innovation. Starting from a low level of development, Spain increased total agricultural production at an annual rate of almost 4 percent between 1960 and 1978, with livestock production increasing more rapidly than crops (*6*). 1/ Although feed grain production, particularly barley, has expanded, it has not kept up with the needs of the growing livestock sectors. In the late seventies, soybeans and soymeal made up 18 percent of total agricultural imports, while another 18 percent was accounted for by other feedstuffs (*22*). Despite the growth in the livestock sectors, Spain is not self-sufficient in all livestock products. However, Spain does produce surplus olive oil, fruits, and vegetables. In 1978, Spain's agricultural trade deficit was 430 billion pesetas (about $6.4 billion).

The climate and terrain are not particularly favorable to agriculture. Much of the land is semiarid or mountainous. Spanish agriculture suffers from structural problems; 60 percent of the farms in 1972 had less than 5 hectares. The farm population has been decreasing, and the age of those remaining in agriculture has increased. Thus, crop yields are generally somewhat lower than in the rest of Europe or in North America.

Average rainfall in most of Spain is less than 40 inches a year (*6*). Rainfall is somewhat heavier in the northwestern and northern parts of the Iberian Peninsula, whereas in the southeastern regions, average annual rainfall is less than 20 inches. In 1978, 13.3 percent of Spain's total agricultural land was under irrigation. Increased irrigation has played an important role in boosting crop production and in increasing the range of crops as well as their yields.

1/ Italicized numbers in parentheses refer to items in the references at the end of this report.

Agricultural production varies greatly from region to region. The proportion of agricultural land under irrigation varies from 30 percent in Levante to 1.6 percent in Norte (22). Cereals are produced in all regions, but the central regions of Ebro, Duero, and Centro account for 64 percent of total cereal acreage (see map). Corn and sorghum are grown primarily on irrigated land, whereas other cereals are produced primarily with dryland cultivation.

Intensive, extensive, and mixed livestock production systems are found throughout Spain. Extensive systems of sheep and cattle production, based on free grazing, are most common in the southwestern region. Intensive poultry and swine operations involving confinement and the use of feed concentrates are common in the northeastern area.

Farms tend to be larger in the dry areas than in Galicia and Norte, although small horticultural and intensive livestock farms are also common in Levante. Little rain falls during the summer months in Duero, Ebro, Centro, Extremadura, and Andalucia Occidental. In these regions, large farms that are devoted to cultivating cereals, olive trees, and vineyards or to extensive livestock raising on natural pasture are the most viable type. In the hilly and wet lands of Galicia and Norte, smaller farms provide adequate income for the farm household, although many people believe that an average farm size of less than 10 hectares is too small to be efficient.

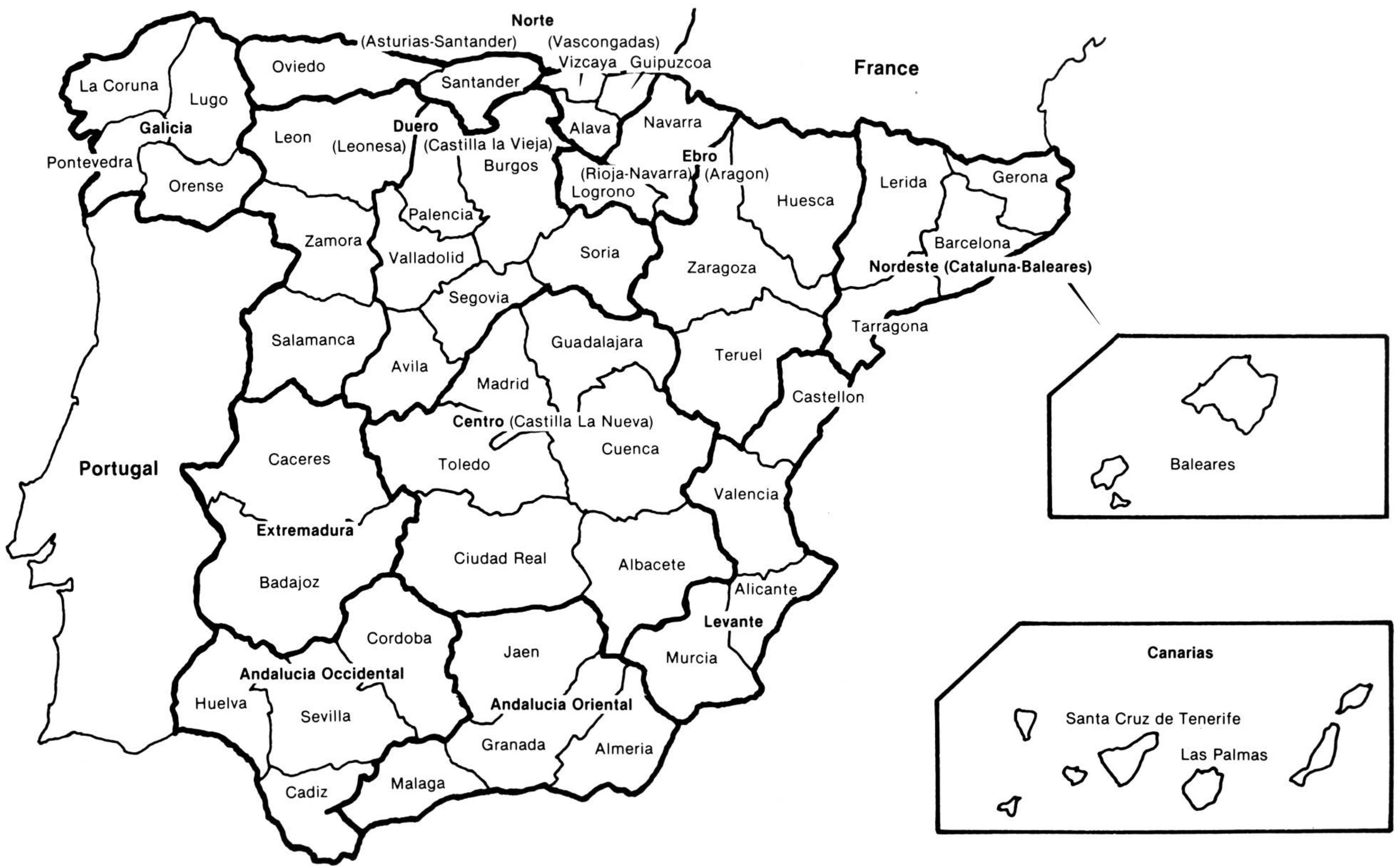
Dairy farming is an important activity in Galicia and Norte. These dairy farms are small and average only three or four cows. Beef production is the most important activity in the cereal-producing areas of extensive livestock farming. In 1973, 77 percent of the cattle farms in Spain had less than six cows (22). Sheep are raised primarily with extensive systems in Ebro, Duero, and Centro. The greatest proportion of broiler and egg production is carried out in intensive systems in the northeast. This region has many intensive swine operations and most of the feed-compounding operations.

Institutional and Policy Setting in Spain

Spanish agricultural policy has developed within the framework of overall economic policies. Prior to the early fifties, the Government used rationing and price controls to promote production of staples, such as wheat. It was at this time that the Servicio Nacional del Trigo (SNT), or National Wheat Board, was established. This National Wheat Board handled all aspects of the commercialization of the Spanish wheat crop. These functions continue to be performed by the SNT (later renamed the Servicio Nacional de Cereales (SNC), or National Grains Board, and finally the Servicio Nacional de Productos Agrarios (SENPA), or National Board for Agricultural Products. Early agricultural policies were oriented toward self-sufficiency in staples, such as wheat and olive oil, at the expense of export crops, such as citrus fruit (11).

Faced with inadequate food production and international isolation, the Franco regime eliminated the Republican agrarian

Map of Spain



Norte
(Asturias-Santander)
(Vascongadas)
Vizcaya
Guipuzcoa
France
La Coruna
Lugo
Oviedo
Santander
Galicia
Pontevedra
Orense
Leon
Duero
(Leonesa)
(Castilla la Vieja)
Burgos
Alava
Navarra
Ebro
(Rioja-Navarra)
(Aragon)
Logrono
Huesca
Lerida
Gerona
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Nordeste (Cataluna-Baleares)
Tarragona
Palencia
Zamora
Valladolid
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Zaragoza
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Canarias
Santa Cruz de Tenerife
Las Palmas

reform institutions in favor of national institutes directed toward colonization and land consolidation. Along with these efforts to open up new lands and achieve more efficient farm sizes, the Government began to promote irrigation as a means to increase production (27). The colonization and irrigation policies of the regime were relatively ineffective in the early years. Although the land consolidation policy led to some increase in farm size in the north, little redistribution of land took place, and large, latifundia-type units managed by absentee landlords still exist in the south (10).

The agricultural policies of the fifties and early sixties were actually detrimental to the production of staple crops. SNT set wheat prices too low, and production fell dramatically. With the opening up of the Spanish economy in the sixties, food imports began to increase. Although the goal of absolute self-sufficiency was abandoned, the regime was disturbed by the rise in imports. Therefore, wheat prices set by the SNT were allowed to rise so that production could be stabilized at a somewhat higher level (15). Simultaneously, growth of the Spanish economy led to increased demand for livestock products. Because the livestock sectors had not expanded under the earlier policies, imports of livestock products began to increase. In the late sixties, agricultural policy was reoriented to encourage feed grain production that would in turn support the expansion of the livestock sectors (6).

During the sixties, Spain embarked on a series of development plans modeled on the French system of indicative planning. In general, these plans were oriented more toward industrial development and placed less emphasis on agriculture. Agricultural policies were aimed at balancing production and consumption through price incentives, subsidies, and the continuation of land consolidation and irrigation programs. At this time, intervention prices for some grains and livestock products were initiated. A 1968 law created the Fondo de Ordenacion y Regulacion de los Precios y Productos Agrarios (FORPPA), or Agency for Marketing and Regulating Prices of Agricultural Products, to establish indicative or guaranteed prices for certain products, to regulate foreign trade, and to administer subsidies and other production aids (27). In the early seventies, the Instituto Nacional de Reforma y Desarrollo Agrarios (IRYDA), or National Institute for Restructuring and Rural Development, was established to coordinate the Government's irrigation, colonization, and land consolidation programs (27).

In 1977, the young democratic government adopted a series of accords known as the Pacts of Moncloa. These pacts established the framework for agricultural policy by suggesting measures to eliminate agricultural disequilibria through market regulation, price policies, and social reforms related to land rents, cooperatives, irrigation, crop insurance, and democratic farm organizations (27). The evolution of Spanish policy was dominated by a common theme--the need to increase domestic production and reduce dependence on foreign supplies. The effect of these policies was to change the nature of agricultural imports in a sequential manner. Favorable prices for wheat resulted in increased production, eliminating the need for imports and eventually creating surpluses. Imports of livestock products subsequently began to increase, and the Government responded by creating price incentives, premiums, subsidies, and other policies to encourage production. This policy shifted the need for imports from livestock products to feed grains and oilseeds. With mounting wheat surpluses and feed imports, Spain has shifted price policies to encourage feed grain production. In recent years, a desire to join the EC has led Spain to harmonize some of its market regulation and price mechanisms with those of the CAP. Its current system is based on many of the EC's own mechanisms.

Spain's Feed Grain and Livestock Economy

We have briefly reviewed Spanish agricultural policy; a variety of sources offer further details (1, 2, 6, 10, 19, 27). Now we describe the characteristics of the relevant feed grain and livestock sectors and the current policies toward these sectors.

Beef and Dairy Cattle

The cattle sector is the most heterogeneous livestock sector in Spain in terms of breeds, farm size, and production methods. Beef, veal, and milk production are joint activities because of the extensive use of dual-purpose breeds and the reliance on dairy calves and cull dairy cows as sources of meat. Over 40 percent of the cattle are Friesians, a breed that is extensively cross-bred with foreign and domestic strains.

Almost 40 percent of Spain's cattle herd is located in Galicia and in the provinces of Santander and Oviedo. This region produced 45 percent of all cow milk and 22 percent of all beef and veal in 1978; it also exports calves to other regions of Spain. Extremadura and Andalucia Occidental produce and export calves for fattening. The Basque provinces import significant numbers of cattle for slaughter as they are important consumption areas. Duero and Ebro are cattle-fattening regions, importing calves and exporting finished animals.

In the seventies, meat produced from fattened yearlings (anojos) became the most important source of beef. In 1979, 24 percent of all bovine meat was veal; 50 percent was beef from yearlings; and the rest was beef from cows and bulls. Most dairy cows are managed within a mixed system with periods of confinement and periods of free grazing on pasture.

Per capita beef and veal consumption increased from 7.7 kilograms (kg.) per year in 1965 to 12.7 kg. in 1978. This level is low compared with amounts consumed in other parts of Europe or in the United States. Per capita beef and veal consumption in 1978 was 56 kg. per year in the United States, 32 kg. in France, and 24 kg. in Italy (20). Annual milk and milk product consumption grew rapidly in Spain from 81 kg. per person in 1960 to 153 kg. in 1978. Current consumption levels are higher than in other Mediterranean countries, but lower than in most of northern Europe.

Government policy is aimed at stimulating meat production, using premiums and price incentives to encourage farmers to raise animals to heavier slaughter weights. Minimum slaughter weights for calves were established in the midsixties. These policies were largely a response to the rapid increase in imports of beef in the early sixties. Dairy policy has been oriented principally toward regulating the distribution and marketing of milk products and toward improving quality (2).

Government policy toward the beef sector is currently based on a set of institutional prices supported by intervention purchases and releases from stocks. Four prices, geared to a standard type of carcass, are established at the beginning of each marketing year:

1. Guaranteed price to the farmer;

2. Lower intervention price, representing the market price at which intervention purchases are initiated;

3. Indicative price, representing the desired market-price level; and

4. Upper intervention price, representing the market price at which meat is released from stocks or is imported.

The Government follows the evolution of actual market price by periodically calculating a reference price based on the prices received by farmers in various regions. Reserve levels for meat are also set each year; they help determine whether or not to import meat when the reference price is above the upper intervention price. The Government carries out foreign trade in beef, as well as other meats. It also sets maximum marketing margins, but they do not appear to be enforced (12). Other Government interventions in beef production include the promotion of farming practices which make greater use of pasture and forage crops and the provision of subsidized credit and technical assistance for pasture improvement. Until 1977, a premium was paid for yearling carcasses heavier than an established minimum; a minimum slaughter weight of 125 kg. is still set for calves.

The Government establishes a minimum price at which cow milk can be purchased from dairy farmers in January and July of each year. It also establishes target and upper intervention prices and a minimum retail price. The Government controls foreign trade in fresh milk. It also promotes producer associations, particularly at the processing stage, and it subsidizes structural improvements on family and cooperative dairy farms.

Swine

Most hogs in Spain are foreign breeds and crosses that are raised in intensive production systems. Indigenous breeds accounted for only 4 percent of hogs in 1978; they are often raised with traditional, extensive systems. Intensive, commercial hog farms produce about 80 percent of all pigmeat; 50 percent are raised under some form of contractual arrangement between producers and feed manufacturers (22). Most commercial hog farms specialize in either breeding or fattening, thus generating considerable movement of pigs, which are often fattened in one province and farrowed in another.

Fattening operations are generally located in the Nordeste and Levante regions near the greatest concentration of feed manufacturers. These regions produce 45 percent of the hogs slaughtered. Hog production has expanded greatly over the past 10 years in conjunction with rapid transition from traditional to modern production methods. This growth in production has been made possible by the introduction of smaller breeds with more rapid weight gain and improved management techniques and feeding practices.

Per capita pigmeat consumption increased from 9.1 kg. per year in 1965 to 22.7 kg. in 1978. This increase can be compared with 1978 per capita consumption levels of 27.9 kg. per year in the United States, 37.2 kg. in France, and 21.3 kg. in Italy. Several experts in Spanish agriculture expressed the belief that future increases in consumption were not feasible. Spain has traditionally been a net importer of small amounts of pigmeat, but has been close to self-sufficiency in recent years. The existence of African Swine Fever in Spain precludes the export of pigmeat to most of Europe, although small amounts are exported to Portugal and Andorra (2).

Guaranteed prices were first established for hogs in 1959. In 1970, upper and lower intervention prices were added to the guaranteed prices which were raised substantially throughout the seventies in an effort to encourage production. Currently, regulation of the pigmeat market is carried out in the same way as that for beef. Guaranteed, indicative, and upper and lower intervention prices are set each year and are maintained through intervention purchases, releases from stocks, and imports. Higher guaranteed prices are set for smaller carcasses with less fat.

Other related policies include a recent regulation prohibiting the establishment of new fattening operations and aimed at isolating African Swine Fever by promoting closed-cycle operations, thus reducing the interfarm movement of animals. The Government has set a high priority on the elimination of African Swine Fever; some progress has been made, although the disease still exists.

Sheep and Goats

Raising sheep for meat, milk, and wool is an important activity, although the number of animals has been declining for many years. Because the number of goats is relatively small and production methods are similar to those employed for sheep, we treat these two sectors together. Sheep and goat production has decreased because of a scarcity of shepherds, falling prices for wool, and competition from other livestock products. Sheep production is oriented more toward the market for meat than for wool, attributable partly to guaranteed prices and premiums for lamb production (27).

Traditional, extensive production methods are still common, although intensive production methods have increased. Because sheep milk is used in some of Spain's most popular cheeses, lambs are frequently weaned early to provide more milk for cheese (27). Then, ewes and lambs are generally fed concentrates for short periods, after which they are fed on pasture and forage. About 15 percent of the sheep are kept in permanent confinement and are fed with concentrates. Lamb is the most important output of this sector (85 percent of all sheep meat), although milk production and wool production are also significant.

The movement toward intensive production systems has shifted production from the traditional regions of Extremadura and Centro to the Duero and Ebro regions. The traditional Merino breed has declined in favor of other domestic and foreign breeds. Intensive production methods have been encouraged because of the difficulty of finding people willing to work as shepherds. Many shepherds who have remained now own their own flocks (22).

Spain is self-sufficient in sheep and goat meat. Per capita consumption has remained virtually the same at about 4 kg. per year over the past 20 years. This level is about the same as for the rest of Europe, but is much higher than for North America. Demand for lamb is highest during the Christmas period, whereas supply reaches a peak during the spring, leading to seasonal price variations.

Price policies are limited to a guaranteed price for lambs supported by intervention purchases. Premiums are also paid for heavier lambs, and the slaughter of lambs below a liveweight of 10 kg. is prohibited. The Government controls trade and is entitled to give export restitutions for the export of sheepmeat. It also sets maximum marketing margins, but as in the case of beef, these do not appear to be enforced (12).

Poultry Meat and Eggs

The poultry sector has experienced an extraordinarily rapid transformation. According to the Yearbook of Agricultural Statistics, some 10 million barnyard chickens were slaughtered for a total production of only 13,000 metric tons of meat in 1960 (17). By 1978, poultry meat production had reached 755,000 metric tons, of which 92 percent of the slaughtered birds were broilers raised in modern, intensive systems of production. Egg production has expanded rapidly, as the sector evolved from a traditional to a modern system relying on selected laying hens. Most broiler and layer breeds are of North American origin, and Spain imports numerous breeding hens from the United States.

Poultry products are produced on highly specialized farms that are frequently vertically linked to feed manufacturing firms. In 1978, there were 2 breeding farms, 278 farms producing eggs for hatching, 113 hatcheries, and an undetermined number of broiler, pullet-growing, and egg-producing farms (16). Most of these farms have no agricultural land base and purchase nearly all inputs, with over 90 percent of their total output made up of poultry products. These commercial enterprises are generally located near large urban centers which are also centers for compound feed manufacture. Many important feed companies control large flocks of broilers and layers through direct ownership or contractural arrangements. A relatively small number of large, automated operations account for most production. Layer operations average about 11,000 birds, while the average broiler flock is about 14,000 birds (14).

Per capita consumption of poultry meat has risen from an estimated 0.4 kg. per year in 1960 to 20.7 kg. in 1978, according to Spanish statistical sources (17). This tremendous expansion in consumption places Spain higher than any other European country and only slightly below the average for North America (20). Per capita egg consumption has fluctuated widely, reaching 17.0 kg. per year in 1976 and falling to 15.4 kg. in 1978. Among the Organization for Economic Cooperation and Development (OECD) member countries, only West Germany and the United States have consistently registered higher levels of egg consumption than has Spain (21).

Before 1971, there was little Government intervention in these industries. Then, a systematic, market regulation policy was established including intervention and indicative prices for producers and a protection price for consumers that was set at the maximum wholesale price allowed. The Government uses a reference price, computed as a weighted-average wholesale price from selected markets, to follow the market (2). If the reference price falls below the intervention price, FORPPA finances the storage of eggs and chickens and may provide export restitutions. If the reference price rises above the consumer protection price, eggs and poultry meat are released from storage or the Government may begin to import poultry products. Trade is a state monopoly.

Grains

Because most rainfall in Spain occurs during the winter months, the greatest proportion of cereal production comes from winter crops. These consist primarily of wheat and barley and, to a lesser extent, of rye and oats. Corn and sorghum, the major summer grains, are grown less extensively because most lands require irrigation. Spain also produces enough rice to meet consumer needs and has traditionally exported small quantities (27).

Although average yields have risen, they are still lower than in other EC countries. In 1977, the average wheat yield in Spain was 1.5 metric tons per hectare, compared with 2.3 metric tons in Italy and 4.2 metric tons in France (17). Barley and corn yields are somewhat closer to those for the rest of Europe. Yields from irrigated land are considerably higher than the national average, highlighting the importance of irrigation in increasing cereal output. Most wheat produced is bread-quality, soft wheat. Durum wheat made up only 3 percent of total wheat production in 1978. More than 75 percent of the corn produced is from hybrid seeds.

Consumption of bread cereals (wheat and rye) has declined over the past 20 years. Very little wheat is currently fed to livestock. Feed grain disappearance has risen substantially as the poultry and swine sectors have expanded. Production and disappearance imbalances appeared in the late sixties when Spain had to import large quantities of feed grains while it had bread cereal surpluses. The Government responded by adjusting relative prices to favor feed grain production (15). From 1975 to 1978, Spain was a net importer of wheat. Barley acreage has increased greatly, replacing wheat as the principal dryland cereal crop. Since 1975, imports of barley have not been needed to satisfy the growing livestock sector. However, the use of corn for feed has increased far more rapidly than production. Spain generally produces only about a third of the corn and sorghum used for feed.

Government intervention in the grain sector has been important since the establishment of the National Wheat Board in 1938. The objective of Spanish policy has been to influence the types of grain produced by manipulating prices. In response to wheat surpluses and feed grain deficits, Spain adjusted cereal prices to favor barley and corn over wheat. In addition to price policies, the Government also uses credit and subsidies to influence production and trade.

Farmers are required to declare the area planted, crop obtained, amount of grain used for seed, home consumption, and the amount available for sale for any cereal they grow. SENPA is the only buyer and seller of wheat and plays an important role in handling feed grains (22). At the beginning of each cropping year, the Government publishes the regulations for that year including institutional prices and complementary measures. Institutional cereal prices are the following:

- Guaranteed prices to producers for soft wheat, durum wheat, barley, oats, and rye with monthly increases to account for storage and financing;
- Guaranteed producer prices for corn and sorghum;
- Selling prices for wheat, barley, oats, and rye set at a fixed margin above producer prices with monthly increases and adjustments for quality;
- Selling prices for corn and sorghum in each province, set so that the monthly average will not deviate more than 2 percent from the threshold price; and
- Threshold prices for imported corn, sorghum, and barley adjusted monthly with increases from October to May; the threshold price for corn is normally set about 10 percent below the guaranteed producer price.

As noted earlier, the Government has manipulated cereal prices to encourage production of particular cereals over others, depending on the perceived needs of the country. From 1974 to

1979, the average soft wheat price was 35-45 percent higher than the barley price and the guaranteed corn price was 26-36 percent above the barley price. The selling and threshold prices for corn are below the price received by producers so that the Government subsidizes the use of domestic corn by feed manufacturers and livestock producers. A variable levy is applied to imported cereals to protect the internal price structure. This levy is similar to the variable levy employed in the EC.

