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ADJUSTMENT OF THE SPANISH FEEDGRAIN AND LIVESTOCK SECTORS FOLLOWING ACCESSION TO THE EUROPEAN COMMUNITY

By

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ABSTRACT

ADJUSTMENT OF THE SPANISH FEEDGRAIN AND LIVESTOCK SECTORS FOLLOWING ACCESSION TO THE EUROPEAN COMMUNITY

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The research described in this dissertation was carried out as part of a larger project, supported by the U. S. Department of Agriculture, to assess the impact of the enlargement of the European Community (EC) to include Greece, Spain and Portugal. The present study concerns adjustments in Spanish production, consumption and trade of livestock products and feedgrains. Spain is expected to enter the EC in 1983 or 1984 and will be required to adopt the Common Agricultural Policy (CAP) of the EC. The new policy will lead to a different set of relative prices as well as changes in agricultural institutions and trade policies.

A simulation model was developed to assess the likely evolution of the Spanish feedgrain-livestock economy. The model is structured along the lines of a balance sheet with separate production, human consumption and derived feed demand components used to determine domestic availability, domestic disappearance and net trade. The commodities treated include beef, veal, milk, pork, sheep and goat meat, poultry meat, eggs, wheat, barley, corn, rye, oats and sorghum.

The human consumption model is a Rotterdam system of demand equations. Statistical tests led to the rejection of the hypothesis that the substitution matrix for the system is symmetric so that the generalized least squares estimates reduced to ordinary least squares. Recursive production models were estimated for cattle (meat and milk), swine, poultry and eggs, sheep and goats, and cereal grains. The model also includes a land accounting component. Derived demand for feedgrains and soybean meal is determined through the use of feed conversion ratios applied to the estimates of meat production.

Since prices have largely been determined by Spanish policy and will continue to be administratively set under the CAP, they are treated as exogenous variables in the model. Real prices constitute the principal explanatory variables. The model is validated through simulation of the period 1968 to 1978. Measures of the forecasting accuracy of the equations are computed and used to evaluate the reliability of the model for forecasting. While some of the equations lead to unacceptable results, the model as a whole allows relatively accurate forecasts to be made.

To analyze the impact of Spain's accession to the EC, the exogenous variables were projected to 1990 according to three scenarios. The baseline scenario reflects the assumptions that Spain remains outside the EC and historical price relationships and policies continue in the future. The other two scenarios are derived from an independent study of future developments in the EC and reflect possible evolutions of the exogenous variables for Spain as a member of the community. Projections of the endogenous variables from the three scenarios can be compared to assess the impact of the policy changes.

The results of the analysis indicate that Spanish surpluses of barley and oats will be larger with entry than in the baseline while the need for imported corn and sorghum for feed will be lower. The amount of feedgrains fed is lower in the simulations for Spain as member of the EC due to assumed changes in feed ration composition and decreases in livestock numbers. Soybean meal disappearance is also projected to be slightly lower with entry while forage acreage is somewhat greater.

Among the livestock enterprises, only hog production is projected to be greater in the EC scenarios than the baseline. Beef and milk production are projected to be slightly lower with entry while poultry meat, sheep and goat meat and egg production are substantially lower in the EC projections. The human demand projections suggest that consumption of livestock products will be lower with entry compared with the baseline scenario.

"The time has come," the Walrus said,
"To talk of many things:
Of Shoes—and ships—and sealing wax—
Of cabbages—and kings—
And why the sea is boiling hot—
And whether pigs have wings."

—Lewis Carroll

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CHAPTER I

INTRODUCTION

In 1957 six European countries signed the Treaty of Rome establishing the European Economic Community. The Community was enlarged in 1973 with the accession of Denmark, Ireland and the United Kingdom. The Treaty of Rome stipulates that any European country can apply for membership but in practice only applications from nations with democratic governments are considered. Thus, although Spain first expressed an interest in becoming a member in 1962, a serious review of the Spanish application, as well as those of Greece and Portugal, was only undertaken after the establishment of democratic administrations in the three countries (26).