The Government also provides subsidized credit for the purchase of seeds and fertilizer for dryland cereals and for the production of corn on small plots, and it finances a crop insurance program for cereals. The Government also provides the services normally carried out by middlemen, contracting with associated organizations for the purchase, assembly, and storage of cereals. Finally, the Government supplies credit and subsidies to encourage the construction of storage and corn and sorghum drying facilities (22).

Oilseeds

Soybean meal is used extensively in feed rations although soybean production is limited. Thus, large quantities of soybeans must be imported. Most of the meal used comes from imported beans processed by numerous domestic crushing facilities. Of course, this crushing also produces soybean oil which could compete with olive oil and domestically produced sunflower oil. Therefore, the Government has put a quota of 90,000 metric tons on the amount of soybean oil sold in Spain, and the excess oil is exported. Spain is the largest exporter of soybean oil in Western Europe.

Imports of Corn and Soybeans

Corn and soybean imports have grown substantially with the rapid increases in livestock production, especially poultry and swine. Annual corn imports increased from 2 million metric tons (mmt) in 1970 to nearly 4.5 mmt in 1979. The United States provided about 75 percent of these imports until the late seventies, when rising imports from Argentina reduced the U.S. market share to 65 percent. Soybean imports nearly doubled from 1970 to 1979, when 2.3 mmt were purchased. Again, the United States was the principal soybean supplier, providing 72 percent of total imports.

The magnitude of corn and soybean imports is an important policy issue because these imports represent a heavy drain on Spain's available foreign exchange. The diversion of variable levies collected on imports by the Spanish Government to the EC's agricultural program budget, when Spain joins the EC, may eventually add to the drain on Spain's foreign exchange.

Each crop year the Government fixes a guaranteed price for soybeans, sunflower, safflower, and rapeseed; these prices are above corresponding international price levels. Variable levies are applied to imports of soybeans and other oilseeds. Finally, the Government regulates retail prices and marketing margins for oilseed oils.

Institutional and Policy Setting in the EC

In joining the EC, Spain will be required to adopt the CAP, although allowance will be made for gradual implementation of EC policies during the transition period. The details of this transition, including temporary dispensations from some of the policies, are now in negotiation. The CAP, of course, changes as new members are integrated into the EC, but the principle of accepting the totality of EC legislation means that these changes are not necessarily made in response to the particular needs of applicant countries. Although the Spanish Government has begun to harmonize agricultural policy with the CAP, further changes will be required following accession. To assess these changes, we will review selected elements of the CAP.

Under the CAP, by far the greatest emphasis is placed on managing agricultural markets through price and commercial policies. To accomplish this objective, the EC uses a wide variety of institutional prices and trade barriers. The target price set for cereals and liquid milk is intended to represent the internal wholesale price expected under normal market conditions. The guide price for cattle and the basic price for pigmeat represent essentially the same concept as the target price. These prices are not guaranteed prices, but are important because support prices and external protection levels are derived from them (10).

The intervention price established for the main cereals, milk products, beef, and pigmeat constitutes a minimum guaranteed price which is supported by intervention purchases. It is set somewhat below the target, guide, or basic prices and serves to support producer prices and to manage the internal market (19). No guaranteed prices are established for poultry meat, eggs, sheep meat, or goat meat. Poultry meat and eggs are protected by a minimum import price, called the "sluice-gate price." A CAP has been developed for sheep meat.

EC measures to protect the internal market from foreign competition include the threshold price, which insures that the target price is not undercut by imports from non-EC countries. Threshold prices are set for the main cereals and milk products. The EC applies the variable levy to imports of these commodities to raise the world price to the level of the threshold price. A supplementary levy can be applied to imports of commodities such as pigmeat, poultry meat, and eggs for which minimum import prices are set. Variable levies and customs duties are also applied to beef meat imports. Finally, the EC provides export refunds or restitutions to exporters of cereals, beef, pigmeat, poultry meat, eggs, and milk products to make up the difference between higher EC prices and prices obtained on world markets (10).

Decisions on price support levels are based on the notion that prices should be set so as to allow modern, efficient farms to remain in that status. To accomplish this, the EC examines the cost structure of a set of representative farms, which it uses to determine the price levels required to maintain incomes (10). Because the determination of the actual support prices is carried out in a political context, prices tend to be higher than they would be if the criterion that incomes on efficient farms should be maintained was strictly applied. In recent years, this tendency toward higher prices has been countered in part by the growing problem of surplus disposal and the budgetary pressures resulting from substantial intervention purchases (13).

The potential for manipulating the common price set in European Currency Units (ECU) as it is translated into national currencies has compromised the goal of common agricultural prices. The 1968 devaluation of the French franc and the subsequent revaluation of the German mark would have in effect raised support prices in France and lowered them in Germany. To avoid this situation, the EC allowed France and Germany to translate the common support prices set in units of account into domestic prices at pre-1968 exchange rates. This event marked the beginning of a multiple exchange rate system with special exchange rates, known as "green rates," applied to agriculture (25).

The effect of the green rates is to create a differential between support prices in the member countries. To avoid the disruption of trade flows that the price differentials might cause, the EC introduced border taxes and subsidies known as monetary compensatory amounts (MCAs). The MCAs offset the differences in prices caused by changes in exchange rates (25). The original purpose of the MCAs was to protect the intervention system as the currency received for selling products into intervention in another member country could have been converted back to the local currency at the market exchange rate rather than at the green rate. The potential for profit in operations of this nature would have acted as an incentive for traders to use the intervention system for purposes other than those for which it had been created (10).

The abandonment of the Bretton-Woods monetary system in the early seventies marked the beginning of a series of EC experiments with floating exchange rates. By 1973, six of the nine EC countries were participating in a joint float. The unit of account used to establish market exchange rates for individual currencies was based on those that were floating jointly and this unit, therefore, moved in harmony with the individual currencies. The EC determined the MCA's by applying the percentage difference between the green rates and the market exchange rates to the intervention price for the commodity. Subsequently, they used a unit of account for agricultural commodities based on the strong joint float currencies to set common prices. As the agricultural unit of account (AUA) rose faster than the European unit of account, common prices were pulled up, leading to more negative than positive MCAs. In 1978, eight of the nine member countries formed the European Monetary System (EMS), which introduced fixed margins of fluctuation around a central rate defined by the ECU based on a basket of all participating currencies (10). Common prices set in ECUs had to be established at levels equivalent to those expressed in AUAs, which had a higher market value than the ECUs.

As an example of how this complex system works, suppose that the central rate for the German mark is 2.52 marks per ECU, whereas an ECU is worth 5.85 French francs. Because the mark is an appreciating currency, the green rate would be higher than the market rate. The franc is a depreciating currency so the green franc would be lower. Suppose that the green rates for France and Germany are 2.75 and 5.75 per ECU, respectively. One would calculate the MCA proportions by dividing the central rate by the green rate and subtracting the result from 1. This leads to a positive MCA rate for Germany of 0.0836 and a negative rate for France of -0.0174. An intervention price for wheat of 200 ECUs per metric ton translates into 1,150 French francs and 550 German marks if the green rates are used. Without MCAs, a speculator could purchase 1,150 French francs at the market rate of 197 ECUs, buy a ton of wheat in France, sell it into intervention in Germany for 550 German marks, and exchange the marks for 218 ECUs. Of course, the ECU is not a true currency, but it is easier to conceive of these transactions in terms of the accounting unit. To avoid speculation of this nature, French exporters are charged 20 French francs at the border (1,150 times 0.0174 = 20) to raise the price to 1,170 francs, which equals 200 ECUs at the market exchange rate. German importers receive a subsidy of 46 marks (550 times 0.0836 = 46) to raise the price from 504 German marks (= 200 ECUs at the market rate) at the border to 550 marks for sale in Germany.

The green rates and MCAs were initially intended to be temporary. However, monetary uncertainties and the addition of three new members in 1973 led to greater refinements of the system. The agri-monetary system is now institutionalized, and member nations have discovered that it can be used to achieve national policy objectives. As eliminating these arrangements would be disruptive, they may have become permanent fixtures of EC agricultural policy. Thus, the original goal for common agricultural prices has not been achieved. To some extent, member nations are able to manipulate green rates and MCAs to sustain domestic support-price levels for agricultural products. Ritson and Tangermann argue that the agri-monetary system of the EC effectively changes the CAP into a set of independent national trade policies (24). MCAs are also applied to trade with non-EC countries.

Expected Policy Changes in Spain

A comparison of Spanish and EC policies indicates how Spanish policy will change as Spain enters the EC. Because the mechanisms of Spain's market and price policies are already similar to those of the EC's, including variable levies and the equivalent of target and intervention prices, adoption of the CAP will affect intervention levels and commodities covered rather than introduce new and unfamiliar management methods. Spanish intervention prices for poultry meat and eggs may need to be eliminated. The new sheep meat policy of the EC allows member nations to establish their own policy prices; thus, Spain's current system may be left intact. However, other commodities dealt with in this study will be subject to EC policies.

Immediate application of the CAP in the absence of monetary manipulations would significantly change price-support levels. Because a transition period is envisaged and exchange rates may be manipulated, the simple peseta equivalent of current EC institutional prices will not be imposed. It is more likely that the structure of relative prices in Spain will move gradually into the EC's relative price structure.

In addition, accession will lead to the elimination of most agricultural subsidies. Input subsidies are not permitted under the CAP, although direct production aids are allowed for a small number of products (10). Spanish policy has relied heavily on credit and other input subsidies to maintain farm incomes without raising consumer prices. The quota on soybean oil consumption may also have to be modified.

As part of the EC customs union, trade barriers between Spain and the EC will be eliminated and protection levels for third countries will be harmonized with those of the EC. These changes should shift some trade patterns and lower levels of protection for specific sectors. The fixed levy applied to Spain's soybean imports will be eliminated. The current Spanish system of state trading for livestock products and cereal will be changed with entry. Accession will not significantly alter Spanish levels of protection with respect to third countries.

Those Spanish institutions which administer price and market policies (FORPPA, SENPA, and CAT) will have to be restructured and coordinated with the European Agricultural Guidance and Guarantee Fund (EAGGF), the agency charged with administering the CAP's price and marketing components. The most dramatic institutional change will affect SENPA's role in cereal marketing. SENPA's monopoly in wheat marketing will be eliminated, and the handling of other cereals will significantly change. Rather than dealing with a single Government agency, producers and users will have to develop a network of marketing channels. When Spain joins the EC, the latter's more highly developed policy on the improvement of marketing structure (5) may accelerate developments in Spain.

These institutional changes may affect Spain's production, consumption, and trade as much as the shift to EC relative prices. However, we will study only the effect of relative price changes because responses to institutional modifications are far more difficult to assess.

IMPACT OF SPAIN'S ACCESSION TO THE EC: AGGREGATE APPROACH

We will now use a simulation model designed to measure the aggregate response of producers and consumers to changing prices and policies to analyze the effects of Spain's accession to the EC. The model was developed as part of a Ph.D. dissertation at Michigan State University (23). We briefly describe the model, explain how the model is used in the analysis, describe the major results and projections to 1990, and discuss the principal conclusions.

Description of the Simulation Model

The simulation model is structured like a balance sheet. Separate production components determine the production of grains, bovine meat and milk, pigmeat, sheep and goat meat and milk, and poultry meat and eggs. Where necessary, we adjust the production estimates from these five recursive components for stock changes to determine domestic availability of each product.

Domestic disappearance is made up of human consumption, livestock consumption, and other uses such as seed or industrial processing. Estimates of human consumption are computed in the human demand component of the model. This component is a Rotterdam system of demand equations (29). Feed grain consumption is estimated in a derived demand component based on feed conversion ratios and estimated equations linking feed use to livestock numbers. Seed and other uses are calculated from historically constant proportions.

Comparing domestic availability with domestic disappearance gives an estimate of surpluses and deficits in Spain. It is assumed that these surpluses and deficits are balanced through trade. The model does not contain a trade component based on international prices and import demand or export supply equations. Nevertheless, the imbalance in domestic supply and demand for the various commodities reflects Spain's net trade position in comparison with the rest of the world.

The complete model contains 150 equations. About 60 of these equations are identities or accounting equations, whereas the rest were estimated by various econometric methods. The estimated relationships involve about 90 exogenous variables. Appendix A includes a complete list of the model equations as well as the endogenous and exogenous variables.

The data used to estimate the model were collected from diverse sources. Most production data are from publications of Spain's Ministry of Agriculture. Consumption data were taken from publications of Spain's national statistical institute (INE) and of the Organization for Economic Cooperation and Development (OECD). Other sources include data tapes compiled by USDA and various Spanish research publications. The base period used in the time-series estimates is 1960-78, although some of the essential statistical series are only available for shorter periods. The data are generally less reliable than desirable. Furthermore, statistics on many useful variables could not be obtained--for example, some biological rates, Government and private stocks, retail food prices, and inputs. We derived some data used in estimation from available statistical series using reasonable assumptions concerning biological or technical relationships.

The lack of reliable data for some series and the rapid growth of Spain's feed grain and livestock sectors frequently led to difficulties in developing sound statistical estimates of producer and consumer responses. Sometimes, we thought it preferable to replace estimated equations with assumptions about the evolution of the variables. Other equations were constrained in the projections to avoid unreasonable predictions. On the whole, the model performed effectively in simulating the base period and we used it to project production and consumption to 1990. However, because of gaps in the data and the generally low quality of much of the available data, plus the inherent problems in developing and refining large-scale computer models, one should not view the forecasts obtained as conclusive. Rather, they should be considered results obtained through a particular methodology that suggest possible directions of change; in some cases, we indicate the need for further research to gain insights or knowledge extending beyond macro-level analysis. Effective forecasting is an ongoing process that requires the development of expertise, the organized assessment of large quantities of aggregate data, and the continuous incorporation of new information. The modeling results presented here contribute to this process, but they should not be viewed as final results that will necessarily withstand the test of time.

A brief description of the structure of the most important components of the model follows.

Production Components

The five major production components of the model are grains; beef, veal, and cow milk; pigmeat; sheep and goats; and poultry meat and eggs.

Grains. Production of wheat, rye, barley, oats, corn, and sorghum is determined in the model by estimated equations for acreage and yields. Separate acreage and yield equations for irrigated and dryland cultivation were estimated for wheat, barley, and corn. Total acreage and yield equations are used for the other grains. Separating irrigated and dryland acreage for the major grains gives us more information on production changes and provides a mechanism for introducing alternative assumptions about the competition for irrigated land among cereals, forage, and other crops.

The yield equations are time trends. The principal explanatory variables in the acreage equations are the average prices received by farmers deflated by the Consumer Price Index (CPI). The wheat and barley equations contain both wheat and barley prices as these two crops readily substitute for one another and their relative prices are manipulated by Government policy to encourage or discourage production depending on the country's needs. In the other acreage variables, we used the real price of diesel fuel and the real index of agricultural wages, along with the prices received, to represent costs. We also used the real price of sugar beets in the irrigated corn acreage equation because sugar beets are an important competitor for irrigated land in Spain. Table 1 contains the elasticities of acreage response derived from the estimated equations.

Multiplying the estimates of acreage and yields from the equations gives an estimate of production of the various grains. The model also includes a set of equations that helps to account for land use in Spain. The land accounting component keeps track of the amounts of land used for cereals, forage, and other crops and of the allocation of irrigated acreage to these categories. It provides a means to evaluate acreage projections and to introduce constraints if cereal acreage predicted by the estimated equations seems questionable.

Beef, Veal, and Cow Milk. The cattle model includes six estimated equations and several identities derived from biological relationships such as calving rates. Meat and milk production are treated as joint activities, depending on the number of cows.

Two equations estimate the size of the breeding herd and the number of cows. Both equations are estimated as functions of gross receipts for milk, gross receipts for cull beef, and a real index of prices paid by farmers. We derive the number of calves slaughtered by relating calving rates to the number of cows and by adjusting for replacement and expansion. The calves available in a given year can either be slaughtered for

Table 1--Elasticities of acreage responses, Spain 1/

Crop	Wheat price	Barley price	Corn price	Sugar-beet price	Rye price	Oat price
Wheat:						
Irrigated	1.52	-0.33				
Dryland	.53	-.40				
Total	.59	-.39				
Barley:						
Irrigated	-1.19	.18				
Dryland	-.78	.22				
Total	-.81	.21				
Corn:						
Irrigated			1.12	-1.41		
Dryland			.15			
Total			.64			
Rye					0.53	
Oats						0.16

Blanks indicate not applicable.

1/ Elasticities of total acreage response for wheat, barley, and corn are calculated as weighted averages of the irrigated/dryland responses. Prices are deflated by the Consumer Price Index.

veal in that year or held for slaughter as steers and heifers in subsequent years. The third estimated equation in the model allocates the calves available for slaughter as veal or, in later years, as beef. The equation estimates the proportion of total calves actually slaughtered as calves as a function of real veal prices, beef prices, and calf feed costs.

Multiplying the proportion slaughtered as calves by the number of calves available gives the number of calves slaughtered for veal. The rest are assumed to be held for slaughter as mature animals. Predictions of dressed slaughter weight are taken from time-trend equations and are used to estimate beef and veal production. One can determine milk production by multiplying average milk yields, estimated by a time-trend equation, by the number of cows milked. The number of cows milked has been a relatively constant proportion of the number of cows on farms in Spain. Thus, one can derive calving rates, replacement rates, and other biological relationships from various statistical series using reasonable assumptions.

Pigmeat. The first equation in the pigmeat model estimates the number of sows as a function of real prices received for slaughter hogs, a cereal price index, and a cost index. Multiplying the number of sows by the estimated average number of surviving pigs per sow gives an estimate of the pig crop. Subtracting the number of pigs held for replacement from the pig crop leaves the number of pigs slaughtered. About 2 percent of this number are slaughtered as suckling pigs, and the rest are raised to maturity in about 200 days. We assumed that pigs born in a given year are slaughtered in that year as no information on the size of the two annual pig crops was available.

We determined pork production by multiplying the dressed slaughter weight by the number of hogs slaughtered. For many farmers, the live slaughter weight is an economic decision, depending on relative prices. We estimated an equation to predict live slaughter weight as a function of a time trend and the ratio of hog to corn prices. The dressed slaughter weight is derived from the live weight and is used to estimate meat production. Although the cattle and hog models are not designed to fully capture the cyclical nature of livestock production, they include those variables which influence individual decisions and lead to cycles. Both models appear reliable as evidenced by the results of using them to simulate the historical period.

Sheep and Goats. The sheep and goat component of the model is relatively simple, involving six estimated equations and two identities. This model differs from the cattle and hog models in that it does not replace estimated relationships with biological rates. Because this sector affects the issues considered in our study less than other sectors do and because biological data are scarce, we decided that the simpler approach was preferable. The disadvantage is that the separate equations are not so tightly linked and inconsistencies can arise in the projections of the dependent variables.

The basic equation in the model relates the number of female sheep and goats to real prices received for adult and immature animals in the previous year as well as to a real index of wages paid to shepherds. The number of female sheep and goats is used as an explanatory variable in equations for lamb and kid slaughter, sheep and goat slaughter, and sheep and goat milk production. Time-trend equations are used to predict dressed slaughter weights. Meat production is determined as the product of slaughter numbers and dressed slaughter weight.

Poultry Meat and Eggs. The poultry sectors proved extremely difficult to model. Production in recent years had expanded greatly in the face of declining real returns. Real prices received have actually fallen more rapidly than real feed prices so that regressions based on these variables consistently resulted in positive coefficients for feed costs and negative coefficients for prices received. Many alternative functional forms were estimated, but none led to acceptable results.

The solution adopted is based on concepts drawn from the theory of the firm. Because the poultry sectors in Spain are relatively new, it is reasonable to assume that they are still moving toward an equilibrium. In a perfectly competitive economy with perfect factor mobility, longrun equilibrium implies that economic profits will be equalized across all industries at zero. Until this equilibrium is reached, an industry characterized by positive economic profits will continue to expand even if these profits are declining. Assuming that a form of workable competition prevails in the relevant industries, it is hypothesized that the poultry industries will continue to expand as long as returns are higher than alternative investment possibilities. Because much of the expansion in both the poultry and swine industries is based on investments by feed compounders in vertically integrated systems, investment in hog production was taken as the alternative to further investment in poultry enterprises. Returns for poultry production are higher than for hog production, although they are declining much more rapidly. Thus, the model is based on the assumption that poultry meat and egg production will continue to expand until profitability in these sectors is the same as that in the swine industry.

The number of broilers slaughtered is estimated by a time trend through 1978. Beginning in 1979, a measure of returns relative to that in swine production is calculated each year, and, depending on this measure, broiler slaughter is projected to continue expanding or to level off. The number of broilers slaughtered is multiplied by the dressed slaughter weight to predict meat production. Egg production is handled similarly, with the number of layers determined mainly by a time trend until 1979, after which a separate relative return measure is calculated and used to determine whether the number of layers will continue to expand. The number of eggs per hen per year is multiplied by estimated layer numbers to determine production. The relative return measures are based on gross margins per unit of product. Expansion is assumed to continue so long as the gross margins for the poultry industries are greater than the gross margin for swine.

Food Demand

Food demand is estimated with a Rotterdam system of demand equations. A good description of this kind of system can be found in Theil (29). The model includes nine demand equations for beef and veal, all milk (cow, sheep, and goat), pigmeat, sheep and goat meat, poultry meat, eggs, bread cereals, other food, and nonfood items. The complete system is structured so that per capita expenditure on these nine categories is equal to total per capita expenditure as reflected in national accounts data. The explanatory variables in these equations are logarithms of first differences of prices and real income. The dependent variables are weighted logarithms of first differences in quantities consumed.

Although the demand component is theoretically sound, it is not so reliable as other components in the model, largely because of lack of data on retail prices, structural changes in food marketing, and shifts in consumption patterns not fully explained by the income and price variables. The equations for bread cereals, poultry meat, and eggs had to be constrained in the projections to avoid unreasonable consumption estimates.

The coefficients from the model can be used to estimate price elasticities of demand. Table 2 presents these price elasticities, along with the estimated income elasticity.

Derived Demand for Feed Grains and Soybean Meal

One can determine feed grain use by applying the relevant conversion ratios to the amount of each type of livestock product produced. Three estimated equations are then used to predict the amounts of bread cereals, barley and oats, and corn and sorghum fed. These equations have total feed grain demand and feed grain prices as explanatory variables. The sum of the predicted amounts of grain fed is constrained to equal total feed grain demand estimated with the conversion rates.

One can determine soybean meal use by multiplying the appropriate conversion ratios by the various categories of meat, milk, and egg production. An estimated equation is also included in this component to account for the relatively small amounts of milk fed to calves, lambs, and kids.

The feed conversion ratios used in the model were taken from USDA publications or were estimated from Spanish statistical documents. The conversion ratios used in the historical simulations are changed in the projections for Spain as a member of the EC to reflect expected changes in feed rations. Table 3 presents the feed concentrate use coefficients used in the model.

In addition, the model contains numerous accounting equations which aggregate the products into the appropriate categories to determine domestic availability and disappearance. The difference between availability and disappearance represents an estimate of the surpluses and deficits, which are assumed to be eliminated through trade.

Use of the Model to Simulate Spain's Accession to the EC

The simulation model is used to project production, consumption, and potential net trade under two scenarios. The first scenario is designed to show the expected evolution of production and utilization if Spain does not join the EC, assuming that historical relationships continue into the future. The outcomes forecast in this baseline scenario would occur only if Spain does not join the EC and if historical policies and trends prevail. We include this scenario so that readers can compare the results with those in the other scenario. The second scenario is based on the expected evolution in Spain following accession to the EC.

The comparisons that follow fall between a trends projection and the results obtained from an aggregate econometric model that reflects differences in prices and from other variables following Spain's accession to the EC. By comparing the two sets of projections, one can gain insights into the direction

Table 2--Price and income elasticities of demand, Spain 1/

Item	Uncompensated price elasticities: Beef and veal	Milk	Pork	Poultry meat	Sheep and goat meat
Beef and veal	-0.825	0.392	-0.211	-0.258	0.153
Milk	-.047	.026	.343	.179	.416
Pork	-.495	.149	.321	.290	.352
Poultry meat	.176	-1.792	.733	.267	-.073
Sheep and goat meat	.189	.298	.086	.024	-3.530
Eggs	-1.098	-.053	.215	-.574	-.455
Bread cereals	.317	-.016	.376	.416	.067
Other food	-.157	-.141	.022	.005	-.019
Nonfood	.084	.010	-.030	-.011	-.053

Item	Uncompensated price elasticities: Eggs	Bread cereals	Other food	Nonfood	Income elasticities
Beef and veal	-0.103	-0.004	0.324	0.529	0.005
Milk	-.044	-.350	-.288	.242	.644
Pork	-.099	-.480	-.128	1.208	.104
Poultry meat	-.155	1.176	-.619	-1.947	4.203
Sheep and goat meat	.036	-.343	-.067	.252	-.114
Eggs	-.052	.976	.136	-.572	1.326
Bread cereals	-.071	-.516	-.289	-.095	-.158
Other food	.109	.123	-.605	-.019	.686
Nonfood	-.034	-.062	-.098	-1.036	1.271

1/ Computed at average weight and prices.

ERRATA

Spain's Entry Into the European Community--Effects on the Feed Grain and Livestock Sectors
FAER 180. April 1983. Economic Research Service, USDA.

Insert the following Table 2 in place of the published Table 2 on page 24.

Table 2--Price and income elasticities of demand, Spain 1/

Item	Uncompensated price elasticities: Beef and veal	Milk	Pork	Poultry meat	Sheep and goat meat
Beef and veal	-0.825	0.392	-0.211	-0.258	0.153
Milk	-.047	-.026	-.343	.179	.416
Pork	-.495	.149	-.321	-.290	.352
Poultry meat	.176	-1.792	-.733	-.267	-.073
Sheep and goat meat	.189	.298	.086	.024	-.353
Eggs	-1.098	-.053	.215	-.574	-.455
Bread cereals	.317	-.016	.376	.416	.067
Other food	-.159	-.141	.022	.005	-.019
Nonfood	.084	.010	-.030	-.011	-.053

Item	Uncompensated price elasticities: Eggs	Bread cereals	Other food	Nonfood	Income elasticities
Beef and veal	-0.103	-0.004	0.324	0.529	0.005
Milk	.044	-.350	-.350	-.242	.644
Pork	-.099	-.480	-.128	1.208	.104
Poultry meat	-.155	1.176	-.619	-1.949	4.203
Sheep and goat meat	.036	-.343	-.067	.252	-.114
Eggs	-.052	.976	.136	-.572	1.326
Bread cereals	-.071	-.516	-.289	-.095	-.158
Other food	.109	.123	-.605	-.019	.686
Nonfood	-.034	-.062	-.098	-1.036	1.271

1/ Computed at average weights and prices.

and magnitude of the most important changes that could result from entry. The differences between the two scenarios are more meaningful than the absolute levels of the projections for either scenario.

Simulation of the baseline and the EC scenarios requires that the exogenous variables be projected to 1990. The exogenous variables fall into one of three categories: (1) those projected according to different scenarios, (2) those for which the same trend projections are used in both scenarios, and (3) those which are left at the 1978 (base year) level in both projections. The most important scenario variables are prices for inputs and outputs and retail food prices. The major impact of adopting the CAP is assumed to derive from the change in price policies as reflected in the evolution of price and cost variables.

For the baseline scenario, prices and costs are projected as linear trends. The price and cost variables used in the EC scenario are derived from projections of EC policy prices contained in a study by Josling and Pearson (13). Josling and Pearson projected EC target prices, inflation rates, and exchange rates to 1990. They used three EC pricing rules in determining the target prices leading to three sets of projections. The EC scenario draws on two of these sets of target price projections. The set reflecting the lowest price

Table 3--Feed grains and soybean meal use coefficients, Spain

Product	Feed grains		Soybean meal	
	1975 estimate 1/	EC estimate 2/	1978 estimate 1/	EC estimate 2/
	Kilograms 3/			
Beef and veal	3.7	0.60	0.384	0.090
Pigmeat	4.0	3.05	1.09	.820
Poultry meat	3.5	2.06	1.01	1.144
Cow milk	.3	.182	.015	.036
Eggs	3.5	2.28	.455	.540
Sheep and goat meat	--	--	.685	.685

-- = Nil or negligible.

1/ Used for historical simulations and projections for the baseline scenario.
2/ Average EC ratios for 1977-79 used in projections for Spain as a member of the EC.
3/ Kilograms of feed concentrates used per kilogram of product.

increases was used for beef, milk, and grain target prices, whereas the set showing moderate price increases was retained for pigmeat.

This combination of projected EC policy prices is based on assumptions concerning the future evolution of the CAP. In the past, price increases were similar to those in the set of projections showing moderate increases. These prices resulted in surpluses and pressures on the EC budget resulting from large intervention purchases. Because past practices will probably not be maintained in light of the budgetary problems, Josling and Pearson use the price projections showing the lowest increases for most commodities.

The target prices projected by Josling and Pearson are expressed in ECU's per ton. To convert these prices into real pesetas, one should use the projected exchange, green, and inflation rates. The target prices are for aggregate categories (for example, cereals) and have to be broken down into the appropriate farm-level prices (for example, wheat). This conversion is accomplished through assumptions about the relationship of particular farm-level prices to target prices. The EC does not set target prices for poultry meat, eggs, and sheep and goat meat. The farm-level prices for these commodities are projected to move toward the average prices in France and Italy in the EC scenario.

The farm-level prices used in the EC simulation are imposed gradually. In 1980, the prices received by farmers are the same in the baseline and the EC scenarios. These prices are made to move gradually to the projected EC levels throughout the eighties. In 1990, the prices in the EC scenarios are the peseta equivalents of the projected EC prices. Feed prices are derived from projected cereal prices. We determine retail prices by aggregating the appropriate farm-level prices and by adding an estimated marketing margin.

In summary, the baseline scenario consists of linear trend projections of price and cost variables. It carries historical relations into the future and provides a comparison with the EC scenario. The EC scenario is designed to reflect the likely evolution of prices and costs as Spain adopts the CAP following its accession to the EC. The price variables used in this scenario were derived from independent projections of EC target prices by Josling and Pearson and from average French and Italian levels when no target prices were available. We used various methods to ensure that the prices introduced for this scenario correspond to the Spanish prices used in estimating the model. The EC price levels are imposed gradually to reflect the expected period of transition in Spain. To complete the EC scenario, we changed the feed conversion ratios in the derived demand component from the estimated values for Spain in the late seventies to estimates of average EC ratios.

In designing the scenarios, we made many decisions concerning future development in Spain. Different assumptions would lead to different results. For example, grain yields are allowed to increase along a linear trend. The yields predicted by these trend equations appear reasonable when compared with present yields in other parts of Europe. However, alternative assumptions concerning the growth in Spanish yields could have been used. Note that the results in the next section are consistent with the specific set of assumptions and projections of exogenous variables used in the two scenarios. Further details on these scenarios appear in the dissertation by Peterson (23).

Projections to 1985 and 1990

Tables 4-10 present projections to 1990 for the two scenarios. Table 10 contains availability, disappearance, and net trade projections from both scenarios and is included to facilitate comparison. The data in the tables have been rounded, and the totals often include adjustments for variables not shown in the tables. These adjustments are explained in the table footnotes; any other discrepancies in the differences between availability and disappearance are due to rounding.

Beef and Veal

Beef and veal production is projected to increase in both scenarios, although the increase is greater in the baseline scenario. The size of the breeding herd and number of cows on farms increase in both projections. Meat production in the EC scenario is slightly lower because the breeding herd is smaller than in the baseline scenario. Furthermore, a slightly greater proportion of meat produced will come from veal calves after entry. This moderate shift also contributes to the lower level of total meat production in the EC projections.

Meat and milk prices are slightly higher in the EC scenario; thus, lower production reflects higher production costs in the EC. Consumer prices for beef and veal are also higher in the EC, and this increase constrains consumption in the EC scenario. Annual per capita consumption of beef and veal is projected to reach 18.9 kg. in 1990 in the baseline as opposed to 17.2 kg. in the EC scenario despite lower production than for the baseline. This difference in per capita consumption is enough to reduce the projected deficit in beef and veal in the EC scenario. Nevertheless, both scenarios indicate that deficits in beef and veal are likely despite higher growth in production.

Pigmeat

The swine industry is projected to continue expanding rapidly in both scenarios, although the higher EC prices lead to predictions of greater production in the EC scenario. Sow numbers, pig crop, and total slaughter are all about 5 percent greater in the EC scenario than in the baseline. Projected higher feed costs in the EC scenario are offset by higher prices received for hogs. The prices used in the two scenarios imply that the ratio of hog to corn prices will fall from 6.63 in 1980 to 6.35 in 1990 in the baseline, while it rises from 6.45 to 10.4 in the EC scenario.

Although the favorable price relationships in the EC scenario lead to predictions of greater production after entry, higher

Table 4--Meat production in the baseline and EC scenarios, Spain, 1985 and 1990

Commodity and year	Slaughter		Slaughter weight		Production		Domestic availability	
	Baseline scenario	EC scenario	Baseline scenario	EC scenario	Baseline scenario	EC scenario	Baseline scenario	EC scenario
	1,000 head		Kilograms		1,000 metric tons			
Beef:								
1985	1,218	1,225	315	315	384	386		
1990	1,334	1,215	315	315	420	383		
Veal:								
1985	535	558	158	158	85	88		
1990	517	638	158	158	82	101		
Beef and veal:								
1985							469	474
1990							502	484
Pigmeat:								
1985	13,764	14,683	68.0	68.0	917	994	1/920	1/997
1990	15,783	16,570	68.0	68.0	1,052	1,100	1/1,055	1/1,107
Lamb and kids:								
1985	12,173	10,087	11.4	11.4	138	115		
1990	12,655	9,380	11.8	11.8	150	111		
Mature sheep and goats:								
1985	1,014	904	18.7	18.7	19	17		
1990	720	483	19.5	19.5	14	9		
Lamb, kids, mature sheep, and goats:								
1985							157	132
1990							164	120
Poultry meat:								
1985	63,192	53,454	1.48	1.48	937	793	2/978	2/835
1990	75,365	63,192	1.48	1.48	1,120	937	2/2,166	2/978

Blanks indicate not applicable.

1/ Estimated production of suckling pigmeat included.
2/ Estimated meat production from traditional barnyard flocks included.

Table 5--Livestock products: Domestic availability, disappearance, and net balance, Spain, baseline and EC scenarios, 1985 and 1990

Product and year	Domestic availability		Per capita consumption		Domestic disappearance		Surplus or deficit	
	Baseline scenario	EC scenario	Baseline scenario	EC scenario	Baseline scenario	EC scenario	Baseline scenario	EC scenario
	1,000 metric tons		- - Kilograms - -		- - - 1,000 metric tons - - -			
Beef and veal:								
1985	469	474	16.4	16.3	643	639	-174	-165
1990	502	484	18.9	17.2	778	707	-276	-223
Pigmeat:								
1985	920	997	26.6	24.8	1,043	975	-123	22
1990	1,055	1,107	29.1	23.9	1,194	982	-139	125
Sheep and goat meat:								
1985	157	132	3.95	4.09	155	160	2	-28
1990	164	-120	4.07	4.16	167	171	-3	-51
Poultry and meat:								
1985	978	835	25.0	25.0	981	986	-3	-151
1990	1,166	978	25.0	25.0	1,028	1,028	138	-50
All milk:								
1985	7,394	7,348	150.0	128.0	6,449	5,590	945	1,758
1990	8,345	8,180	147.0	107.0	6,612	4,949	1,733	3,231
Eggs:								
1985	652	604	18.0	18.0	706	706	-54	-102
1990	756	666	18.0	18.0	740	740	16	-74

Minus sign represents a deficit.

Table 6--Milk and egg production in the baseline and EC scenarios, Spain, 1985 and 1990

Item and year	Number of animals		Yields 1/		Production 2/		Domestic availability	
	Baseline scenario	EC scenario	Baseline scenario	EC scenario	Baseline scenario	EC scenario	Baseline scenario	EC scenario
	1,000 head						- - 1,000 metric tons - -	
Cow numbers:								
1985	2,719	2,708						
1990	2,863	2,815						
Cow milk:								
1985	2,083	2,074	3,217	3,217	6,700	6,670		
1990	2,193	2,156	3,487	3,487	7,648	7,519		
Sheep and goat milk:								
1985					479	462		
1990					455	423		
All milk:								
1985							7,394	7,348
1990							8,345	8,180
Selected layers:								
1985	43,610	40,020	227	227	945	863	652	604
1990	51,415	44,669	227	227	1,080	951	756	666

Blanks indicate not applicable.

1/ Liters per cow and number of eggs per hen.
2/ Million liters for milk and million dozen for eggs including egg production from barnyard flocks.

Table 7--Cereal grain production, baseline scenario, Spain, 1985 and 1990

Crop and year	Acreage			Yield		Production	Domestic availability
	Irrigated	Dry	Both	Irrigated	Dry		
	1,000 hectares			Kilograms/hectare		1,000 metric tons	
Wheat:							
1985	162	2,338		3,660	1,780	4,744	
1990	105	2,044		3,980	1,960	4,433	
Rye: 1/							
1985		90			1,150	103	
1990		25			1,230	30	
Wheat and rye:							
1985							4,020
1990							3,636
Barley:							
1985	310	3,848		3,790	2,250	9,834	
1990	342	4,242		4,100	2,460	11,833	
Oats: 1/							
1985		456			1,380	629	
1990		458			1,500	686	
Barley and oats:							
1985							10,656
1990							12,690
Corn:							
1985	217	109		6,650	2,670	1,736	
1990	197	64		7,410	2,910	1,644	
Sorghum: 1/							
1985		32			6,540	212	
1990		30			7,600	228	
Corn and sorghum:							
1985							1,949
1990							1,872

Blanks indicate not applicable.

1/ Irrigated and dry combined.

Table 8--Cereal grain production, EC scenario, Spain, 1985 and 1990

Crop and year	Acreage		Yield		Production	Domestic availability
	Irrigated	Dry	Irrigated	Dry		
	1,000 hectares		Kilograms/hectare		1,000 metric tons	
Wheat:						
1985	186	2,366	3,660	1,780	4,880	
1990	150	2,065	3,980	1,960	4,653	
Rye: 1/						
1985		103		1,140	117	
1990		51		1,260	64	
Wheat and rye:						
1985						2/4,170
1990						2/3,890
Barley:						
1985	296	3,726	3,790	2,250	9,506	
1990	315	3,982	4,100	2,460	11,083	
Oats: 1/						
1985		478		1,380	658	
1990		550		1,500	748	
Barley and oats						
1985						2/9,853
1990						2/11,738
Corn:						
1985	179	111	6,650	2,570	1,484	
1990	151	68	7,410	2,910	1,318	
Sorghum: 1/						
1985		25		6,540	161	
1990		15		7,600	118	
Corn and sorghum:						
1985						1,645
1990						1,436

Blanks indicate not applicable.

1/ Irrigated and dry combined.
2/ Adjusted for changes in stocks.

Table 9--Grain availability, disappearance, and net trade, baseline and EC scenario, Spain, 1985 and 1990 1/

Crop and year	Domestic availability: Baseline scenario	Domestic availability: EC scenario	Per capita consumption: Baseline scenario	Per capita consumption: EC scenario	Feed: Baseline scenario	Feed: EC scenario
	1,000 metric tons		- - Kilograms - -		1,000 metric tons	
Bread cereals:						
1985	4,020	4,170	65.0	65.0	127	129
1990	3,636	3,890	65.0	65.0	127	129
Barley and oats:						
1985	10,656	9,853	NA	NA	7,856	5,108
1990	12,690	11,738	NA	NA	8,987	5,760
Corn and sorghum:						
1985	1,949	1,645	NA	NA	8,330	5,660
1990	1,872	1,436	NA	NA	9,722	6,499

Crop and year	Domestic disappearance 1/: Baseline scenario	Domestic disappearance 1/: EC scenario	Surplus or deficit: Baseline scenario	Surplus or deficit: EC scenario
	1,000 metric tons			
Bread cereals:				
1985	3,910	3,921	110	249
1990	4,012	4,027	-376	-137
Barley and oats:				
1985	8,971	6,187	1,685	3,666
1990	10,266	6,959	2,424	4,779
Corn and sorghum:				
1985	8,755	6,085	-6,806	-4,440
1990	10,147	6,924	-8,275	-5,488

NA = Not available.

1/ Includes human and livestock consumption, seed, processing losses, and industrial uses.

Table 10--Commodity projections, baseline and EC scenarios, Spain, 1985 and 1990

Commodity and year	Availability		Disappearance		Surplus or deficit	
	Baseline scenario	EC scenario	Baseline scenario	EC scenario	Baseline scenario	EC scenario
	1,000 metric tons					
Beef and veal:						
1985	469	474	643	639	-176	-165
1990	502	484	778	707	-276	-223
Milk:						
1985	7,394	7,348	6,449	5,590	945	1,758
1990	8,345	8,180	6,612	4,949	1,733	3,231
Pork:						
1985	920	997	1,043	975	-123	22
1990	1,055	1,107	1,194	982	-139	125
Sheep and goat meat:						
1985	157	132	155	160	2	-28
1990	164	120	167	171	-3	-51
Poultry meat:						
1985	978	835	981	986	-3	-151
1990	1,166	978	1,028	1,028	138	-50
Eggs:						
1985	652	604	706	706	-54	-102
1990	756	666	740	740	16	-74
Wheat and rye:						
1985	4,020	4,170	3,910	3,921	110	249
1990	3,636	3,890	4,012	4,027	-376	-137
Barley and oats:						
1985	10,656	9,853	8,971	6,187	1,685	3,666
1990	12,690	11,738	10,266	6,959	2,424	4,779
Corn and sorghum:						
1985	1,949	1,645	8,755	6,085	-6,806	-4,440
1990	1,872	1,436	10,147	6,924	-8,275	-5,488
Soybean meal:						
1985	--	--	2,620	2,540	--	--
1990	--	--	3,030	2,870	--	--

-- = Nil or negligible.

retail prices lead to forecasts of a lower per capita consumption in 1990. Lower consumption, combined with 5-percent greater production in the EC scenario, should lead to self-sufficiency and possibly to a small surplus of pigmeat in 1990. In the baseline scenario, Spain is projected to have a deficit in pigmeat in 1990.

Sheep and Goats

Entry into the EC is projected to hasten the decline of the sheep and goat sectors. The number of females declines in both scenarios, but it is projected to be 28 percent lower in 1990 in the EC scenario. The number of lambs and kids slaughtered is projected to decline more in the EC scenario. Total sheep and goat meat production is predicted to be about 27 percent less with entry into the EC.

The lower prices used in the EC scenario are the cause for the greater decline. Real lamb prices have increased historically and are allowed to continue increasing in the baseline scenario. Average lamb prices in France and Italy are somewhat lower than those in Spain; thus, real prices are projected to decline in the EC scenario. Hence, meat production will be lower in 1990 after entry.

Consumption of sheep and goat meat is estimated to be only about 2 percent greater in 1990 for the EC scenario. Thus, annual sheep and goat meat consumption is projected to remain near historical levels of about 4 kg. per capita in both scenarios. The decline in production following entry suggests that Spain will import small, but increasing, amounts of lamb, mutton, and goat meat.

These projections reflect no change in the structure of the industry. If production evolves significantly towards intensive systems based on confinement feeding and cultivated forage, the indicated decline in production may slow perceptibly or even be reversed.

Poultry Meat and Eggs

The relative return measures used in the poultry models to determine whether production growth will continue are based on feed costs which are higher in the EC scenario. In the baseline analysis, estimated returns to broiler production remain high relative to returns to hog production throughout the projection period. Estimated returns to egg production are relatively low from 1979 to 1982, slowing growth in the number of layers in those years after which expansion resumes. The higher feed costs in the EC scenario cause the relative return measures to evolve differently: the number of broilers slaughtered does not grow from 1982 to 1986, but the number of layers grows until 1989.

Broiler slaughter will be 16 percent less in 1990 with accession. The number of layers is 13 percent lower in 1990 in the EC scenario. Poultry meat and egg production increase over the projection period in both scenarios, but the rate of growth is lower in the projections in the EC scenario. Poultry meat production is projected to be 16 percent lower with entry, while egg production is 12 percent lower. The implication of these projections is that rising feed costs following accession will reduce profitability in the poultry sectors enough to slow expansion.

The poultry meat and egg demand equations both led to projections of unrealistically high per capita consumption and were constrained at 25 and 18 kg. per year, respectively. The imposition of these constraints means that consumption is projected to be the same in both scenarios. The differences in production are reflected in the levels of net trade. In the baseline scenario, a surplus of 139,000 metric tons of poultry meat and a small surplus in eggs are projected for 1990. During most of the period, a small deficit of both poultry meat and eggs was projected. The projections in the EC scenario suggest deficits in both poultry meat and eggs during most of the projection period, reaching 50,000 metric tons and 74,000 metric tons, respectively, in 1990.

Because the poultry sectors are important in projections of feed disappearance, it is unfortunate that they proved so difficult to model, both in production and consumption. Therefore, the projections are best seen as indicative. Production may grow more rapidly after entry than the model predicts, but the rate of growth is likely to be slower than recently. Spain will probably remain self-sufficient in poultry meat and eggs after entry, but will unlikely become a large exporter.

Milk and Milk Products

Both the number of cows milked and the yield in milk per cow increase over the projection period in both scenarios. Therefore, milk production is projected to increase substantially. As for beef and veal, production levels are slightly higher in 1990 in the baseline than in the EC scenario. Sheep and goat milk production is lower in the EC scenario because of the smaller number of females compared with those in the baseline. Total milk available after accession is predicted to be 2 percent less than in the baseline scenario.

Milk consumption changes very little in the baseline scenario, but declines in the EC scenario as a result of higher retail prices in the EC. Both these projections indicate that Spain could become a surplus producer of milk. However, the model projections probably overstate the potential for generating excess production, especially in the EC scenario where, for example, a decline in consumption is indicated that may not occur. Production increases and modest consumption growth in the baseline projections together indicate a smaller surplus. The substantial production increases may be realized only if yield per cow continues to increase at recent historical rates. Barring unforeseen changes, Spain will be at least self-sufficient in milk and will not become a major market for EC milk and milk product surpluses.

Grains

Total cereal acreage is projected to be about 3 percent less in 1990 in the EC scenario than in the baseline. Wheat acreage is projected to be higher in the EC scenario, whereas barley acreage is predicted to be lower in 1990. However, total wheat acreage is projected to decline over the projection period in both scenarios, but barley acreage is projected to increase between 1980 and 1990. Total corn acreage in 1990 declines in both scenarios, but is projected to be 19 percent lower in the EC scenario. The proportion of total irrigated acreage is about the same for all three crops in both scenarios, remaining at about 5-7 percent for wheat and barley and increasing to 70-75 percent for corn.

Bread cereal production and availability are about 7 percent greater in the EC scenario than the baseline in 1990, although they decline in both scenarios between 1980 and 1990. For barley and oats, production is predicted to increase over the projection period in both scenarios, but at a lower rate in the EC scenario. Production of barley and oats in 1990 is predicted to be 6 percent lower in the EC scenario. Corn and sorghum production is projected to be 23 percent lower after entry in 1990, while remaining at about the current level in the baseline scenario. Because both scenarios have the same yield projections, these differences reflect projected acreage changes.

Bread cereal disappearance is about the same in both projections because per capita consumption has been constrained. The amount of wheat and rye used as animal feed also remains about the same in both projections. Both scenarios predict bread cereal deficits in 1990, although the deficit in the EC scenario is smaller. The projected deficits are relatively small, suggesting that Spain may be close to self-sufficiency following accession.

The change to EC feed use patterns lowers the demand for feed grains in the EC scenario. Total feed grain consumption increases in both scenarios over the projection periods, but the increase in 1990 is less in the EC scenario. The lower level of feed grain disappearance in the EC scenario leads to a projection of much larger barley and oat surpluses. Lower corn and sorghum disappearances in the EC scenario simultaneously reduce the size of the deficit. Nevertheless, corn and sorghum imports are expected to grow over the period, and the 5.5 million metric tons of projected imports for 1990 are greater than current levels.

Projections of a slower growth of feed grain use in the EC scenario need to be qualified because the two analyses assume different rates of concentrate feeding. Although these ratios do not differ greatly in some cases, they differ substantially for beef, veal, and milk. The rates are those that could be obtained from available data. An error in these differences could bias the results, probably leading to underestimated feeding levels in the EC scenario and thereby either overstating the extent of surplus production or understating Spain's feed grain import needs.

Soybean Meal

Table 10 shows soybean meal disappearance under the two scenarios. Soybean meal used as feed is predicted to be about 5 percent less in 1990 in the EC scenario. However, disappearance is projected to increase in both scenarios, and 1990 figures for the EC scenario are 28 percent larger than those in 1978. Spanish production of soybeans is very small and is not included in the model because the potential for expansion is limited. The projected levels of disappearance are likely to be made up almost exclusively of imports.

In summary, the simulation model of Spain's feed grain and livestock economy can help highlight potential problems in an enlarged EC. The magnitudes of the predicted imbalances are less important than the tendencies they reveal. Spanish authorities, in collaboration with the EC Commission, will likely change agricultural prices and policies to alter some of the projections.

The aggregate analysis suggests that Spanish membership in the EC will do little to alleviate the problem of surpluses in the European feed grain and livestock sectors. Rather than absorbing some of the surplus EC milk, Spain may add to the surplus. The large barley surpluses predicted by the model would increase the current small EC surpluses. Few complementarities between the surpluses and deficits in Spain and the EC are likely to occur.

Furthermore, entry into the EC may lead to retail price changes, causing consumers to switch from pork to chicken. Total meat consumption is likely to be somewhat lower after accession, suggesting that entry will lead to a higher proportion of total calories from bread, eggs, and other foods. Higher food prices will mean that consumers will spend a larger proportion of their incomes for food after entry into the EC.

IMPACT OF SPAIN'S ACCESSION TO THE EC: FARM-LEVEL APPROACH

The second analytical approach we employ to assess the effects of Spain's accession to the EC focuses on production adjustments at the farm level. The analysis is based both on the use of farm budgets for different enterprises and on a least-cost-ration linear programming model. Introducing EC prices into the budgets and programming model will change the relative profitability of the enterprises and lead to different feed combinations in livestock rations. These analyses indicate that adjustments in production activities and feed use may occur at the farm level.

The research described here was carried out at Michigan State University (22). In our study, we will discuss the data and methodology of these approaches and present the results. We summarize the principal conclusions derived from the farm-level research and assess their implications for Spain's adjustment following its entry into the EC.

Description of the Farm-Level Approach

We employ two methods to analyze farm-level adjustments in Spain. The first method uses enterprise budgets to describe current production practices, which form the basis of a partial budgeting analysis. The second method relies on a linear programming model to compute least-cost feed rations under different sets of prices. The data used in these analysis were collected during the summer of 1980; they refer to the 1978-80 period. Information on technical relationships, prices, and input use were provided by feed manufacturing firms, agricultural research institutes, and Government agencies.

Enterprise budgets are developed for barley, soft wheat, corn, broilers, eggs, swine, beef, veal, cow milk, and lambs. These budgets reflect the organization of these enterprises in 1979 for a set of case-study farms. Given the heterogeneity of the sectors and the paucity of census and farm structure data, these farms cannot be taken as representative of the entire country. However, the budgets are based on case-study farms which do reflect the structure of farms commercially important in the feed grain and livestock economy. No budgets have been developed for extensive livestock activities; the emphasis is on modern livestock enterprises which are the most important users of feed grains and soybean meal. Although the analytical results cannot be extended to the entire sector, they can still provide insights into expected adjustments in production that are most relevant to our study.

Feed manufacturing firms in the region of Catalonia provided many of the data on the poultry and swine sectors. These firms are often vertically linked to poultry and swine operations and were thereby able to supply information on the costs and returns of these intensive production systems. The regional center of the Instituto Nacional de Investigaciones Agrarias (INIA), or National Institute of Agricultural Research in Galicia, and the Agencia de Desarollo Ganadero, or Livestock Development Agency, provided most of the data on cattle operations. The regional centers of INIA in Zaragoza and Cordoba were sources of further information on beef production, sheep farming, and cropping enterprises. Some descriptive information was drawn from publications of the Ministry of Agriculture, particularly the "Red Contable Agraria Nacional," which is based on farm surveys.

The budgets are formulated to include gross revenue, variable costs, and a gross margin equal to the difference between the other two components. Fixed costs have not been included in most of the budgets because the basic farm structure is assumed to remain unchanged in the baseline and EC membership situations. The imposition of a new set of prices in these budgets changes revenue and costs, leading to different gross margins. A comparison of the gross margins between Spanish and EC prices in 1979 will show how profits may be affected after entry into the EC. Because the comparison is made for a specific time period, only those prices likely to be affected by accession were varied. Other costs, such as wages for farm workers, remain the same in both sets of budgets as it is assumed accession will not significantly alter these costs in the short run.

The prices used in the budgeting analysis are the prices actually paid and received by farmers. These prices do not always coincide with institutional prices, particularly in the case of livestock products. In an effort to estimate the actual prices that Spanish farmers would have paid and received in 1979 if Spain had been a member of the EC, we compared actual Spanish prices with average French and Italian farm-level prices. Using this comparison, the relative institutional prices in Spain and the EC and expected policy adjustments when Spain adopts the CAP, we estimated a set of farm-level prices after accession. Tables 11 and 12 show actual 1979 Spanish prices and the estimated farm-level prices in 1979 if Spain had already joined the EC.

The farm-level budget analysis is similar to the aggregate analysis as both scenarios reflect conditions for Spain as a member of the EC compared with the actual situation in 1979. However, the two approaches differ because the aggregate analysis rests on the projected evolution of institutional prices whereas the farm-level analysis is based on actual farm-level prices. The two sets of prices are not always the same, although the projected shifts in the structure of relative prices are similar in both approaches.

The second part of the farm-level analysis concerns changes in the composition of feed rations as a result of entry. The poultry and swine sectors are the most important consumers of compound feeds and, because of their links with feed-manufacturing firms, we had sufficient technical information on these operations to develop a linear programming model. This model was used to compute least-cost feed rations for broilers, layers, and hogs. The model is validated by a comparison of the actual composition of feed rations in 1979 with the ration estimated by the model, based on actual Spanish prices. We compare typical 1979 Spanish rations for cattle and sheep with French or Italian rations to suggest how they may change when Spain enters the EC.

The analysis of feed rations allows us to derive compound feed prices for the EC scenario in the budgeting analysis. The prices used for the linear programming analysis are the same as those shown in tables 11 and 12.

Because most of the farm-level analysis is based on data for 1979, we need to know whether that year was a typical agricultural year. Although climatic conditions in 1979 were less favorable than in 1978, a record year for crop production, total crop output was higher than the average for 1970-78. Livestock production increased at a lower rate than in the previous 8 years. The overall rise in livestock production was due primarily to substantial increases in pork and egg production; other sectors remained at the same level or declined. Although the nominal prices received by farmers rose in 1979, the increases were more than offset by the 15.7-percent inflation rate. In summary, 1979 can be considered a fairly typical agricultural year with supply, demand, and prices generally in line with the trends of previous years. Moreover, many analysts consider the economic conditions prevailing in 1979 to be characteristic of the early eighties.

Enterprise Budgets

The first step in developing the enterprise budgets was to identify a type of farm representing the average case study farm considered. The technical relationships used in the budgets were the most common or, in some cases, an average of several farms. The data for the case study farms were related to appropriate geographic locations. Thus, the budgets are based on a synthesis of available information, and they reflect the average situation in specific regions.

The budgets are presented in the form of tables that compare returns, costs, and gross margins in Spain in 1979 with those computed for the EC scenario. The assumptions for each budget are listed in each table. Six crop budgets and six livestock enterprise budgets are included.

Wheat, Barley, and Corn

Table 13 shows the estimated costs and returns from dryland barley and soft wheat production in the Ebro region. Cereal cultivation is a major activity in this region where barley and soft wheat are the main competing crops for dryland acreage. Cropping rotations typically involve 1 year of fallow, followed by 1 year of cereal cultivation. The budgets relate to a mechanized farm of 50-150 hectares. We took current Government policy that allows farms to obtain

Table 11--Prices received by farmers, baseline and EC scenarios, Spain, 1979

Product	Unit 1/	Baseline scenario	EC scenario	Change
				Percent
Wheat, soft II	Pts./kg.	15.60	15.20	-2.6
Wheat, soft III	do.	15.15	15.20	+.3
Barley	do.	11.30	13.36	+18.3
Corn	do.	13.55	13.65	+.74
Broilers	Pts./kg. lw.	77.36	74.27	-4.0
Eggs	Pts./doz.	58.12	58.12	0
Pigs	Pts./kg. lw.	95.45	96.84	+1.5
Piglets	Pts./animal	3,000	2,800	-4.0
Beef (anojo)	Pts./kg. lw.	136.55	133.80	-2.0
Veal	do.	165.35	165.35	0
Milk	Pts./lit.	19.30	17.75	-8.0
Lamb	Pts./kg. lw.	166.10	166.10	0
Cull hens	do.	40.00	40.00	0
Cull sows/boars	Pts./animal	11,500	11,500	0
Cull dairy cows	do.	45,000	45,000	0

1/ Pts./kg. = pesetas per kilogram; lw = liveweight; lit. = liter.

Table 12--Prices paid by farmers, baseline and EC scenarios, Spain, 1979

Product	Baseline	EC	Change
	---- Pesetas per kilogram ----		Percent 1/
Feedstuffs:			
Wheat	2/	14.3	2/
Barley	11.6	13.8	+18.5
Corn	13.5	15.1	+12.0
Sorghum	12.5	14.8	+18.4
Bran	10.2	11.6	+13.9
Soybean meal (44 percent)	20.5	20.5	0
Sunflower meal (36 percent)	13.6	13.6	0
Fish meal (63 percent)	45.0	40.0	-11.1
Meat meal	21.0	21.0	0
Alfalfa, dehydrated (17 percent)	10.3	11.4	+10.7
Urea	15.0	15.0	0
Skim milk	43.0	43.0	0
Milk replacer	55.0	65.0	+18.0
Alfalfa hay	7.1	7.8	+10.0
Forage	3.0	3	0
Straw	3.0	3.3	+8.0
Feed compounds:			
Broiler feed	22.5	25.0	+11.0
Layer feed	18.1	20.4	+12.5
Weaner hog	23.5	24.5	+4.3
Fattening hogs	17.5	19.8	+13.0
Breeder swine feed	16.0	18.2	+13.7
Cattle fattening	16.3	18.1	+11.0
Complete dairy ration	16.8	18.5	+11.0
Beef feed-mix	12.0	14.5	+20.8
Complete lamb ration	18.0	18.1	+.6
	----- Pesetas per animal -----		
Live animals:			
Baby chicks	15.8	15.8	0
Laying hen	230.0	230.0	0
Piglet	3,000	2,880	-4.0
Sow	15,000	15,000	0
Boar	35,000	35,000	0
Calf (40 kg. lw)	16,500	15,800	-4.2
Dairy cow	60,000	60,000	0
	---- Pesetas per kilogram ----		
Fertilizer:			
Nitrogen (N)	42.5	42.5	0
Phosphate (P_2O_5)	35.5	35.5	0
Potash (K_2)	21.4	21.4	0
Seeds:			
Wheat	21.0	21.0	0
Barley	15.0	17.2	+15.0

1/ Calculated from unrounded numbers.
2/ Wheat not used for feed in baseline scenario.

Table 13--Dryland barley and soft wheat: Estimated costs and returns, Ebro region, 1979

Item	Unit	Barley: Baseline price scenario	Barley: EC price scenario	Wheat: Baseline price scenario	Wheat: EC price scenario
Gross revenue:					
Grain	Pesetas per hectare	27,572	32,598.4	28,785	28,880
Total gross revenue	do.	27,572	32,598.4	28,785	28,880
Variable costs:					
Seed	do.	2,250	2,587.5	4,200	4,200
Fertilizer	do.	4,152	4,152	8,832.5	8,832.5
Herbicides	do.	250	250	1,000	1,000
Labor	do.	2,712.5	2,712.5	2,975	2,975
Traction	do.	5,600	5,600	6,000	6,000
Harvesting	do.	3,000	3,000	3,000	3,000
Loading and transportation	do.	1,200	1,200	950	950
Interest	do.	703	1,073.7	766	1,482.5
Total variable costs	do.	19,887.5	20,595.7	27,723.5	28,440
Gross margin	do.	7,684.5	12,002.7	1,061.5	440
Assumptions:					
Grain prices	Pesetas per kilogram	11.3	13.36	15.15	15.20
Yields	Kilograms per hectare	2,440	2,440	1,900	1,900
Seeds	do.	150	150	200	200
Seed prices	Pesetas per kilogram	15.0	17.25	21.0	21.0
Fertilizer	Kilograms of nitrogen/phosphate/potash per hectare 1/	45/45/30	45/45/30	60/75/50	60/75/50
Varieties	--	six row	six row	soft-type III	soft type III
Farm size 2/	Hectares	50-150	50-150	50-150	50-150

-- = Not applicable.

1/ Kilograms of plant nutrients.
2/ Mechanized farms, harvest combine hired.

subsidized credit for the purchase of seeds and fertilizer into account when we calculated the interest on circulating capital. The cost of seed and fertilizer was deducted from the circulating capital on which interest is computed. This policy is expected to be eliminated with entry; therefore, the interest charges in the EC budget are higher.

Under current conditions, barley is more profitable than wheat for these mechanized farms. Although the selling price for wheat is higher than for barley, the greater fertilizer and herbicide requirements make it more costly to produce. The greater profitability of barley production is also due to the higher yields for barley in the Ebro region. Despite the higher net returns to barley cultivation, much wheat is still grown, partly because of the differences between the institutional prices and the prices farmers actually receive. In 1979, actual barley prices were slightly higher than the guaranteed price, whereas wheat prices were essentially the same. Yields and profitability for dryland cultivation also varied greatly from year to year.

The estimated EC prices in these budgets lead to larger gross margins for barley and a small decline in the gross margin for wheat. The estimated EC price for barley is much higher than the 1979 Spanish price, offsetting the slightly higher cost for seed and interest. The price for wheat in the EC scenario is almost the same as the 1979 baseline. The increased profitability of barley suggests that farmers in the Ebro region will have an incentive to shift land from soft wheat to barley.

Tables 14 and 15 show the estimated budgets for corn and wheat cultivated on irrigated land in the Ebro and Guadalquivar valleys. These areas account for much of the corn produced in Spain. Many crops compete for irrigated acreage. Only wheat is compared with corn, but adjustments in irrigated corn acreage following accession will largely be determined by the relative profitability of other crops, such as alfalfa, sugar beets, cotton, sunflower, and sorghum, rather than wheat.

Both irrigated wheat and corn were highly profitable according to the 1979 budgets based on Spanish prices. Corn is slightly more costly to produce, and the price received is lower. The gross margins for wheat and corn are similar because of the effect of much higher corn yields. Further increases in corn yields from irrigated land in these regions seem possible.

Variable costs are not changed by Spanish entry into the EC and the prices received are only slightly different. Therefore, the estimated gross margins for both wheat and corn are similar in the two scenarios. Corn production is more labor- and energy-intensive than wheat cultivation so that if energy and labor costs are higher in the EC, corn cultivation would become less competitive. However, both crops remain profitable in the EC scenario.

Table 14--Irrigated soft wheat and corn: Estimated costs and returns, Ebro valley, Spanish and EC prices, 1979

Item	Unit	Wheat		Corn	
		Baseline price scenario	EC price scenario	Baseline price scenario	EC price scenario
Gross revenue:					
Grain	Pesetas per hectare	67,080	65,360	92,140	92,820
Total gross revenue	do.	67,080	65,360	92,140	92,820
Variable costs:					
Seed	do.	5,250	5,250	3,220	3,220
Fertilizer	do.	12,353	12,353	19,811	19,811
Herbicides	do.	400	400	2,600	2,600
Labor	do.	5,162.5	5,162.5	14,175	14,175
Traction and energy	do.	8,200	8,200	13,400	13,400
Harvesting	do.	3,750	3,750	6,500	6,500
Loading and transportation	do.	2,150	2,150	3,400	3,400
Interest	do.	2,050	2,050	2,471	2,471
Total variable costs	do.	39,315.5	39,315.5	66,577	66,577
Gross margin	do.	27,764.5	26,044.5	25,563	26,243
Assumptions:					
Grain prices	Pesetas per kilogram	15.60	15.20	13.55	13.65
Yields	Kilograms per hectare	4,300	4,300	6,800	6,800
Seeds	do.	250	250	23	23
Seed prices	Pesetas per kilogram	21.0	21.0	140.0	140.0
Fertilizer	Kilograms of nitrogen/phosphate/potash per hectare 1/	450 of 12/24/12	450 of 12/24/12	700 of 15/15/15	700 of 15/15/15
Varieties	--	Soft-type II	Soft-type II	Hybrid	Hybrid
Farm size	Hectares	10-25	10-25	10-25	10-25

-- = Not applicable.

1/ Kilograms of plant nutrients.

Table 15--Irrigated soft wheat and corn: Estimated costs and returns, Guadalquivir valley, Spanish and EC prices, 1979

Item	Unit	Wheat: Baseline price scenario	Wheat: EC price scenario	Corn: Baseline price scenario	Corn: EC price scenario
Gross revenue:					
Grain	Pesetas per hectare	70,200	68,400	108,400	109,200
Total gross revenue	do.	70,200	68,400	108,400	109,200
Variable costs:					
Seed	do.	4,620	4,620	2,220	--
Fertilizer	do.	9,295	9,295	18,440	--
Herbicides	do.	720	720	6,500	--
Labor	do.	4,380	4,380	12,151	--
Traction and energy	do.	8,080	8,080	17,600	--
Harvesting	do.	2,750	2,750	6,500	--
Loading and transportation	do.	2,250	2,250	4,000	--
Interest	do.	1,765	1,765	3,708	--
Total variable costs	do.	33,860	33,860	71,119	71,119
Gross margin	do.	36,340	34,540	37,281	38,081
Assumptions:					
Grain prices	Pesetas per kilogram	15.60	15.20	13.55	13.65
Yields	Kilograms per hectare	4,500	4,500	8,000	8,000
Seeds	do.	220	220	30	30
Seed prices	Pesetas per kilogram	21	21	74	74
Fertilizer	Kilograms of nitrogen/phosphate/potash per hectare 1/	50/100/50	50/100/50	150/100/100	150/100/100
Varieties	--	Soft-type II	Soft-type II	Hybrid	Hybrid
Farm size	Hectares	5-25	5-25	5-25	5-25

-- = Not applicable.

1/ Kilograms of plant nutrient.

Crops such as cotton and sugar beets that compete for irrigated land in Guadalquivir are not expected to expand greatly under the CAP. But sunflowers, which also compete for irrigated land, may receive higher prices following accession. Given the similarity in the gross margins for corn and wheat and the potential for competition from other crops, production increases for corn are more likely to result from higher yields than from expanded acreage.

For both irrigated and dryland wheat, profitability following accession will be influenced by the proportion which qualifies as bread wheat. Lower quality wheats in the EC are classified as feed wheat and receive much lower prices. The cultivation of hard and durum wheats, which receive higher prices than soft wheat in the EC, may also increase.

Livestock Production

The higher prices for grains in the EC scenario mean that feed prices paid by livestock farmers are also higher. The prices received by livestock producers are not expected to increase as much as feed costs so that the gross margins for all livestock enterprises considered in this analysis are lower in the EC scenario. The large increase in the cost of feed grains is partly due to the elimination of the implicit subsidy for corn users. The Spanish threshold price is lower than the guaranteed price for corn producers; therefore, livestock growers can purchase foreign corn at a lower price. With entry, the threshold price will move to the EC level, raising the cost of corn.

Estimated costs and returns for boiler production are shown in table 16. The case study farm is representative of large, industrial operations which account for the bulk of poultry meat production. It is assumed that this operation processes about 100,000 birds annually in five 56-day cycles of 20,000 birds each. Feed costs constitute 74 percent of the variable costs in this type of operation, while baby chicks account for another 14 percent of the costs. The price structure shown in table 16 does not include the loading and transportation costs usually borne by the farmer.

The estimated gross margin of almost 20 pesetas per bird based on the 1979 Spanish prices represents a 16.24-percent return above variable costs. It is difficult to assess the profitability of these enterprises because heavy investments are required and some secondary costs to farmers have not been included. There may also be significant internal pricing in large commercial enterprises that are vertically linked to feed manufacturing firms. Nevertheless, the production of broilers under actual conditions appears profitable.

The enterprise budget computed on the basis of estimated EC prices shows a sharp reduction in the gross margin because the price received for broilers is lower and the cost of feed is much higher in the EC scenario. The rise in feed costs is particularly important for the poultry industries as most of the variable costs are feed expenditures. The estimated gross margin for the EC scenario is still positive, but the inclusion of fixed costs and transportation costs from the farm to first handlers could result in negative net returns for this type of broiler operation.

The results of the budgeting analysis for eggs are similar to those for broilers. The case study farm represented by the figures in table 17 is assumed to have 15,000 layers which are kept for 1 year. Average yield per hen per year is assumed to

Table 16--Broilers: Estimated costs and returns, Spanish and EC prices, 1979

Item	Unit	Baseline: price scenario	EC price scenario
Gross revenue:			
Broiler	Pesetas per bird	139.15	133.69
Total gross revenue	do.	139.25	133.69
Variable costs:			
Feed	do.	89.10	99.0
Baby chicks	do.	17.01	17.01
Labor	do.	4.38	4.38
Medicants and veterinary	do.	2.50	2.50
Other	do.	3.10	3.10
Interest	do.	3.71	4.03
Total variable costs	do.	119.80	130.02
Gross margin	do.	19.45	3.67
Assumptions:			
Broiler prices	Pesetas per kilogram liveweight	77.36	74.27
Broiler liveweight at slaughter	Kilograms	1.8	1.8
Feed prices	Pesetas per kilogram	22.5	25.0
Feed conversion	Kilograms of feed per kilogram liveweight	2.2:1	2.2:1
Mortality	Percent	4.5	4.5
Farm structure	--	1/	1/

-- = Not applicable.

1/ Certified breed, 20,000 birds per cycle, and 5 cycles per year (1 cycle = 56 days). Labor requirements are 0.58 FTE (full-time equivalent). One FTE equals 2,400 person-hours per year.

be 20 dozen eggs, and the farm uses mechanized collection systems. Production practices may vary greatly depending on decisions about the length of production cycles, culling, and flock replacement. With broilers, loading and transportation costs usually borne by the farmer were not included in the variable costs.

Table 17--Egg operation: Estimated costs and returns, Spanish and EC prices, 1979

Item	Unit	Baseline price scenario	EC price scenario
Gross revenue:			
Eggs	Pesetas per dozen eggs	58.12	58.12
Cull hens	do.	3.30	3.30
Total gross revenue	do.	61.42	61.42
Variable costs:			
Feed	do.	35.30	39.78
Hen (20 weeks old)	do.	13.57	13.57
Labor	do.	1.51	1.51
Medicants and veterinary	do.	.40	.40
Other	do.	.67	.67
Interest	do.	1.45	1.62
Total variable costs	do.	52.90	57.55
Gross margin	do.	8.52	3.87
Assumptions:			
Egg prices	do.	58.12	58.12
Eggs per layer/ cycle	Dozen	20	20
Feed prices	Kilogram	18.10	20.40
Feed conversion	Kilograms of feed per dozen eggs	1.95:1	1.95:1
Mortality	Annual percent	18	18
Farm structure	--	1/	1/

-- = Not applicable.

1/ Certified breed (brown eggs), 15,000 hens per one cycle per year. No molting. Labor requirements are 0.6 FTE (full-time equivalent). Mechanized collection of eggs.

Prices in Spain were quite different in 1978 than in 1979. In 1979, there was an excess supply of eggs, and the average price for that year would have resulted in a gross margin of only 1.9 pesetas per dozen eggs. The average 1978-79 price is considered a better indicator of normal market conditions and is, therefore, used in this analysis.

We used the same price for eggs in both scenarios so the estimated reduction in the gross margin following accession results solely from the higher feed costs. Although the gross margin is positive in the EC scenario, the assumed fixed costs of 4 pesetas per dozen eggs results in negative net returns. Broiler and egg prices are either the same or slightly lower than in France and Italy. Because feed accounts for 60-80 percent of the variable costs of producing eggs and broilers, accession will likely increase costs because of higher feed prices. Again, we find that the historical growth of the sectors will be slowed following entry.

Feed prices are also important to the future of swine operations. Spain's swine enterprises have three main production systems. The first type of farm specializes in the production of weaners. The second type specializes in growing and fattening. The third type is a closed-cycle system in which production of weaners, growing, and fattening all take place on the same farm. As noted earlier, the Spanish Government is promoting closed-cycle operations as a way to isolate African Swine Fever. The case study farm chosen for this analysis is assumed to operate with a closed cycle. The data in table 18 are based on an assumed production cycle of 6 months, two litters of eight piglets per sow each year, and a feed conversion ratio of 3.2 kg. of feed per 1.0 kg. liveweight.

Under these conditions, the enterprise yield returns 15.38 percent above variable costs in the 1979 baseline scenario. Feed costs represent 78 percent of the total variable costs. The feed conversion ratio and the number of piglets weaned per year are important technical coefficients. Less efficient farms will have lower gross margins than the case study farm if these coefficients are less favorable. Fixed costs for this type of farm are estimated at 650 pesetas per hog, leaving an estimated net farm income of 591 pesetas per hog under 1979 conditions.

As with the poultry sectors, higher feed costs associated with EC membership significantly reduce the gross margin in spite of a small increase in hog prices. With fixed costs of 650 pesetas per hog, net returns become negative. Similar results were obtained for specialized weaner and fattening farms, for which the budgets are not reported here (22). The reduction in profitability following accession (implied by the budgeting analysis) ultimately spurs productivity. Productivity may be increased by higher energy feed rations. Improving the feed-conversion ratio from the 3.2 kg. of feed per 1.0 kg. of meat to 3.15 kg., for example, would reduce additional feed costs by 10 percent.

Table 18--Swine operation: Estimated costs and returns, Spanish and EC prices, 1979

Item	Unit	Baseline price scenario	EC price scenario
Gross revenue:			
Fattened hogs	Pesetas per hog	9,067.75	9,199.80
Cull sows and boars	do.	241.31	241.31
Total gross revenue	do.	9,309.06	9,441.11
Variable costs:			
Feed--			
Sows and boars	do.	1,257.74	1,430.67
Weaners and replacements	do.	669.49	710.03
Hogs	do.	4,368.00	4,942.08
Labor	do.	743.61	743.61
Other	do.	431.50	431.50
Interest	do.	597.63	660.63
Total variable costs	do.	8,067.97	8,918.52
Gross margin	do.	1,241.09	522.59
Assumptions:			
Hog prices	Pesetas per kilogram liveweight	95.45	96.84
Hog liveweight at slaughter	Kilograms	95	95
Feed compound prices:			
Sows	Pesetas per kilogram	16.0	18.2
Weaners	do.	23.5	24.5
Hogs	do.	17.5	19.8
Feed conversion ratio	Hogs weighing 17 - 95 kilograms	3.2:1	3.2:1
Farrowing	Piglets weaned per sow per year	16	16
Mortality of sows, boars, and hogs	Percent	2.5	2.5
Farm structure	--	1/	1/

-- = Not applicable.

1/ Assumes 115 sows, of which 100 are productive, and 5 boars (all cross breeds); 35 replacements a year raised on the farm; and weaners transferred to feeding at 17 kilograms. Labor requirements are 1.5 FTE (full-time equivalents).

The budget analysis suggests that swine operations, like poultry operations, will come under pressure after entry because increased feed costs will more than offset the small rise in prices received for hogs. This conclusion differs from the aggregate analysis where the estimated prices received for hogs rise faster than feed costs. In the aggregate analysis, EC institutional prices are not fully imposed until 1990. Nevertheless, using the formulas in the price-generating component and the estimated institutional prices from the study by Josling and Pearson, we can derive an implicit 1980 price for the EC scenario. The ratio of this price to the assumed 1980 price in the baseline scenario is 1.24 to 1.0. In the farm-level analysis, this ratio is 1.01 to 1.0. For hog-feed prices, the ratios are approximately 1.13 to 1.0 for the farm-level analysis and 1.05 to 1.0 for the aggregate analysis. Different price assumptions account for the different predictions in the two approaches.

The budget analysis for beef cattle enterprises is complicated by a greater choice of feeding alternatives. Furthermore, meat and milk production are frequently joint activities. The case study farm chosen for the analysis is a semi-intensive operation based on forage and feed supplements where the animals graze freely until the final 150 days before slaughter when they are kept in permanent confinement and fed mixed feeds. On this type of farm, calves are raised in about 356 days to a liveweight of about 450 kg. The farm described in the budget in table 19 is assumed to produce its own hay and forage and to mix its own feed from purchased inputs. Such a farm is representative of cereal-producing regions that are partially irrigated.

The gross margin per yearling is about 2,300 pesetas in the 1979 baseline scenario. Feed costs for this type of operation make up about 49 percent of total variable costs. Budgets for intensive beef and veal operations not reported here show somewhat lower gross margins. The proportion of total variable costs accounted for by feed is about the same for the intensive beef farm, but is a little lower for the intensive veal operation. Fixed costs are relatively low in all these operations.

The lower estimated beef price in the EC scenario combined with higher feed costs leads to a negative gross margin for the case study farm after entry. Negative gross margins also developed in the intensive beef and veal operations. Feed grains are currently an important part of the diet on intensive and semi-intensive beef farms. The beef and veal sectors are less modern and more labor-intensive than the poultry and swine sectors and may be less able to adjust to changing conditions under the CAP. However, producers have a wider range of feeding alternatives, and Spain is trying to encourage more extensive production systems to reduce dependence on imported feed grains. Prices of other feedstuffs are not likely to increase as much as feed grain prices when Spain joins the EC. This situation will encourage cattle farmers to make greater use of other feedstuffs, such as forage crops.

The budgets presented in table 20 were developed for a relatively large dairy farm in northern Spain. The case study farm is above average, but a mechanized dairy farm with 30 cows is not unusual; it also represents a type of farm which will probably be economically viable in the future. The budget computed on the basis of 1979 Spanish prices indicates that milk production is fairly profitable for this type of farm. This may be partly because Spanish policy has been

Table 19--Beef operation: Estimated costs and returns, Spanish and EC prices, 1979

Item	Unit	Baseline price scenario	EC price scenario
Gross revenue:			
Yearlings (anojo)	Pesetas per animal	61,447.5	60,210
Total gross revenue	do.	61,447.5	60,210
Variable costs:			
Feed--			
Skim milk	do.	946	946
Feed-mix	do.	22,266	26,376.95
Forage	do.	5,040	5,040
Straw	do.	837	906.75
Weaners	do.	16,995	16,274
Labor	do.	3,780	3,780
Medicants and veterinary	do.	250	250
Other	do.	879	879
Interest	do.	8,159	8,770.15
Total variable costs	do.	59,152	63,582.85
Gross margin	do.	2,295.5	-3,372.85
Assumptions:			
Beef cattle prices	Pesetas per kilogram liveweight	136.55	133.8
Animal liveweight at slaughter	Kilograms	450	450
Feed-mix prices	Pesetas per kilogram	12	14.5
Calf prices	Pesetas per calf	16,500	15,800
Mortality	Percent	3	3
Farm structure	--	1/	1/

-- = Not applicable.

1/ Assumes 100 Friesian or Brown Swiss-Charolais cross calves on a 10-hectare irrigated farm; 1 cycle a year. Calves are purchased at 40 kilograms liveweight. All forage is produced on the farm and other feeds are purchased and mixed on the farm. Labor requirements are 0.5 FTE (full-time equivalent).

oriented toward the large number of small dairy farmers and because more efficient and larger farms benefit from the relatively high prices. Fixed costs were estimated at 2.14 pesetas per liter, leaving net returns of 2.78 pesetas per liter.

As for beef and veal operations, higher feed costs and lower prices received significantly reduce the gross margin for this enterprise in the EC scenario. However, the gross margin is positive, and net returns after deducting fixed costs of 2.14

Table 20--Dairy operation: Estimated costs and returns, baseline and EC price scenario, 1979

Item	Unit	Baseline price scenario	EC price scenario
Gross revenue:			
Milk	Pesetas per liter	19.3	17.75
Calves	do.	2.61	2.50
Cull cows	do.	1.87	1.87
Total gross revenue	do.	23.78	22.12
Variable costs:			
Feed:			
Pasture	do.	4.56	4.56
Feed compound	do.	4.70	5.18
Milk powder	do.	.08	.08
Straw for bedding	do.	.40	.43
Replacements	do.	1.50	1.50
Labor	do.	6.30	6.30
Other	do.	.83	.83
Interest	do.	.49	.50
Total variable costs	do.	18.86	19.38
Gross margin	do.	4.92	2.74
Assumptions:			
Milk prices	do.	19.3	17.75
Milk production	Liters per cow	4,000	4,000
Feed compound prices	Pesetas per kilogram	16.8	18.50
Calving rate per year	Calves per cow	.76	.76
Replacements (only 50 percent purchased)	Percent per year	.20	.20
Farm structure	--	1/	1/

-- = Not applicable.

1/ Assumes 30 Friesian cows, mechanized milking and semi-mechanized feeding, and a labor requirement of 1 FTE (full-time equivalent).

pesetas also remain positive, although they are less than 1 peseta per liter of milk. It should be emphasized that these results pertain to larger-than-average and to modern dairy farms. The many very small dairy farmers in northwestern Spain may find it difficult to adjust to the EC price structure. Thus, dairy farmers may be pressured into expanding and into adopting more modern production methods.

Table 21 presents estimated costs and returns for a lamb-fattening operation. The lamb and sheep sector is heterogeneous with regional variations in the age and weight at which lambs are slaughtered. Supply and demand imbalances also lead to seasonal price fluctuations. The budgets represent an intensive lamb-fattening operation of the type found primarily in the Ebro and Centro regions (table 21). Fixed costs were estimated at 25 pesetas per lamb, leaving positive net returns of more than 100 pesetas per lamb under current conditions.

The budget analysis suggests that entry into the EC will not greatly affect operations of the type described by the budget. The price received for lambs is assumed unchanged by accession, while feed costs per lamb will increase by less than 6 percent. The gross margin of 85 pesetas per lamb indicates that this operation will remain profitable after entry, although net returns after deducting fixed costs are reduced to about 60 pesetas per lamb.

For all the livestock enterprises considered in the farm-level analysis, feed costs constitute an important part of total variable costs. The estimated Spanish equivalent of 1979 EC prices suggests that the prices received by livestock producers in 1979 would have been about the same or slightly lower had Spain been a member of the EC. But, the cost of compound feeds and feed grains would have been substantially higher if Spain had been a member in 1979. Thus, all the gross margins are lower in the EC scenario than under actual 1979 conditions. The modern poultry, swine, and dairy enterprises, as well as intensive lamb-fattening operations, continue to achieve positive gross margins over variable costs after entry, but only dairy and lamb activities appear to remain profitable after fixed costs are deducted. Beef and veal operations show negative gross margins following the shift to estimated EC prices. Tables 22 and 23 summarize these changes.

Feed Rations

Accession to the EC will change relative feed grain prices. This change will affect feed grain use by the feed-mixing industry. The objective of the feed ration analysis is to assess the nature of these changes. Because the poultry and swine sectors are the major consumers of compound feed, we developed a linear programming model to calculate the least-cost rations for these sections. For the other sectors, we compared typical 1979 Spanish rations with typical French or Italian rations to suggest how the compositions of these rations may change when Spain joins the EC.

Table 21--Lamb fattening operation: Estimated costs and returns, baseline and EC price, 1979

Item	Unit	Baseline price scenario	EC price scenario
Gross margin:			
Lamb (Pascual)	Pesetas per lamb	4,318.6	4,318.6
Total gross margin	do.	4,318.6	4,318.6
Variable costs:			
Feed--			
Barley	do.	184.8	211.8
Concentrate	do.	403.2	405.4
Alfalfa hay	do.	119.3	131.0
Weaner	do.	3,111	3,111
Labor	do.	151.2	151.2
Medicants and veterinary	do.	60	60
Other	do.	32	32
Interest	do.	130	131.3
Total variable costs	do.	4,191.5	4,233.7
Gross revenue	do.	127.1	84.9
Assumptions:			
Lamb prices	Pesetas per kilogram liveweight	166.1	166.1
Lamb liveweight at slaughter	Kilograms	26	26
Feed prices:			
Barley	Pesetas per kilogram	12	13.8
Concentrate	do.	18	18.1
Alfalfa hay	do.	7.1	7.8
Mortality	Percent	2	2
Farm structure	--	1/	1/

-- = Not applicable.

1/ Assumes 1,000 lambs per cycle, 5 cycles a year. Manchega breed. Weaner purchased at 12 kilograms liveweight and all feed purchased. Labor requirements are 1 FTE (full-time equivalent).

Table 22--Variable costs of production per unit of output, baseline and EC scenarios, Spain, 1979

Product	Unit	Variable costs of production 1/ Baseline	Variable costs of production 1/ EC scenario	Change in costs	Change in price received
		--Pesetas per unit--		--------Percent--------	
Broiler	Kg./lw.	66.56	72.23	+8.5	-4.0
Eggs	Doz.	49.60	54.25	+9.4	0
Swine 2/	Kg./lw.	91.03	97.18	+5.6	+1.5
Beef cattle 3/	Kg./lw.	131.45	141.30	+7.5	-2.0
Milk	Ltr.	14.38	15.01	+4.4	-8.0
Lamb	Kg./lw.	161.21	162.84	+1.0	0

1/ Net of revenues from joint products--that is, total variable costs minus revenues from culling and sale of calves.
2/ Feeder-pig production.
3/ Semi-intensive beef production.

Table 23--Ratio of farm gate livestock prices to compound feed prices, baseline and EC scenarios, Spain, 1979

Item	Unit	Baseline scenario	EC scenario
Broiler to compound feed	Pts./kg. lw. to pts./kg feed	3.44	2.97
Eggs to compound feed	Pts./doz. to pts./kg. feed	3.21	2.85
Pigs to compound feed	Pts./kg. lw. to pts./kg. feed	5.45	4.89
Beef to compound feed	Pts./kg. lw. to pts./kg. feed	8.35	7.39
Milk to compound feed	Pts./lit. to pts./kg. feed	1.15	.96

Table 24 shows the ratios of various feed grain prices to barley and corn for the two situations analyzed in this study. The ratios indicate that corn will become cheaper relative to barley as a feed ingredient after entry. Corn contains more energy and less fiber than barley, making it the more valuable feed grain for feed compounders.

Poultry. We computed least-cost rations for broilers and layers on the basis of 1979 Spanish prices and of estimated prices if Spain had been in the EC. The least-cost ration, based on Spanish prices, can be compared with a typical ration currently used in Spain and with a typical French ration. Appendix B gives the technical matrices for the linear programming models.

Table 25 presents the results of the analysis of poultry rations. Corn and soybean meal are the most important ingredients in the broiler rations for both scenarios. The cost of forcing barley into the optimal solution was relatively high. The broiler rations were not changed when estimated EC prices were used, but the ration became more expensive because of increased corn prices. The linear programming results are supported by the similarity of actual French and Spanish rations in 1979. The formulations of broiler rations are conditioned by the desire to achieve good feed-conversion rates. It is more profitable to use slightly higher cost rations if they allow a farmer to grow out a broiler in the shortest possible time. For broiler rations, farmers tend to rely heavily on corn over a wide range of prices.

Spanish rations for laying hens in the egg production phase have a higher protein content than in the growing phase. Layers in production are fed a ration containing at least 50 percent corn, with 16-22 percent protein feeds. The least-cost ration based on 1979 prices indicates that farmers could use more grain than they currently do for layer rations. Both rations contain barley. As the price for barley is reduced, it begins to substitute for corn, although there is a technical limit to the amount of barley that can be used in layer feed.

The linear programming results for the EC scenario show an almost complete switch to corn as the source of energy in the layer rations. Soybean meal is about the same in both linear programming, least-cost rations. The typical ration includes significant amounts of manioc. The potential for manioc use in Spanish feed rations is difficult to assess because few

Table 24--Relative prices of feed grain and bran, Spain 1/

Item	Baseline scenario		EC scenario	
	Barley = 1.0	Corn = 1.0	Barley = 1.0	Corn = 1.0
	Ratio			
Barley	1.00	0.86	1.00	0.91
Corn	1.164	1.0	1.099	1.0
Sorghum	1.078	.93	1.076	.98
Wheat	2/	2/	1.04	.95
Bran	.875	.75	.801	.76

1/ Based on data in table 12.
2/ Wheat not used for feed.

Table 25--Poultry feed rations: Spain, baseline and EC scenarios, and France, 1979

Feed ingredients	Unit	Broilers				Layers			
		Actual	Spanish scenario 1/	EC scenario 1/	France	Actual	Spanish scenario 1/	EC scenario 1/	France
Barley	Percent	--	--	--	--	8	14	--	--
Corn	do.	58	64	64	65	58	64	74	2/60
Sorghum	do.	4	--	--	--	--	--	--	--
Wheat bran	do.	--	--	--	--	--	--	4	--
Manioc	do.	--	--	--	--	--	--	--	12
Soybean meal	do.	28	30	30	25	15	9	10	17
Sunflower meal	do.	--	--	--	--	4	--	--	--
Alfalfa, dehydrated	do.	1	--	--	--	1	--	--	2
Fish and meat meal	do.	4	4	4	4	2	7	7	--
Other feeds, minerals and vitamins	do.	5	2	2	6	12	6	5	9
Total	do.	100	100	100	100	100	100	100	100
Cost	Pesetas per kilogram	22.5	NA	25.0	NA	18.1	NA	20.4	NA
Percentage increase	Percent	NA	NA	11	NA	NA	NA	12.5	NA
Energy 2/	Kilocalories	NA	2,926	2,926	NA	NA	3,050	30,066	NA
Crude protein	Percent	NA	22.5	22.5	NA	NA	16.3	16.5	NA

-- = Nil or negligible.

Blanks indicate not applicable.

NA = Not available.

1/ Linear programming analysis.
2/ All grains, but mainly corn.

Sources: Primary data from Spanish feed manufacturers and typical rations from the Confederacion Nacional de Fabricantes de Piensos Compuestos (National Confederation of Feed Manufacturers). French ration from (30).

technical or economic data are available on its use in Spain. Manioc is difficult to handle, and overland transport raises the price considerably. Experts generally do not consider it feasible for Spain to import manioc from Rotterdam where there are extensive unloading and handling facilities. Thus, the potential for manioc use is likely to be determined by the capacity to receive it in Spanish ports and the feasibility of constructing special handling facilities.

Swine. Hog rations based on barley produce a low-energy feed whereas those using corn and sorghum produce high-energy feeds. The high-energy feed is more expensive, but allows better feed-conversion rates. Typical Spanish rations are currently based on barley and soybean meal. The estimated least-cost ration computed from 1979 prices is also a low-energy feed based on barley and soybean meal.

The linear programming analysis indicates that sunflower meal will be used increasingly as a source of protein. However, sunflower meal contains a lot of fiber, as does barley. Therefore, there is a tradeoff in the rations between barley-soybean meal and corn-sunflower meal. The solution of the least-cost ration based on estimated EC prices in Spain shows a shift toward corn and sunflower meal from the current barley-soybean meal. Greater use of corn in these rations raises the energy level of the feed, suggesting lower feed-conversion ratios.

Under current conditions in Spain, corn is substituted for barley when the price of corn is less than 15 percent above that for barley. Based on estimated EC prices, barley is substituted for corn as the corn price reaches 7 percent or more above the barley price. The sensitivity analysis also indicates that under EC prices feed wheat will enter the solution if the price of corn is raised 16 percent above that of barley. Increasing the limit on the crude fiber content of these rations allows the proportion of barley to be increased at the expense of corn.

Regarding current Spanish and French rations, the main difference is the use of feed wheat and manioc in the French ration. For feed wheat to enter the least-cost ration for the EC scenario, it must be at least 6 percent cheaper than corn. Table 26 compares breeder and weaner rations for Spain with those for France and Italy. The typical French ration indicates that corn use in the rations for sows and boars may increase following accession, whereas typical weaner rations scarcely differ. Overall, the analysis suggests that swine rations will be made up mostly of corn and wheat, rather than barley. It also suggests that the use of soybean meal may decline somewhat in favor of sunflower meal. However, sunflower meal is limited by its availability, and some experts do not foresee much potential for expanded production and use.

Cattle and Sheep. Table 27 shows the composition of typical Spanish cattle and sheep rations, both for the baseline

Table 26--Swine feed rations, by percentage of ingredients, Spain, baseline and EC scenarios, and France, 1979

Feed ingredient	Unit	Fattening hogs				Sows and boars		Weaners	
		Actual	Baseline scenario 1/	EC scenario 1/	France	Baseline scenario	EC scenario 2/	Baseline scenario	EC scenario 2/
Barley	Percent	36	58	17		64	25	32	32
Corn	do.	24	28	65	3/70	--	36.5	23	23
Sorghum	do.	10	--	--		--	--	--	--
Wheat bran	do.	--	--	--		10	12	--	5
Manioc	do.	--	--	--	Some	--	--	--	--
Soybean meal	do.	20	9	--	16	11	7.5	23	20
Sunflower meal	do.	2	--	13	--	2	4	6	7
Alfalfa, dehydrated	do.	--	--	--	--	5	4	--	--
Fish and meat meal	do.	3	4	4	--	--	2	3	3
Skim milk	do.	--	--	--	--	--	--	10	8
Other feeds, minerals, and vitamins	do.	5	1	1	7	4	6	9	9
Total	do.	100	100	100	100	100	100	100	100
Cost	Pesetas per kilogram	17.5	NA	19.8	NA	16	18.2	23.5	24.5
Percentage increase	Percent	NA	NA	13	NA	NA	13.7	NA	4.3
Energy	Feed units	1.02	1.03	NA	NA	NA	NA	NA	NA
Crude protein	Percent	NA	15.0	15.5	NA	NA	NA	NA	NA
Crude fiber	Percent	NA	4.5	4.5	NA	NA	NA	NA	NA

-- = Nil or negligible.

Blank indicates not applicable.

NA = Not available.

1/ Linear programming analysis.
2/ Based on rations in France and Italy.
3/ All grains, but mainly wheat.

Sources: Primary data from Spanish feed manufacturers and typical rations from the Confederacion Nacional de Fabricantes de Piensos Compuestos (National Confederation of Feed Manufacturers). French ration from (30).

Table 27--Cattle and lamb feed rations, by percentage of ingredients, baseline and EC scenarios, Spain, 1979

Item	Unit	Semi-intensive feed mix		Beef intensive starter		Intensive		Dairy		Lamb supplement	
		Baseline: scenario	EC scenario 1/	Baseline: scenario	EC scenario 1/	Baseline: scenario	EC scenario 1/	Baseline: scenario	EC scenario 1/	Baseline: scenario	EC scenario 1/
Barley	Percent	73	NC	17	2/58	66	2/68	20	NC	--	--
Corn	do.	--	--	40		10		55	NC	--	--
Wheat bran	do.	7	NC	10	7	7	5	--	--	6	NC
Soybean meal	do.	--	--	23	22	4	5	10	NC	42	NC
Sunflower meal	do.	--	--	--	--	9	10	10	NC	40	NC
Alfalfa, dehydrated	do.	16	NC	--	--	--	--	--	--	--	--
Urea	do.	2	NC	--	--	--	--	0.5	NC	--	--
Skim milk	do.	--	--	5	--	--	--	--	--	--	--
Other feeds, minerals, and vitamins	do.	2	NC	5	13	4	12	4.5	NC	12	NC
Total	do.	100	100	100	100	100	100	100	100	100	100
Cost of feed ration	Pesetas per kilogram	12	14.5	17.75	19.7	16.3	18.1	16.8	18.5	18	18.1
Percentage increase	Percent		20.8		11		11		11		0.6

NC = No change.

-- = Nil or negligible.

Blanks indicate not applicable.

1/ Derived from typical French or Italian rations.
2/ Barley and corn.

Source: Primary data from Spanish feed manufacturers and typical rations from the Confederacion Nacional de Fabricantes de Piensos Compuestos (National Federation of Feed Manufacturers).
French ration from (30).

scenario and for the EC scenario based on French and Italian rations. The available data do not reveal representative EC rations for dairy cows and lambs. (See appendix table B-2 for the prices used to estimate the cost of the rations.) Prices for most cattle rations are estimated to increase 11 percent following entry. The feed mix used in semi-intensive beef enterprises will increase 21 percent because of the large proportion of cereals and hay in the ration; both would be more expensive under the CAP.

Our analysis of feed rations supports the budgeting analysis; that is, compound feed prices are estimated to increase. Furthermore, the composition of feed rations may change. Current broiler rations are not likely to change much with entry, but rations for laying hens will probably include more corn and less barley. Corn is also more attractive than barley as an ingredient in hog rations, based on estimated prices for the EC scenario. Feed wheat and sunflower meal may become more important in hog rations after entry. However, no major changes in the composition of cattle rations are foreseen.

In summary, the results of the farm-level analysis pertain to a set of case study farms. Although the types of enterprises represented by these farms are important in the Spanish feed grain and livestock economy, the enterprises do not reflect average production practices for all of Spain. Because most poultry meat, eggs, and pigmeat are produced on modern farms like those described in the budgeting analysis, results for these farms are more likely to reflect the overall impact of accession than are results for other sectors. Our analysis is based on estimates of the actual prices Spanish farmers would have received in 1979 if Spain had been a member of the EC. Different assumptions concerning the prices paid and received would, of course, alter the results.

CONCLUSIONS

We have used two approaches to analyze the likely adjustments of Spain's grain and livestock sectors to entry into the EC. The aggregate approach is based on a national simulation model estimated with time-series data for the 1960-78 period. We developed two scenarios to project production, consumption, and trade to 1990. The baseline projections reflect the expected evolution of production and consumption if the explanatory variables, mainly prices, continue to develop as in the recent past. The EC scenario is based on projections of CAP prices and on assumptions about how these prices will be translated into farm-level prices in Spain.

The second approach focuses on the adjustment of production at the farm level through the use of enterprise budgets and a linear programming model of livestock rations. We compared two sets of prices--one, the actual prices prevailing in Spain in 1979 (baseline scenario), and the other, the estimated prices that would have prevailed under the CAP (EC scenario). The enterprise budgets pertain to a particular set of farms and rely on estimates of farm-level prices rather than on projected policy prices. The EC scenario budgets assume that the basic input combinations for each enterprise are the same as those for the 1979 baseline.

Each approach is designed to examine a specific set of questions. The aggregate approach treats production, consumption, and trade, and it is based on a comparison of projections for Spain as a member of the EC with projections assuming a continuation of past trends. The farm-level approach estimates the differences in gross margins and feed-ration composition if Spanish producers had operated under EC prices in 1979. Although the two approaches are aimed at different questions, they are designed to be complementary. The results of the farm-level analysis generally support the aggregate results and indicate the nature of expected adjustments, although minor differences sometimes occur. These differences result from differing assumptions about the prices paid and received by producers. Some variation may occur because the farm-level approach relates to case study farms, whereas the simulation model more nearly reflects national averages.

Our purpose is to develop a set of conclusions on how Spain's feed grain and livestock economy will adjust to EC entry. We will summarize and reconcile the two approaches where they differ. Others have carried out similar studies. To broaden the assessment of the implications of Spanish accession to the EC, we will refer to these studies in developing overall conclusions. Finally, we will discuss the implications of the expected adjustments on Spain, the EC, and other countries.

Adjustment of Spain's Feed Grain and Livestock Economy

Following a discussion of the aggregate and farm-level results for each commodity sector, we summarize the conclusions from other studies and present expert opinions obtained during the fieldwork in Spain. The four independent studies referred to in this section include informal assessments by USDA's Foreign Agricultural Service (FAS) (31), by Agra-Europe (1), a European agricultural journal, and by a group of Spanish experts (2); the fourth study is based on a large programming model developed by Garry Smith (26). We use the results from these sources to develop an overall conclusion for each sector.

Grains and Other Feedstuffs

The aggregate analysis suggests that accession to the EC will cause total cereal acreage to decline slightly, whereas the baseline projections indicate a slight increase. Wheat acreage declines by similar amounts in both scenarios. Total barley acreage increases in both scenarios, although less rapidly in the EC scenario than in the baseline. Total corn acreage declines slightly more in the EC projections.

The farm-level analysis indicates that certain types of farms will have an incentive to switch from wheat to barley, suggesting that barley acreage would have been greater in 1979 under the CAP than under actual Spanish prices. Gross margins for irrigated wheat and corn did not change.

The results of the two approaches are consistent except for barley. Although barley acreage increases in the projections, it is lower for the EC scenario than for the baseline. The ratio of wheat to barley prices in both analyses is 1.0 to 1.13. However, the institutional prices used to simulate the Spanish sectors after entry are higher than in the baseline scenario. The EC scenario for the farm-level analysis assumes higher prices for barley and lower prices for soft wheat in 1979. Because of the inclusion of cross-effects in the aggregate model and the use of projected institutional prices rather than estimated farm-level prices, the two analyses differ.

The evolution of grain production follows acreage projections. Between 1980 and 1990, wheat output declines in both scenarios of the aggregate analysis, whereas barley production increases. However, by 1990, wheat production is projected to be higher and barley production to be lower in the EC scenario. The projections allow for yield increases. The farm-budget analysis indicates that barley acreage would be higher for the EC scenario. The budget analysis also suggests that increases in wheat and corn production will come from improved yields rather than from expanded acreage.

Discrepancies in the production estimates between the aggregate and farm-level analyses are the result of differences in the institutional and farm-level prices that the two approaches assume. Nevertheless, the farm-level results do not contradict the overall conclusion that wheat production will continue to fall and barley production will rise. Neither approach suggests that there is much potential for corn production to expand.

Total feed grain use is projected to be less following acccession. The farm-level approach does not allow conclusions on total feed grain use, but does suggest that shifts in relative prices will encourage corn use in place of barley in some livestock rations. The aggregate analysis also indicates a moderate shift in the proportion of total feed grains fed in favor of corn. In 1990, corn and sorghum are projected to make up 51.6 percent of total feed grain consumption in the baseline projections, while barley and oats will account for 47.7 percent. For the EC scenario, the proportions are 52.5 percent for corn-sorghum and 46.5 percent for barley-oats. The lower demand for barley, combined with projected production increases, will lead to barley surpluses. The farm-level analysis supports this conclusion. Both approaches suggest that deficits in corn and sorghum will continue to increase. However, because of the lower total feed grain demand predicted by the simulation model, corn imports are expected to be lower after accession.

The least-cost ration analysis, undertaken as part of the farm-level analysis, indicates that changes in broiler rations will be minimal, whereas the EC price structure should encourage corn use in swine and layer rations. Less soybean meal may be used in swine rations if corn-sunflower meal feeds become more common. The aggregate analysis of feed use is based on the assumptions that fewer feed grains will be used in livestock rations, greater amounts of soybean meal will be used in poultry rations, and less soybean meal will be used in hog rations. Thus, soybean demand should not be greatly affected by entry. Sunflower meal and forage use may increase following entry, but the potential for greater use of manioc depends primarily on infrastructural issues related to the handling and transport of this product.

Wheat and rye are not currently used extensively for livestock feed. The aggregate projections indicate that this situation is not likely to change after entry. The farm-level analysis indicates that wheat may enter least-cost rations for hogs and will be considerably cheaper than corn.

Human consumption of bread cereals will likely continue to decline whether or not Spain joins the EC. Thus, the lower projected output for wheat will probably be sufficient to meet demand. Both scenarios for the simulation model show deficits in 1990 for bread cereals, but these deficits do not differ significantly from the small net imports recorded in the late seventies. The farm-level analysis also suggests that the EC price structure may lead to greater cultivation of durum wheat. Because data were unavailable, we could establish no statistical relationships for durum wheat at the national level.

The FAS study (31) concluded that Spain's entry into the EC will encourage a shift from soft wheat to barley. If Spain does not join the EC, FAS predicts that barley production will be slightly lower than consumption. With accession, however, FAS projects a surplus of more than 1.5 million tons by 1988. Corn production is projected to be the same in both scenarios, but consumption is much lower in the EC scenario. The FAS study generally supports the results of our analysis, suggesting that total feed grain consumption will be about 9 percent less following entry. FAS also foresees some shifting from soft wheat to durum wheat, barley, and other crops when Spain joins the EC. FAS predicts declining bread consumption and suggests that Spain would import 400,000 tons of wheat as a member of the EC.

The report prepared by the staff of Agra-Europe (1) suggests that soft wheat production may be lower with accession because its relative price in the EC is lower. Agra-Europe comes to the same conclusions concerning durum wheat production and barley surpluses as does FAS. Its researchers foresee little scope for expanded corn production, and they expect Spain's continued dependence on imported U.S. corn. They argue that accession to the EC will force the Spanish feed-manufacturing industry to make significant adjustments as the cost of feed grains rises. They believe the use of feed wheat and manioc in livestock rations will increase. Manioc could displace domestic cereals in feed compounds and increase the need for imported soybeans. Finally, the Agra-Europe researchers emphasize the importance of the change in SENPA's role in wheat marketing.

A Spanish study (2) foresees difficulties for cereal producers following Spain's entry into the EC. The author suggests that only hard and durum wheat production will prove advantageous when Spain joins the EC. This study emphasizes the problems of low yields for cereals, the cultivation of cereals on marginal land better suited for pasture, and the small size of many Spanish farms which suggest that these cereal producers will be at a disadvantage in competing with European producers.

Using a large, quadratic programming model, Smith analyzes the effects of Spanish accession on production, consumption, and trade of feed grains and oilseeds (26). He concludes that wheat, rye, and oat production would have been lower in the late seventies if Spain had been in the EC, but barley, corn, and sorghum acreage would have been greater. Smith concludes that the cost of mixed feeds will be higher under the CAP. Higher grain prices lead to greater use of nongrain substitutes (manioc), which implies increased need for protein meal in the rations.

Most of the conclusions in these four studies are consistent with those in our analysis. The principal inconsistency is the conclusion from our simulation projections that barley production would be slightly lower in the EC scenario. This situation occurs because the EC scenario assumes that average wheat and barley prices will both be higher after entry, whereas all the other studies assume that soft wheat prices will be slightly lower, and barley prices will be much higher.

The following conclusions can be drawn concerning cereal grains and feed rations:

- Wheat production in Spain will likely decline over the next 10 years and may be somewhat lower after entry. However, consumption will also decline so that Spain will probably remain nearly self-sufficient in wheat. CAP prices will provide some incentive to expand durum wheat production.

- Barley production will be encouraged by accession to the EC, but domestic use will expand more slowly. Spain may have barley surpluses of 2-4 million metric tons by 1990. These surpluses are greater than expected under the baseline scenario.

- Corn production has probably reached its peak. There seems to be little potential for acreage expansion, although improved yields may lead to small production increases. Demand for corn will remain strong. Under the projected EC price relationships for feed grains, the proportion of total corn consumption will be slightly higher, whereas the proportion for barley will be lower. Thus, Spain will continue to need to import corn. However, the lower growth rate in feed grain use following accession will mean that Spain will import less corn.

- Higher feed grain prices in the EC will slow the growth rate for feed grain use in livestock rations. Feed wheat consumption may increase, and more use will likely be made of forage and pasture in the production of ruminant animals and animal products. Accession to the EC will not greatly affect Spain's demand for imported soybeans and soybean meal.

Beef and Veal

The simulation model projects that beef and veal production will be slightly lower with EC entry. The farm-level analysis suggests that increased feed costs and lower beef prices in the EC will considerably reduce the net margins realized from the more intensive cattle-fattening operations. Therefore, this sector may have an economic incentive to reduce the use of feed grains in favor of forage. Structural changes will also be encouraged for producers to gain economies of scale. Because the beef and veal sector is less modern than other livestock sectors, it may have more difficulty in adjusting to the changes following entry.

Beef and veal consumption is projected to be lower in the EC scenario. Lowered consumption levels resulting from higher EC meat prices will probably be sufficient to reduce production deficits. Nevertheless, large beef and veal deficits are predicted in both scenarios.

The FAS study (31) notes that current production practices and an inefficient marketing system have caused relatively high consumer prices for beef. FAS researchers did not attempt to quantify production and consumption adjustments, but they anticipated a steady increase in production. The authors of the *Agra-Europe* report (1) argue that accession will harm Spanish beef production despite the EC's slightly higher intervention prices. They suggest that the generally low level of development of this sector will keep it from competing with other EC producers. Hence, continuing deficits in beef will likely be balanced by imports from the EC that replace current imports from Latin America. The study by the Spanish group (2) also predicts difficulties for Spanish beef producers following accession.

All these studies support the conclusion that Spain's growth in beef production will be adversely affected by entry into the EC. Higher consumer prices in the EC will simultaneously restrain consumption so that accession will retard the growth in beef deficits. Nevertheless, these deficits are likely to be quite large by 1990 and would probably grow whether or not Spain joins the EC.

Swine

The aggregate analysis indicates that pigmeat production will continue to expand under the CAP. This result differs from the farm-level analysis, which suggests lower gross margins for hog producers following accession. The prices used in the EC scenario in the aggregate analysis are higher than those used in the baseline, more than offsetting the rise in feed costs associated with accession. In the farm-level analysis, feed cost increases are much greater than increases in prices received. The different assumptions about prices lead to different results.

Spain's swine sector is quite modern and may be able to adapt to changing conditions. The linear programming analysis suggests that hog rations may change from current low-energy, barley-soybean meal toward higher-energy, corn-soybean or sunflower meal that allows a better feed conversion. Production may expand over the projection period even with the lower baseline prices. The farm-level analysis indicates that, although the gross margins for hog producers will be considerably reduced by entry, they will still be positive. Although higher feed costs will probably reduce the profitability of this sector after entry, output will probably continue to grow.

The authors of the FAS study (31) believe that the modern swine sector in Spain will continue to expand. They project production of 1.2 mmt in 1988, a little higher than the 1.1 mmt predicted for 1990 by our simulation model for the EC scenario. The *Agra-Europe* report (1) agrees with FAS, noting that Spain could even export pigmeat if the problem of African Swine Fever can be overcome. The *Agra-Europe* researchers believe consumption may also increase. The Spanish study (2) also suggests that the swine sector will be able to compete well within the EC. All these sources note problems in sanitation and market organization that could affect the future viability of Spain's swine industry.

Generally, the growth in pigmeat production will not be slowed appreciably by accession. Higher consumer prices in the EC will stabilize consumption with surpluses likely in the late nineties. However, unless African Swine Fever can be eliminated, projections for pigmeat would be effectively limited by domestic demand. In this case, the actual prices received by farmers could be closer to those used in the farm-level analysis, suggesting a somewhat lower rate of production growth.

Poultry Meat and Eggs

The aggregate analysis suggests that poultry meat and egg production will be restrained by the higher feed costs in the EC. The farm-level analysis supports this conclusion. In the aggregate analysis, the real prices received are assumed to be lower in the EC scenario. In the farm-level analysis, the prices received for broilers are lower in the EC scenario, whereas those for eggs are the same. Higher feed costs, in combination with these price assumptions, lead to much slower growth in the poultry and egg sectors following accession.

Poultry meat and egg consumption are projected to increase moderately whether or not Spain joins the EC. Accession to the EC will lead to relatively small production deficits in poultry meat. This projection is in contrast to the projected surplus recorded in the baseline scenario for 1990. The lower egg production projected for the EC scenario results in a significant deficit in contrast to the small surplus projected in the baseline scenario. Although the size of the deficits in the EC scenario may be exaggerated, it is unlikely production will expand beyond self-sufficiency if Spain joins the EC.

The FAS study (31) suggests that poultry meat production will continue to grow moderately following accession, reaching 1.1 mmt in 1988. This level is similar to that predicted for 1990 in the baseline scenario, but is higher than the 978,000 metric tons projected for 1990 in the EC scenario. The FAS group also projects egg production will increase, reaching 910,000 metric tons in 1988, compared with projections of 756,000 metric tons and 666,000 metric tons in the baseline and EC scenarios, respectively. The FAS study also foresees a potential for continued rapid growth in the consumption of these products.

The writers of the Agra-Europe study note the advanced technology of the Spanish poultry meat industry and conclude that this sector has little to fear from accession. They note that the industry could be harmed by higher feed costs, but conclude that surpluses will develop, partly because they believe consumption is not likely to expand as rapidly as production. They reach similar conclusions for eggs. The author of the Spanish study (2) also predicts continued expansion of production and the development of surpluses.

The conclusions of these studies differ from those in our study where both aggregate and farm-level analyses indicate that poultry meat and egg production will grow more slowly than in the past because of an expected sharp increase in feed costs. The aggregate analysis may underestimate production, but even with somewhat higher production levels and allowing for only moderate growth in consumption, Spain is unlikely to develop large poultry meat and egg surpluses. Thus, we conclude that higher feed costs will slow the growth rate of the poultry industry. Because further increases in consumption are likely to be small, Spain is expected to remain self-sufficient following accession, but will probably not become a major exporter of poultry meat and eggs.

Sheep and Goat Meat

The sheep and goat sectors are extremely heterogeneous. Spain employs traditional, extensive systems of production and more modern, intensive systems. Seasonal imbalances in supply and demand lead to significant price fluctuations. Per capita consumption of sheep and goat meat has been virtually unchanged over the past 20 years, and it is not expected to deviate greatly from the current 4 kg. per person per year.

The aggregate analysis indicates that production of sheep and goat meat will be lower with accession. Because the simulation model is based on historical trends, the tendencies of the past 20 years are built into the equations. Over this period, the traditional sheep and goat sector has declined or remained stagnant; this situation is projected to persist in the baseline scenario. The growing unwillingness of people to work as shepherds has contributed to the sector's decline. Accession to the EC is projected to worsen the situation.

The farm-level analysis is concerned only with the production of high-quality lambs grown in an intensive system. Although feed costs are higher and gross margins smaller under the CAP, this type of operation might be able to adjust to membership in the EC. The future of this component of the sheep sector depends primarily on the ability of farmers to develop improved production systems aimed at producing high-quality lambs for the Spanish market and for export to other EC countries where consumers prefer meat from heavier lambs than Spain currently raises.

The Agra-Europe report (1) notes that Spain is almost self-sufficient in sheep meat and may be able to supply a part of the EC's deficit after entry. Spain's export potential may lie in the production of heavy lambs, but considerable adjustment will be required if the sheep meat sector is to expand. The authors of the Spanish study believe that the sheep sector will not be hurt by accession. They also note the need for investment and adjustment of the production systems because of high labor costs and differing tastes in other European countries.

The decline in the sheep and goat sector projected by the simulation model for the EC scenario results primarily from the EC's lower predicted prices. However, the EC's new sheep meat policy allows member countries to set independent target prices. Thus, the predicted EC prices used in the projections may be too low. Higher prices would modify the projections, but not enough to cause major production increases. It is likely that specialized lamb production will expand following accession, but the more traditional mutton and goat meat sector will probably continue to decline.

Milk

The simulation model projects substantial increases of 25-30 percent in total milk production in both the baseline and EC scenarios over the 1980-90 period. Production increases are slightly less in the EC scenario--2 percent less for cow milk and 7 percent less for sheep and goat milk.

The farm-level analysis indicates that, although higher feed costs and lower milk prices will reduce gross margins, large dairy operations will remain profitable under the CAP. Over time, it is anticipated that dairy farms supplying urban fluid milk markets will become larger and more efficient, whereas many milk producers may have difficulty adjusting to the changing marketing conditions in the EC.

The aggregate demand analysis projects a leveling off of per capita milk consumption, whereas EC consumption levels are estimated to decrease significantly. In both the baseline and EC scenarios, milk surpluses develop by 1985 and 1990, so production continues to expand faster than consumption. However, there is reason to believe that the simulation model overestimates the rates at which production will actually increase. It is also doubtful that consumption levels will decrease as the EC scenario projects.

The FAS report (31) concludes that Spain will be unable to compete with other European countries in manufactured dairy products, but will be able to maintain its current self-sufficiency in fluid milk. The Agra-Europe group (1) notes the large number of small dairy operations and the higher Spanish milk prices, arguing that any price reduction following accession will have adverse effects on milk production. These authors conclude that the EC could increase its exports of dairy products to Spain after accession. The author of the Spanish study (2) notes that Spanish policy has been oriented toward assuring adequate supplies whereas EC policy focuses on the elimination of surpluses. He suggests that the Spanish dairy sector has been modernizing rapidly in recent years and must continue this trend if it is to compete effectively in the EC.

The authors of these four studies seem to agree that Spanish dairy production will be lower following accession. Our aggregate analysis predicts continued growth in dairy production in both scenarios, although the projected 1990 level is slightly lower for the EC scenario. But, this production growth will require a fairly substantial transformation of the dairy sector. There does not appear to be much potential for further increases in consumption levels, except for some types of cheese. Consequently, if the projected production increases do not materialize, Spain will likely remain self-sufficient in milk. If production increases do occur, Spain may add to the problem of surplus milk in the EC. We conclude that Spain will not be able to absorb a significant portion of European dairy surpluses when it becomes a member of the EC.

Implications

Spanish accession to the EC will cause adjustments in the Spanish feed grain and livestock economy. These changes will affect the EC and third countries as well as Spain's own producers and consumers.

Impact of Accession in Spain

The Spanish Government will be faced with a number of policy issues following accession. Substantial deficits are projected for beef and corn at the same time that barley surpluses are increasing. Imports of corn will be burdensome because they will directly affect the balance of payments. Furthermore, revenues from the variable levy must be paid to the EC, reducing the current income from this source and adding to the balance of payments deficit with the rest of the EC. Disposal of the barley surplus will be a problem for the EC, but Spanish authorities will undoubtedly encourage domestic barley use at the expense of imported corn.

The projected beef deficits will also constitute an undesirable situation from the viewpoint of the Spanish Government. Accession could lead to surplus pigmeat production. However, pigmeat surpluses can only be exported if African Swine Fever is eliminated. But, the production of poultry meat, which is an exportable product, will likely expand only enough to meet domestic demand. If the projected evolution of meat production and consumption occurs, the Spanish Government may want to adjust relative meat prices through adjustments in "green rates" and MCA manipulations. Higher beef and poultry meat prices would stimulate production and restrain consumption. Lower hog prices would have the reverse effect. Thus, a set of relative meat prices different from the ones used in this analysis could have the salutory effect of reducing beef deficits and pigmeat surpluses while increasing poultry meat exports.

Accession to the EC will generally increase the proportion of consumers' budgets devoted to food. Consumers are projected to consume less meat and milk when Spain joins the EC, deriving a greater proportion of total caloric intake from other foods.

In addition to the adjustments induced by the imposition of the EC price regime, Spain's accession will lead to changes in its institutions. New marketing channels for bread cereals will be required as the role of SENPA is altered. The current system of state trading for all livestock products will be modified with entry. A greater number of private traders and distributors may, therefore, be required to assure the orderly marketing of livestock products and cereal grains.

Impact of Accession on the EC

The major implication for European feed grain and livestock sectors is that few complementarities exist between current EC surpluses and deficits and potential Spanish surpluses and deficits. Our conclusion is supported by a report by the EC Commission, suggesting that Spanish market outlets will do little to alleviate existing surpluses (3). The EC is currently a little more than self-sufficient in barley so that the projected barley surplus in Spain will add to the EC's surplus disposal problem. Both the EC and Spain import corn and sorghum, and this situation will not be affected by Spain's accession.

The EC may be able to export some of its beef surplus to Spain, displacing imports from Latin America. However, little potential exists for expanded EC dairy exports to Spain. If Spain makes structural changes, its more efficient dairy sector may actually add to the EC surplus. Some European informants have blamed the EC's current surplus of milk on the low cost of imported feed, particularly soybeans. The current variable levy on soybean imports in Spain will be eliminated, and entry will increase the likelihood that Spanish dairy farms will become like those in the rest of Europe. This situation could contribute to increased milk surpluses in the enlarged EC.

Spain will continue to import large quantities of soybeans to extract the meal for feed rations. However, policies toward oilseeds, including import policies on soybeans, will be an area of controversy in an enlarged EC. Spanish olive oil production will add to the EC surplus. Although soybean meal will be needed for livestock feeding, the oil from soybean crushings could become a greater burden. The large Spanish crushing capacity and the need for soybean meal in feed rations should make it easy for Spain to adopt the EC's more liberal soybean trade policy. However, olives are an important crop in Spain's agricultural economy, and there are limited alternative uses for land now in olive groves. Spain may join other groups in the EC in demanding import restrictions on soybeans to reduce dependence on foreign suppliers and to lessen competition with olive oil.

Spain's production of sunflower seeds has increased in recent years. Maintaining or increasing the current barriers to soybean imports would encourage feed compounders to substitute domestically produced sunflower meal for imported soybean meal. However, the possibilities of substituting alternative protein sources for soybean meal appears limited, and it is unlikely that Spain would want to leave much of its extensive soybean crushing capacity idle.

A key element in the vegetable oil situation in the enlarged EC is eliminating the restrictions on soybean oil consumption in Spain. The Spanish Government is likely to request an exemption to EC rules on consumption quotas because eliminating these quotas would reduce olive oil consumption in Spain and would increase the EC's olive oil surplus. There are currently no restrictions on the entry of soybean oil into the EC, yet most Spanish soybean oil exports go to North Africa and the Middle East. If the EC allows Spain to retain consumption restrictions on soybean oil, exports to other EC countries might increase little, if at all.

Several sources, including the EC Commission report, conclude that the major problems associated with Spain's accession are related to Mediterranean crops such as olive oil, wine, and fruits and vegetables. The authors of the Agra-Europe report (1) state that some form of tax on vegetable oils that compete with olive oil is inevitable in the enlarged EC. Although we do not deal here with Mediterranean products, any consideration of European soybean use must include an assessment of changes in the EC's vegetable oil policy.

The EC is currently faced with a mounting budget crisis caused by the need for substantial intervention purchases, especially dairy products, and the costs of surplus disposal. Budget pressures have led to many suggestions for CAP reform. Our analysis suggests that Spain's membership in the EC will not alleviate the problem of surplus production and, in some cases, may make it worse. Thus, as Spain and other new members are integrated into the EC, pressures may develop to change both the mechanisms for implementing European agricultural policy and the processes by which that policy is made.

Implications of Accession for Trade with Third Countries

The United States and some Latin American countries are the major trading partners that will be affected by Spain's accession to the EC. Traditional links with Latin America may be altered as Spain implements the preferential trade policies with African, Caribbean, and Pacific countries as defined in the EC's Lomé Convention, although there will be no direct effect on grain-livestock trade. Some trade diversion may occur if Spain switches to European beef imports at the expense of Argentina.

The primary focus here is on the implications for Spain's other major trading partner, the United States. We will concentrate on assessing the likely impact of accession on U.S. trade with Europe.

The growth in feed grain consumption is projected to be slower in Spain after entry into the EC. Thus, total imports of corn and sorghum may expand less rapidly as Spain is integrated into the EC. Nevertheless, corn and sorghum exports to Spain can be expected to grow and the degree of Spain's self-sufficiency in these products is not likely to change much.

From the viewpoint of U.S. corn exporters, Spain's accession will lead to somewhat slower growth in Spanish imports. However, trade patterns may shift following entry as Spain will no longer apply a variable levy to French corn. France is the only member of the EC which currently produces more corn than it consumes. Because of its geographical proximity and because of EC preferences, French corn can reach Spanish markets more cheaply than U.S. corn. Therefore, some U.S. corn exports to Spain may be replaced by French exports. However, as the EC as a whole is far from self-sufficient in corn, sales of French corn in Spain imply increased needs for U.S. corn in other parts of the EC.

The United States occasionally exports small quantities of wheat to Spain. The projected small wheat deficits in Spain will likely be filled by other members of the EC following accession. U.S. exports of other cereal grains to Spain are insignificant, and any displacement of these small U.S. wheat exports by other countries in the EC will have a minor impact on U.S. wheat trade.

Spain's need for imported soybeans will not be significantly affected by accession. The use of soybean meal in livestock feeds should continue to grow, unless the EC institutes new policies on soybean imports. U.S. soybean exports to Europe will be affected by vegetable oil policies which are developed in Europe; these policies will be influenced by the entry of the three major olive-oil-producing countries (Spain, Portugal, and Greece).

In general, Spain's accession to the EC will not cause major changes in U.S. exports of grains and oilseeds. The relatively small impact on demand for imported feedstuffs in Spain will be gradual. The significant issue from the perspective of U.S.

policymakers is not enlargement per se, but the desire on the part of many Europeans, including the Spanish, to achieve self-sufficiency in food. The desire to reduce dependency on imported agricultural products may lead to EC policies that would affect not only U.S. corn, sorghum, and soybean exports but also sales in Europe of other imported feedstuffs such as manioc. However, the EC will probably remain partially dependent on foreign supplies of feed grains, oilseeds, and non-feed grain energy sources for the foreseeable future. Spain's accession to the EC will not significantly alter this situation.

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APPENDIX A: SIMULATION MODEL FOR SPAIN'S FEED GRAIN AND LIVESTOCK SECTORS

The purpose of this appendix is to present the structure of the simulation model in detail. A list of variable names and units precedes the estimated equations and identities which make up the model components. A full description of the model, estimation procedures, and data can be found in Peterson (23). Standard errors for the coefficients of the estimated equations are shown in parentheses, and the R^2, Durbin-Watson (D.W.) statistic, and degrees of freedom (d.f.) are set out below the equations. The subscript t represents the current year.

Appendix table A-1--Model variables and symbols: Endogenous

Symbol	Unit	Description
Cattle model:		
1. BH	1,000 head	Cows and bulls (breeding herd) on farms
2. COWS	do.	Number of cows on farms
3. COWM	do.	Number of cows milked
4. CA	do.	Number of calves available for slaughter
5. VSCA		Proportion of calves available slaughtered as calves (VS/CA)
6. VS	do	Number of calves slaughtered
7. SHS	do.	Steers and heifers slaughtered
8. CBS	do.	Cow and bull slaughter
9. BFS	do.	Total beef cattle slaughter (SHS + CBS)
10. VSW	Kilograms	Dressed slaughter weight, calves
11. BFSW	do.	Dressed slaughter weight, beef cattle
12. DY	Liters	Milk per cow per year
13. VPROD	Metric tons	Veal production
14. BPROD	do.	Beef production
15. DPROD	Million liters	Cow milk production
Hog model:		
1. SOW	1,000 head	Number of sows on farms
2. PIGS	do.	Pig crop
3. THSL	do.	Total hog slaughter
4. LESL	do.	Slaughter of suckling pigs
5. HSL	do.	Mature hog slaughter
6. LSW	Kilograms	Live hog slaughter weight
7. HSLW	do.	Dressed hog slaughter weight
8. HPROD	Metric tons	Pigmeat production
9. LPROD	do.	Suckling pig production
Sheep and goat model:		
1. FEM	1,000 head	Number of female sheep and goats
2. YM	do.	Lamb and kid slaughter
3. ADULT	do.	Sheep and goat slaughter
4. MKPROD	Million liters	Sheep and goat milk production
5. YMPROD	Metric tons	Lamb and kid meat production
6. ADPROD	do.	Mutton and goat meat production
7. YMSW	Kilograms	Lamb/kid dressed slaughter weight
8. ADSW	do.	Sheep/goat dressed slaughter weight

See notes at end of table.

Continued--

Appendix table A-1--Model variables and symbols: Endogenous--continued

Symbol	Unit	Description
Poultry meat and egg models:		
1. NBS	1,000 head	Number of broilers slaughtered
2. TPPROD	Metric tons	Total poultry meat production
3. BRPROD	do.	Broiler meat production
4. SLAY	1,000 head	Number of selected laying hens
5. TPEGPR	Million dozen	Total poultry egg production
6. SEPROD	do.	Selected layer egg production
7. AEPROD	do.	Production of all eggs
Crop model and land use:		
1. WDA	1,000 hectares	Dryland wheat acreage
2. WIA	do.	Irrigated wheat acreage
3. BDA	do.	Dryland barley acreage
4. BIA	do.	Irrigated barley acreage
5. CDA	do.	Dryland corn acreage
6. CIA	do.	Irrigated corn acreage
7. RA	do.	Total rye acreage
8. OA	do.	Total oat acreage
9. SA	do.	Total sorghum acreage
10. ROSA	do.	RA + OA + SA
11. ROSDA	do.	Dryland rye, oat, sorghum acreage
12. WBCIA	do.	WIA + BIA + CIA
13. WBCDA	do.	WDA + BDA + CDA
14. TICA	do.	Total irrigated cereal acreage
15. TDCA	do.	Total dryland cereal acreage
16. TCA	do.	Total cereal acreage
17. TFOR	do.	Total forage acreage
18. DFOR	do.	Dryland forage acreage
19. TOCA	do.	Total other crop acreage
20. TOCIA	do.	Irrigated acreage in other crops
21. TOCDA	do.	Dryland acreage in other crops
22. TDA	do.	Total dryland acreage
23. WDY	Kilograms/hectare	Dryland wheat yield
24. WIY	do.	Irrigated wheat yield
25. BDY	do.	Dryland barley yield
26. BIY	do.	Irrigated barley yield
27. CDY	do.	Dryland corn yield
28. CIY	do.	Irrigated corn yield
29. RY	do.	Average rye yield
30. OY	do.	Average oat yield
31. SY	do.	Average sorghum yield
32. WPROD	1,000 metric tons	Total wheat production

See notes at end of table. Continued--

Appendix table A-1--Model variables and symbols: Endogenous--continued

Symbol	Unit	Description
33. BAPROD	do.	Total barley production
34. CPROD	do.	Total corn production
35. RPROD	do.	Rye production
36. OPROD	do.	Oat production
37. SPROD	do.	Sorghum production
Demand model: 1/		
1. XB	Log kilograms	Beef and veal
2. XM	do.	Milk
3. XP	do.	Pigmeat
4. XC	do.	Poultry meat
5. XSG	do.	Sheep/goat meat
6. XEG	do.	Eggs
7. XBC	do.	Bread cereals
8. XOF	do.	Other food
9. XNF	do.	Nonfood items
10. WB		Beef/veal value share
11. WM		Milk value share
12. WP		Pigmeat value share
13. WC		Poultry meat value share
14. WSG		Sheep/goat meat value share
15. WEG		Egg value share
16. WBC		Bread cereal value share
17. WOF		Other food value share
18. WNF		Nonfood value share
19. QT	Log/kilograms	Real income term
20. BFC	Kilograms/year	Per capita consumption of beef/veal
21. MKC	do.	Per capita milk consumption
22. PKC	do.	Per capita pigmeat consumption
23. CHC	do.	Per capita poultry meat consumption
24. SGC	do.	Per capita sheep/goat meat consumption
25. EGC	do.	Per capita egg consumption
26. BRC	do.	Per capita bread cereal consumption
27. OFC	do.	Per capita other food consumption
28. NFQ		Per capita nonfood consumption
29. TBF	Metric tons	Total beef consumption
30. TMK	do.	Total milk consumption
31. TPK	do.	Total pigmeat consumption
32. TCH	do.	Total poultry meat consumption
33. TSG	do.	Total sheep/goat meat consumption
34. TEG	do.	Total egg consumption
35. TOF	do.	Total other food consumption

See notes at end of table.

Continued--

Appendix table A-1--Model variables and symbols: Endogenous--continued

Symbol	Unit	Description
Other endogenous variables:		
1. FDEM	1,000 metric tons	Total feed grain disappearance
2. BCFDC	do.	Bread cereals fed
3. BOFDC	do.	Barley and oats fed
4. SCFDC	do.	Corn and sorghum fed
5. SOYCON	do.	Soybean meal fed
6. MKFD	do.	Milk fed to animals
7. BCDIS	do.	Total bread cereal disappearance
8. BODIS	do.	Total barley/oat disappearance
9. SCDIS	do.	Total corn/sorghum disappearance
10. MKDIS	do.	Total milk disappearance
11. BCSTK	do.	Change in bread cereal stocks
12. BOSTK	do.	Change in barley/oat stocks
13. SCSTK	do.	Change in corn/sorghum stocks
14. BCAV	do.	Domestic bread cereal availability
15. BOAV	do.	Domestic barley/oat availability
16. SCAV	do.	Domestic corn/sorghum availability
17. MKAV	do.	Cow, sheep and goat milk availability
18. BCTR	do.	Net trade in bread cereals
19. BOTR	do.	Net trade in barley and oats
20. SCTR	do.	Net trade in corn and sorghum
21. BFTR	Metric tons	Net trade in beef and veal
22. PKTR	do.	Net trade in pigmeat
23. CHTR	do.	Net trade in poultry meat
24. MKTR	do.	Net trade in milk
25. SGTR	do.	Net trade in sheep/goat meat
27. EGTR	do.	Net trade in eggs

Blanks indicate not applicable.

1/ One through nine are weighted log change dependent variables in Rotterdam demand system.

Appendix table A-2--Model variables and symbols: Exogenous variables

Symbol	Unit	Description
DRET	Pesetas	Milk yield times milk price
BRET	do.	Cull beef price times slaughter rate
BREP		Cattle replacement rate
CULL		Cattle cull rate
CR		Calving rate
FD	Pesetas/kilogram	Cost of calf feed (deflated)
CP	do.	Cattle ("anojo") premium
DPRV	do.	Real price received for calves
DPRC	do.	Real price received for cows/bulls
DPRD	Pesetas/liter	Real price received for cow milk
DPRN	Pesetas/kilogram	Real price received for steers/heifers
L2BHC	1,000 head	Change in breeding herd at t + 2
BH2	do.	Breeding herd at t + 2
DG	Pesetas/kilogram	Real calf price less real feed costs
DWPR	do.	Real price received for wheat
DBPR	do.	Real price received for barley
DCPR	do.	Real price received for corn
DRPR	do.	Real price received for rye
DOPR	do.	Real price received for oats
DSBPR	do.	Real price received for sugar beets
DSPR	do.	Real price received for sorghum
DGOPR	Pesetas/liter	Real price of diesel fuel
DSI		Real agricultural wage index
DPIC		Real cereal price index
FORIR	1,000 hectares	Irrigated forage acreage
TCLB	do.	Total cropland base
TIA	do.	Total irrigated acreage
RICE	do.	Total rice acreage
ROSIA	do.	Irrigated rye, oat, sorghum acreage
OICA	do.	Other cereal irrigated acreage
ODCA	do.	Other cereal dryland acreage
FAL	do.	Total acreage in fallow
DHPR	Pesetas/kilogram	Real price received for hogs
PPS		Surviving pigs per sow
PREP		Hog replacement rate
HCRAT		Hog-corn ratio
DYOPR	Pesetas/kilogram	Real price received for lambs/kids
DADPR	do.	Real price received for sheep/goats
DMKPR	Pesetas/liter	Real price received for sheep/goat milk
DSSAL		Real wage index for shepherds
BRSW	Kilograms	Broiler slaughter weight, dressed
EGY		Eggs per hen per year
CHPI	Pesetas	Relative returns measure for broilers
EGPI	do.	Relative returns measure for eggs
DPOPR	Pesetas/kilogram	Real price received for poultry meat
DEGPR	do.	Real price received for eggs

See notes at end of table.

Continued--

Appendix table A-2--Model variables and symbols: Exogenous--continued

Symbol	Unit	Description
DPCAM	Pesetas/kilogram	Real price of broiler feed
DPCAL	do.	Real price of layer feed
DCONPR	do.	Real price of hog concentrate
OTEG	Million dozen	Goose, duck, and other eggs
POP	Millions	Population
NBRP	Pesetas/kilogram	Nominal retail beef price
NMKRP	do.	Nominal retail milk price
NPKRP	do.	Nominal retail pigmeat price
NCRP	do.	Nominal retail poultry meat price
NSGRP	do.	Nominal retail sheep/goat meat price
EGRP	do.	Nominal retail egg price
BCRP	do.	Nominal retail bread cereal price
OFP	do.	Nominal retail other food price
NFP		Nonfood retail price index
PCE	Pesetas	Per capita consumer expenditure
P1		Beef veal 1/
P2		Milk 1/
P3		Pigmeat 1/
P4		Poultry meat 1/
P5		Sheep/goat meat 1/
P6		Eggs 1/
P7		Bread cereals 1/
P8		Other food 1/
BCEXT		Bread cereal extraction rate
CNSDO	1,000 metric tons	Nonfeed corn/sorghum disappearance
SOYRES	do.	Soybean meal residual correction
DBCPR	Pesetas/kilogram	Real average price received wheat/rye
DBOPR	do.	Real average barley/oat price received
DSCPR	do.	Real average corn/sorghum price received
DGBOP	do.	Real average Government price for barley and oats
DGSCP	Pesetas/kilogram	Real average Government price for corn and sorghum
EGCON	Dozen/kilogram	Conversion rate for eggs, dozens to kilograms
CPI		Projected Spanish Consumer Price Index
ER	Pesetas/European Currency Unit	Projected exchange rate/green rate
CER	Pesetas/kilogram	Projected EC price for cereal grains
SYM	do.	Projected soybean meal price in Spain
FTPI		Projected fertilizer price index
BV	Pesetas/kilogram	Projected EC guide price for beef
MKG	do.	Projected EC price for milk
PGM	do.	Projected EC price for pigmeat

Blanks indicate not applicable.
1/ Deflated log change price variable.

Appendix table A-3--Parameter estimates for the Rotterdam system of demand equations, Spain

Item	μi	$\pi i1$	$\pi i2$	$\pi i3$	$\pi i4$	$\pi i5$	$\pi i6$	$\pi i7$	$\pi i8$	$\pi i9$	R^2	Degrees of freedom	Durbin-Watson statistic
Beef-veal	0.015 (1.77)	-2.564 (1.20)	1.219 (1.04)	-0.656 (.997)	-0.802 (.883)	0.474 (1.43)	-0.321 (.64)	-0.013 (1.215)	1.011 (1.2)	1.654	0.56	9	1.94
Milk	2.236 (.768)	-.092 (.522)	-.012 (.452)	-1.106 (.434)	.655 (.362)	1.475 (.622)	.183 (.278)	-1.142 (.528)	-.499 (.523)	.539	.68	9	2.29
Pork	.386 (2.85)	-1.827 (1.93)	.567 (1.68)	-1.176 (1.61)	-1.07 (1.34)	1.308 (2.3)	-.362 (1.03)	-1.771 (1.96)	-.391 (1.94)	4.72	.46	9	2.23
Poultry	6.598 (1.85)	.479 (1.25)	-2.588 (1.09)	-.907 (1.04)	-.315 (.871)	-.027 (1.49)	-.157 (.669)	2.062 (1.27)	.487 (1.26)	.965	.72	9	1.50
Sheep-goat	-.158 (.551)	.257 (.375)	.408 (.325)	.113 (.311)	.030 (.26)	-.493 (.446)	.047 (.1997)	-.482 (.379)	-.130 (.375)	.250	.46	9	1.30
Eggs	1.922 (1.06)	-1.527 (.718)	-.005 (.622)	.390 (.596)	-.799 (.498)	-.630 (.855)	-.048 (.383)	1.485 (.726)	.667 (.718)	.468	.79	9	2.16
Breads cereals	-.610 (2.309)	1.201 (1.569)	-.083 (1.361)	1.425 (1.304)	1.593 (1.089)	.249 (1.869)	-.282 (.837)	-2.013 (1.588)	-1.278 (1.57)	-.811	.58	9	2.22
Other food	14.978 (5.16)	-3.006 (3.506)	-2.568 (3.04)	1.034 (2.91)	.341 (2.43)	-.208 (4.18)	2.567 (1.87)	3.168 (3.55)	-9.944 (3.51)	8.616	.78	9	1.74
Nonfood items	74.633	7.081	3.061	.883	.476	-2.147	-1.085	-1.293	10.077	-17.052			

Parameter estimates and standard errors should be divided by 100.
Standard errors in parentheses.
Blanks indicate not applicable.

I. Production components

A. Cattle model

(1) $BH_t = 1412.31 + 0.568*BH_{t-1} + 0.0091*DRET_{t-1} - 0.0032*BRET_t - 599.03*DCOST_t$

Standard errors: (768) (0.16) (0.023) (0.027) (286)

$R^2 = 0.94$ D.W. = 2.08 d.f. = 11

(2) $COWS_t = 1384.28 + 0.565*COWS_{t-1} + 0.0094*DRET_{t-1} - 0.0008*BRET_t - 591.35*DCOST_t$

Standard errors: (764) (0.161) (0.023) (0.027) (285)

$R^2 = 0.94$ D.W. = 2.08 d.f. = 11 h = -0.005

(3) $CA_t = CR_t*COWS_t - CULL_t*BH_{t+2} - (BH_{t+3} - BH_{t+2})$

(4) $VSCA_t = 0.4056 - 0.0178*CP_t + 0.00999*DPRV_t - 0.0224*DPRN_t + 0.0911*FD_t$

Standard errors: (0.29) (0.008) (0.017) (0.024) (0.022)

$R^2 = 0.83$ D.W. = 0.97 d.f. = 10

(5) $VS_t = VSCA_t*CA_t$

(6) $SHS_t = (1 - VSCA_{t-1})*CA_{t-1}$

(7) $CBS_t = CULL_t*BH_t$

(8) $BFS_t = SHS_t + CBS_t$

(9) $COWM_t = 0.766*COWS_t$

(10) $VSW = 5760.28 + 2.982*YEAR + 0.522*DG$

Standard errors: (552) (0.279) (0.476)

$R^2 = 0.91$ D.W. = 0.97 d.f. = 14

(11) $BFSW = 9653.93 + 5.012*YEAR + 1.15*CP$

Standard errors: (541) (0.275) (0.425)

$R^2 = 0.98$ D.W. = 1.36 d.f. = 14

(12) $DY = -104270.0 + 54.15*YEAR$

Standard errors: (8870) (4.5)

$R^2 = 0.91$ D.W. = 1.73 d.f. = 15

(13) $VPROD_t = VS_t * VSW_t$

(14) $BPROD_t = BFS_t * BFSW_t$

(15) $DPROD_t = COWM_t * DY_t$

B. Hog component

(1) $SOW_t = 2344.78 + 11.38*DHPR_{t-1} - 11.57*DPIC_t - 12.48*DCOST_t$

(208) (9.38) (4.46) (4.99)

$R^2 = 0.93$ D.W. = 2.57 d.f. = 8

(2) $PIGS_t = PPS_t * SOWS_t$

(3) $THSL_t = PIGS_t - (PREP_t * SOWS)$

(4) $LESL_t = 0.02*THSL_t$

(5) $HSL_t = THSL_t - LESL_t$

(6) $LSW_t = 2855.8 - 14.0*YEAR_t + 1.82*HCRAT_t$

(101) (0.052) (0.385)

$R^2 = 0.98$ D.W. = 1.84 d.f. = 15

(7) $HSLW_t = 0.8*LSW_t$

(8) $HPROD_t = HSLW_t * LCW_t$

(9) $LPROD_t = LESL_t * 10.0$

C. Sheep and goat component

(1) $FEM_t = 18413.4 - 196.7*DADPR_{t-1} + 108.5*DYOPR_{t-1} - 44.19*DSSAL_t$

(2281) (120.5) (69.18) (12.07)

$R^2 = 0.82$ D.W. = 1.40 d.f. = 13

(2) $YM_t = 6645.18 + 0.016*FEM_{t-1} - 0.621*ADULT_{t-1} + 147.42*DYOPR_{t-1}$

(2380) (0.113) (0.476) (45.56)

$R^2 = 0.77$ D.W. = 1.77 d.f. = 10

(3) $YMSW_t = 173.747 + 0.093*YEAR_t$

(19.7) (0.01)

$R^2 = 0.84$ D.W. = 0.96 d.f. = 17

(4) $YMPROD_t = YM_t * YMSW_t$

(5) $ADULT_t = 452.0 + 0.132*FEM_{t-1} - 2.08*DSSAL_t$

(708) (0.044) (1.27)

$R^2 = 0.86$ D.W. = 1.56 d.f. = 10

(6) $ADSW_t = 269.9 + 0.145*YEAR_t$
(45) (0.023)

$R^2 = 0.70$ D.W. = 1.80 d.f. = 17

(7) $ADPROD_t = ADULT_t*ADSW_t$

(8) $MKPROD_t = 297.3 + 0.016*FEM_t + 4.85*DMKPR_{t-1} - .014*DCOST_t$
(67.1) (0.006) (8.14) (0.91)

$R^2 = 0.75$ D.W. = 1.89 d.f. = 6

D. Poultry models

1. Poultry meat

(1A) $NBS_t = -47660800.0 + 24345.4*YEAR_t$ for $t \leq 1978$
(2965530) (1504)

$= NBS_{t-1} + 24345.4$ for $t > 1978$ and $CHPI > 0$

$= NBS_{t-1}$ for $t > 1978$ and $CHPI \leq 0$

1/ R^2 (trend) = 0.96 D.W. (trend) = 1.75 d.f. = 12

(2) $BRPROD_t = NBS_t*BRSW_t$

(3) $TPPROD_t = 218657.0 + \rho TPPROD_{t-1} + 1.345*(NBS_t - \rho NBS_{t-1})$
(161620) (0.193)

$- 39053.0*(DCPR_t - \rho DCPR_{t-1})$
(28028)

$R^2 = 0.98$ D.W. = 1.52 d.f. = 11

$\rho = 0.544$ (0.224)

2. Eggs

(1A) $SLAY_t = -1929330.0 + 1003.9*YEAR_t$
(913893) (456.8)

$- 3950.6*DPCAL_t$ for $t \leq 1978$
(2750)

$= SLAY_{t-1} + 1003.9 - 3950.6*(DPCAL_t - DPCAL_{t-1})$
for $t > 1978$ and $EGPI > 0$

$= SLAY_{t-1}$ for $t > 1978$ and $EGPI \leq 0$

1/ $R^2 = 0.88$ D.W. = 1.93 d.f. = 12

(2) $SEPROD_t = SLAY_t*EGY_t$

(3) $TPEGPR_t = 91.92 + \rho TPEGPR_{t-1} + 0.019*(SLAY_t - \rho SLAY_{t-1})$
(84.4) (0.001)

1/ Equation statistics refer to the period prior to 1978.

$R^2 = 0.99$ D.W. = 1.68 d.f. = 12

$\rho = 0.939\ (0.092)$

(4) $AEPROD_t = TPEGPR_t + OTEG_t$

E. Crop components

1. Wheat

(1) $WDA_t = 338.65 + 0.749*WDA_{t-1} + 364.37*DWPR_{t-1} - 352.8*DBPR_{t-1}$

(0.091) (104.8) (155.1)

$R^2 = 0.97$ D.W. = 2.39 d.f. = 12

$h = -2.24$ $\rho = -0.48$

(2) $WIA_t = -46.05 + 0.384*WIA_{t-1} + 77.36*DWPR_{t-1} - 21.92*DBPR_{t-1}$

(116.4) (0.211) (31.6) (19.12)

$R^2 = 0.90$ D.W. = 2.07 d.f. = 12

$h = -2.43$ $\rho = -0.89$

(3) $WDY_t = -73320.1 + 37.8*YEAR_t$

(9341) (4.74)

$R^2 = 0.79$ D.W. = 2.21 d.f. = 17

(4) $WIY_t = -124606 + 64.62*YEAR_t$

(16215) (8.24)

$R^2 = 0.78$ D.W. = 1.83 d.f. = 17

(5) $WPROD_t = (WDA_t * WDY_t) + (WIA_t * WIY_t)$

2. Barley

(1) $BDA_t = 2027.76 + 0.631*BDA_{t-1} - 332.34*DWPR_{t-1} + 119.23*DBPR_{t-1}$

(356) (0.077) (75.4) (74.7)

$R^2 = 0.99$ D.W. = 2.08 d.f. = 14

$h = -0.173$

(2) $BIA_t = 246.66 + 0.448*BIA_{t-1} - 37.12*DWPR_{t-1} + 7.13*DBPR_{t-1}$

(66.8) (0.174) (14.4) (13.8)

$R^2 = 0.97$ D.W. = 2.06 d.f. = 14

$h = -0.875$

(3) $BDY_t = -80472 + 41.67*YEAR_t$

(14933) (7.6)

$R^2 = 0.64$ D.W. = 2.31 d.f. = 17

(4) $BIY_t = -121551 + 63.14*YEAR_t$

(20125) (10.2)

$R^2 = 0.69$ D.W. = 1.55 d.f. = 17

(5) $BAPROD_t = (BDA_t*BDY_t) + (BIA_t*BIY_t)$

3. Corn

(1) $CDA_t = 343.86 + 7.99*DCPR_{t-1} - 1.02*DSI$

(58) (7.51) (0.190)

$R^2 = 0.93$ D.W. = 1.17 d.f. = 15

(2) $CIA_t = 571.35 + 61.58*DCPR_{t-1} - 334.94*DSBPR_{t-1} - 94.71*DGOPR_t$

(56) (26.99) (91.53) (30.92)

$R^2 = 0.75$ D.W. = 1.18 d.f. = 14

(3) $CDY_t = -93470.3 + 48.43*YEAR_t$

(17401) (8.84)

$R^2 = 0.64$ D.W. = 1.36 d.f. = 17

(4) $CIY_t = -293653 + 151.29*YEAR_t$

(17304) (8.79)

$R^2 = 0.95$ D.W. = 0.98 d.f. = 17

(5) $CPROD_t = (CDA_t*CDY_t) + (CIA_t*CIY_t)$

4. Rye

$RA_t = 314.0 + 41.89*DRPR_{t-1} - 1.21*DSI$

(114.8) (14.97) (0.397)

$R^2 = 0.95$ D.W. = 1.03 d.f. = 15

$RY_t = 56892 + 29.17*YEAR_t + 5.08*DPIC_t$

(30954) (15.54) (4.77)

$R^2 = 0.58$ D.W. = 2.18 d.f. = 16

$RPROD_t = RA_t*RY_t$

5. Oats

$OA_t = 308.44 + 21.23*DOPR_{t-1} + 35.89*DGOPR_t$

(20.15) (13.0) (16.04)

$R^2 = 0.85$ D.W. = 1.48 d.f. = 15

$$OY_t = -45335 + 23.53*YEAR_t$$
$$\quad (10688) \quad (5.43)$$

$R^2 = 0.53$ D.W. = 2.28 d.f. = 17

$$OPROD_t = OA_t*OY_t$$

6. Sorghum

$$SA_t = -704.25 + 0.396*YEAR_t - 16.65*DGOPR_t$$
$$\quad (1385) \quad (0.696) \quad (6.91)$$

$R^2 = 0.65$ D.W. = 1.32 d.f. = 12

$$SY_t = 416683 + 213.21*YEAR_t$$
$$\quad (48369) \quad (24.5)$$

$R^2 = 0.85$ D.W. = 1.13 d.f. = 13

$$SPROD_t = SA_t*SY_t$$

7. Land accounting component (lower case symbols represent exogenous variables)

Cereals

WBCIA = WIA + BIA + CIA

WBCDA = WDA + BDA + CDA

RCRIA = rice + rosia + oica

TICA = WBCIA + RCRIA

ROSA = RA + OA + SA

ROSDA = ROSA - rosia

TDCA = WBCDA = ROSDA + odca

TCA = TICA + TDCA

Forage

$$TFOR_t = -58145 + 29.95*YEAR_t + 51.66*DGOPR_t$$
$$\quad (5888) \quad (2.96) \quad (23.3)$$

$R^2 = 0.96$ D.W. = 0.74 d.f. = 16

DFOR = TFOR - forir

Other crops

TOCA = tclb - (TCA + TFOR)

TOCIA = tia - (forir + TICA)

TOCDA = TOCA - TOCIA

Total land use

TDA = tclb - tia

TCLBF = tclb + fal

II. Human demand model

A. Rotterdam Demand Equations

$$X_{it} = u_i * QT + \xi_j \Pi_{ij} P_j$$

Where:

X_{it} = XB, XM, XP, XC, XSG, XEG, XBD, XOF, XNF

Pj = P1, P2, P3, P4, P5, P6, P7, P8

The coefficients u and Π_{ij} are shown in appendix table 3.

B. Value share:

$$W_{it} = q_{it} \text{ Pit/PCE}_t$$

Where:

W_{it} = WB, WM, WP, WC, WSG, WEG, WBD, WOF, WNF

q_{it} = BFC, MKC, PKC, CHC, SGC, EGD, BRC, OFC, NFQ

P_{it} = NBRP, NMKRP, NPKPR, NCRP, NSGRP, EGRP, BCRP, OFP, NFP

and:

$$\xi_i W_{it} = 1$$

C. Per capita consumption

$$q_{it} = q_{it-1} * \exp (2 X_{it} / (W_{it} + W_{it-1}))$$

D. Real income term

$$QT = \xi_i X_{it}$$

E. Total consumption

TBF = BFC * POP
TMK = MRC * POP
TPK = PKC * POP
TCH = CHC * POP
TSG = SGC * POP
TEG = EGC * POP
TOF = OFC * POP

III. Derived feed demand

A. Feed grains

(1) $\text{FDEM}_t = 4.0 * \text{THPROD}_t + 3.5 * \text{TPPROD}_t + 3.7 * \text{BVPROD}_t + 0.3 * \text{DPROD}_t + 3.5 * \text{TPEGPR}_t + (332.99 + 109.24 * T)$

(232) (20.3)

R^2(time trend) = 0.63

(2) $\text{BCFD}_t = 694998 - 349.5 * \text{YEAR}_t + 0.051 * \text{FDEM}_t - 1390.8 * \text{DBCPR}_t$

(118782) (0.059) (289.6)

$R^2 = 0.72$ D.W. = 1.57 d.f. = 14

(3) $BOFD_t = -1262.6 + 0.521 * FDEM_t - 331.6 * DBOPR_t + 460.7 * DSCPR_t$
(2453) (0.112) (619.1) (428.1)

$R^2 = 0.92$ D.W. = 1.01 d.f. = 15

(4) $SCFD_t = 482.4 + 0.499 * FDEM_t + 274.9 * DBOPR_t - 390.6 * DSCPR_t$
(1870) (0.086) (471.8) (326.3)

$R^2 = 0.97$ D.W. = 1.57 d.f. = 15

(5) $Y_t = BCFD_t + BOFD_t + SCFD_t$

(6) $X_t = FDEM_t - Y_t$

(7) $BCFDC_t = BCFD_t + (BCFD_t/Y_t) * X_t$

(8) $BOFDC_t = BOFD_t + (BOFD_t/Y_t) * X_t$

(9) $SCFDC_t = SCFD_t + (SCFD_t/Y_t) * X_t$

B. Soybean meal

$SOYCON_t = 1.09*THPROD_t + 1.01*TPPROD_t + 0.384*BVPROD_t + 0.015*DPROD_t + 0.455*TPEGPR_t + 0.685*SGPROD_t$

C. Milk fed

$MKFD_t = 368.4 - 31.9*T + 22.6*DPRV_{t-1}$
(423.6) (5.6) (10.96)

$R^2 = 0.72$ D.W. = 1.26 d.f. = 15

IV. Domestic availability

A. Stock changes

(1) $BCSTK_t = 3740.1 + 0.667*(BCPROD_t - BCPROD_{t-1}) - 0.904*BCCON_t + 125.5*DBCPR_t$
(1140) (0.112) (0.302) (99.8)

$R^2 = 0.73$ D.W. = 2.17 d.f. = 14

(2) $BOSTK_t = 3355 + 0.471*(BOPROD_t - BOPROD_{t-1}) - 0.310*BOCON_t - 631.4*DGBOP$
(1954) (0.124) (0.156) (380.1)

$R^2 = 0.55$ D.W. = 2.59 d.f. = 12

(3) $SCSTK_t = -5092.3 + 193.5*T - 0.156*(SCPROD_t - SCPROD_{t-1})$
(4446) (88.9) (0.693)

$$-0.233*SCCON_t + 1067.7*DGSCP$$
$$(0.360) \qquad (868)$$

$R^2 = 0.37$ D.W. = 2.16 d.f. = 11

B. Availability

(1) $BCAV_t = WPROD_t + RPROD_t - BCSTK_t$

(2) $BOAV_t = BAPROD_t + OPROD_t - BOSTK_t$

(3) $SCAV_t = CPROD_t + SPROD_t - SCSTK_t$

V. Domestic disappearance

(1) $BCDIS_t = TBC_t/BCEXT_t + BCFDC_t$
$+ 0.4 * (WDA_t + WIA_t + RA_t)$

(2) $BODIS_t = 0.15 * (BDA_t + BIA_t) + BOFDC_t$
$+ 0.05 * BAPROD_t$

(3) $SCDIS_t = SCFDC_t + CNSDO_t$

(4) $MKDIS_t = TMK_t + MKFD_t$

VI. Net trade (includes adjustments to make the units conform)

(1) $BCTR_t = BCAV_t - BCDIS_t$

(2) $BOTR_t = BOAV_t - BODIS_t$

(3) $SCTR_t = SCAV_t - SCDIS_t$

(4) $BFTR_t = BVPROD_t - TBF_t$

(5) $MKTR_t = MKAV_t - MKDIS_t$

(6) $PKTR_t = HPROD_t + LPROD_t - TPK_t$

(7) $CHTR_t = TPPROD_t - TCH_t$

(8) $SGTR_t = YMPROD_t + ADPROD_t - TSG_t$

(9) $EGTR_t = AEPROD_t - TEG_t$

APPENDIX B: FARM-LEVEL ANALYSIS: PRICE DATA AND TECHNICAL COEFFICIENTS

Appendix table B-1--Prices received by farmers, Spain, France, and Italy, 1979, and institutional prices, 1979-81 1/

Product	Unit	Spain, baseline (A)	Spain scenario, EC (B)	B-A / A (C)	France (D)	Italy (E)	Institutional price, 1979-80: Spain (F)	Institutional price, 1979-80: EC (G)	G-F / F (H)
		--- Dollars ---		Percent	------------ Dollars			------------	Percent
Wheat, durum	100 kilograms	27.42	33.36	+21.7	25.97	31.56	2/27.56	2/34.15	+23.9
Wheat, soft II	do.	23.24	22.65	-2.5	19.37	24.05	2/23.24	3/23.04	-.9
Barley	do.	16.84	19.91	+18.2	17.50	22.78	2/16.39	2/20.45	+24.8
Corn	do.	20.19	20.34	+.7	18.27	23.07	2/22.35	2/20.45	-8.5
							4/20.11	5/24.52	+21.9
Sunflower seed	do.	41.08	NA	NA	NA	NA	2/40.97	2/52.78	+28.8
Chicken	100 kilograms liveweight	115.27	110.66	-4.0	6/106.71	7/104.15	8/124.91	NA	NA
Eggs	Dozen	.87	.87	0	.92	.81	8/.91	NA	NA
Pigs	100 kilograms liveweight	142.22	144.30	+1.58	9/ 10/127.02	11/147.29	8/ 10/133.50	8/10/144.30	+8.1
Piglets	18 kilogram animal	44.70	42.91	-4.0	37.23	37.76	NA	NA	NA
Beef	100 kilograms liveweight	203.46	199.36	-2.0	12/200.47	13/174.44	8/223.50	8/211.87	-5.2
Veal	do.	246.37	246.37	0	14/280.41	15/241.88	NA	NA	NA
Milk	100 liters	28.76	26.45	-8.0	16/24.36	16/30.63	8/28.91	8/10/28.48	-1.5
Lamb	100 kilograms liveweight	17/247.50	17/247.50	0	18/258.32	19/230.28	NA	NA	NA

NA = Not available.

1/ Exchange rates used are: 100 FF = 23.505 US$, 100 Lira = 0.12035 US$, 100 ECU = 137.065 US$, and 100 Pts = 1.490 US$. 2/ Intervention price. 3/ Reference price for bread wheat. 4/ Entry price. 5/ Threshold price. 6/ "Poulets d'élevage" price, conversion 70 percent. 7/ "Polli di allevamento in batteria." 8/ Indicative, target, basic or guide price. 9/ "Porcs--class II." 10/ Price derived from carcass weight price, conversion equals 70 percent. 11/ "Suini grassi." 12/ "Genisses R" (heifer). 13/ "Manze I" (heifer). 14/ "Veaux." 15/ "Vitelli I." 16/ Converted from Kg. at 1 Kg. = 0.971 liters. 17/ "Pascual." 18/ "Agneaux gris." 19/ "Agnelloni."

Sources: (4, 6, 7, 8, 9, 15, 17).

Appendix table B-2--Prices paid by farmers for feeds in Spain, France, and Italy, 1979

Feed	Spain baseline (A)	Spain, EC scenario (B)	$\frac{B-A}{B}$ x 100 (C)	France (D)	Italy (E)
	Dollars per 100 kilograms		Percent	Dollars per 100 kilograms	
Feed wheat	NA	21.31	NA	NA	NA
Barley	17.28	20.49	+18.6	20.92	23.68
Corn	20.11	22.51	+11.9	22.32	22.88
Sorghum	18.62	22.06	+18.5	NA	NA
Bran	15.12	17.22	+13.9	16.40	18.86
Soybean meal (44 percent)	30.54	30.54	0	NA	30.09
Sunflower meal (36 percent)	20.26	20.26	0	20.46	NA
Fish meal (63 percent)	67.05	59.60	-11.1	48.84	56.00
Meat and bone meal	31.29	31.29	0	29.89	31.52
Skim milk	64.07	64.07	0	NA	NA
Milk replacer	81.98	96.85	+18.1	107.49	95.77
Urea	22.35	22.35	0	NA	NA
Alfalfa, dehydrated (17 percent)	15.35	16.99	+10.7	15.34	20.34
Alfalfa hay	10.58	11.62	+9.8	NA	NA
Forage	4.47	4.47	0	NA	NA
Straw	4.47	4.84	+8.3	3.56	5.91
Broiler compound	33.52	37.25	+11.1	36.10	30.67
Layer compound	26.97	30.40	+12.7	29.52	30.22
Piglet compound	35.01	36.50	+4.3	33.53	30.24
Hog compound	26.07	29.50	+13.2	28.68	28.35
Bulk swine complement	23.84	27.12	+13.8	27.58	NA
Beef complement	24.29	26.97	+11.0	27.05	26.92
Dairy complement	25.03	27.56	+10.1	26.25	27.50

NA = Not available.

Sources: (4, 6, 7, 8, 9, 15, 17).

Appendix table B-3--Matrix of technical coefficients and nutrient requirements for estimating least-cost poultry rations, Spain

Item	Unit	Barley	Corn	Sorghum	Wheat bran	Alfalfa meal
Feed	Kilograms	1.0	1.0	1.0	1.0	1.0
Metalizable energy	Kilocalories	2,800	3,370	3,250	1,600	1,040
Crude protein	Percent	10.0	9.5	9.5	15.5	17.5
Lysine	do.	.35	.25	.20	.4	.72
Methionine and cystine	do.	.4	.35	.25	.41	.4
Tryptophane	do.	.15	.07	.09	.3	.4
Calcium	do.	.05	.02	.04	.15	1.35
Phosphorus	do.	.35	.2	.3	1.15	.25
Sodium	do.	.05	.02	.05	.2	.9

Item	Unit	Fish meal	Meat meal	Soybean meal	Animal fat	Limestone
Feed	Kilograms	1.0	1.0	1.0	1.0	1.0
Metalizable energy	Kilocalories	2,800	1,920	2,200	7,800	--
Crude protein	Percent	65.0	50.0	45.0	--	--
Lysine	do.	4.8	2.6	2.8	--	--
Methionine and cystine	do.	2.2	.9	1.3	--	--
Tryptophane	do.	.6	.25	.63	--	--
Calcium	do.	3.8	10.0	.3	--	38.0
Phosphorus	do.	2.5	5.0	.6	--	--
Sodium	do.	.5	.73	.04	--	--

Item	Unit	Phosphorous (dical)	Salt	Methionine	Requirements per kilograms fed: Broiler	Requirements per kilograms fed: Layer
Feed	Kilograms	1.0	1.0	1.0	1.0	1.0
Metalizable energy	Kilocalories	--	--	--	1/ 3,190	1/ 2,860
Crude protein	Percent	--	--	98.0	≥22.0	≥16.0
Lysine	do.	--	--	--	≥1.15	≥.7
Methionine and cystine	do.	--	--	98.0	≥.86	≥.52
Tryptophane	do.	--	--	--	≥.22	≥.15
Calcium	do.	21.0	--	--	≥.86	≥2.8
					≤.94	≤3.15
Phosphorus	do.	18.5	--	--	≥.55	≥.65
Sodium	do.	.1	38.0	--	≥.13	≥.13
					≤.19	≤.19

= Nil or negligible.

1/ The program used allowed for balancing the ratio by adjustment of the energy content (low energy vs. high energy).

Sources: (11, 18).

Appendix table B-4--Matrix of technical coefficients and nutrient requirements for estimating least-cost swine rations, Spain

Item	Unit	Barley	Corn	Sorghum	Wheat	Wheat bran	Alfalfa meal
Feed	Kilograms	1.0	1.0	1.0	1.0	1.0	1.0
Feed unit	Index	1.0	1.1	.98	1.02	.8	.7
Crude protein	Percent	10.0	9.5	9.5	10.5	15.5	17.5
Crude fiber	do.	5.5	2.2	2.6	2.5	9.5	25.0
Calcium	do.	.05	.02	.04	.05	.15	1.35
Phosphorus	do.	.35	.2	.3	.4	1.15	.25
Salt	do.	--	--	--	--	--	--
Lysine	do.	.35	.25	.2	.35	.4	.72
Methionine and cystine	do.	.4	.35	.25	.53	.41	.4
Tryptophane	do.	.15	.07	.09	.16	.3	.4

Item	Unit	Fish meal	Meat meal	Soy-beans	Sunflower meal	Blood meal	Limestone
Feed	Kilograms	1.0	1.0	1.0	1.0	1.0	1.0
Feed unit	Index	1.0	.83	1.02	.78	1.2	--
Crude protein	Percent	65.0	50.0	45.0	39.0	81.0	--
Crude fiber	do.	1.0	1.0	7.0	16.0	1.0	--
Calcium	do.	3.8	10.0	.3	.3	.3	33.84
Phosphorous	do.	2.5	5.0	.6	1.2	.3	.02
Salt	do.	--	--	--	--	--	--
Lysine	do.	4.8	2.6	2.8	1.7	6.0	--
Methionine and cystine	do.	2.2	.9	1.3	2.2	2.3	--
Tryptophane	do.	.6	.25	.63	.5	1.0	--

Item	Unit	Phos-phorous	Salt	Requirements: 20-60 kilograms	Requirements: 60-95 kilograms	Requirements: Single ration
Feed	Kilogram	1.0	1	1.0	1.0	1.0
Feed unit	Index	--	--	1/1.0	1/1.0	1/1.0
Crude protein	Percent	--	--	≥16.0	≥14.0	≥15.0
Crude fiber	do.	--	--	≤4.0	≤5.0	≤4.5
Calcium	do.	23.13	--	≥.5	≥.5	≥.5
				≤.8	≤.8	≤.8
Phosphorous	do.	18.65	--	≥.6	≥.5	≥.55
Salt	do.	--	100	≥.25	≥.25	≥.25
Lysine	do.	--	--	≥.6	≥.55	≥.55
Methionine and cystine	do.	--	--	≥.4	≥.3	≥.35
Tryptophane	do.	--	--	≥.11	≥.09	≥.1

-- = Nil or negligible.

1/ The program used allowed for balancing the ration by adjustment of the energy content (low energy vs. high energy).

Sources: (11, 18).

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