The economic impact on the European Community (EC) and the applicant country receives a great deal of attention in considering a new member and is the object of extensive negotiations prior to official entry. However, there appears to be the presumption in the EC that appropriate transitional measures can be instituted to ease the economic adjustments inherent in the enlargement process so that the primary factors in obtaining a favorable opinion in response to an application remain the nature of the applicants' political system and the fundamental philosophical orientation of the EC. While the communitarian philosophy of the founders of the EC leads to the predisposition to favor enlargement on the part of many European leaders, the adjustments and changes resulting inevitably from the accession of new members are likely to adversely affect, or at least be perceived to adversely affect, the interests of specific groups within the countries concerned. As a consequence, debate concerning the economic implications of enlargement can be quite prolonged even when the acceptance of an application for membership appears to be a foregone conclusion.

The first enlargement of the EC followed some two years of negotiation. Because the economies of Spain, Greece and Portugal differ more significantly from the rest of the EC than was the case in the first enlargement, the negotiations have been longer. Greece signed a treaty of accession in 1980 after five years of negotiations. Portugal and Spain began negotiations in 1978 and 1979 and are not expected to become members before 1984. In addition, longer transition periods are envisioned for the three Mediterranean countries than in the first enlargement (26).

The negotiations with the applicant countries are also taking place at a time when strains on Community institutions have appeared. World economic conditions as well as internal tensions exacerbated by the first enlargement have resulted in the need to reassess Community policies and institutions. In this context, some European leaders have expressed a desire to move slowly on the second enlargement in order to allow the EC time to resolve some of the present issues before taking on a new set of problems.

The Common Agricultural Policy (CAP) of the EC is the institution surrounded by the greatest controversy. Since its inception, agricultural policy has been a difficult issue within the EC. The concern the evolution of the CAP after enlargement and the adjustments in other agricultural sectors such as fruits and vegetables. As described in the research agreement, the specific objectives of the Michigan State project are as follows:

1. Describe the structure of the feed-livestock subsectors in the three applicant countries, the trends in production, consumption and trade, and the agricultural policies which have had a major influence on subsector organization and performance.

2. Carry out projections to 1985 and 1990 of consumption and production of livestock products in the three applicant countries and related shifts of production, importation and utilization of feedgrains and oilseeds.

3. Analyze and discuss probable impacts of EC enlargement and modifications in the CAP on U.S. exports of feedgrains and oilseeds to the three applicant countries and to the new EC-12.

Since Spain is the largest of the applicants, greater emphasis has been placed on understanding the Spanish feedgrain-livestock economy. In addition to the research reported here, another researcher is conducting an analysis of micro-level adjustments in Spain (72). The research on Spain will be combined with separate studies of Greece and Portugal in the final report to USDA.

In order to assess the implications of Spanish membership in the EC for U.S. trade, it is necessary to analyze the way in which Spanish production and consumption can be expected to adjust to the changed policy framework. Integration into the EC will involve harmonization of Spanish agricultural policies with the CAP leading to a new set of relative prices. The shift to the EC price regime harmonization of diverse national policies has led to a complicated system which is presently absorbing a disproportionate share of Community resources. While there is general agreement within the EC that something must be done about the CAP, there is no clear consensus concerning the most desirable and politically feasible measures to be taken. In this setting, discussions with the Spanish and Portuguese governments on agriculture are likely to be arduous and are further complicated by European fears of the agricultural potential in these countries (14).

In addition to the European considerations, accession will also affect the agricultural sectors of non-European countries. Shifts in trade patterns may result from entry as barriers between the applicant countries and the EC are reduced. In 1978, the United States exported feedgrains and oilseeds worth $1.1 billion to Spain, Greece and Portugal. When added to EC imports of $3.5 billion in 1978, the 12 European countries absorbed 41 percent of total U.S. exports of these commodities. Changes in Europe which affect this trade could have a significant impact on the feedgrain and oilseed sectors in the U.S.

For these reasons there is a great deal of interest in both Europe and the U.S. in ascertaining the implications of the second enlargement. The U.S. Department of Agriculture (USDA) is coordinating several research projects related to the enlargement issue. The research agreement between USDA and Michigan State University relates to study of the feedgrain-livestock sectors of the applicant countries and the implications of enlargement for U.S. trade in feedgrains and oilseeds. Other research projects being carried out concern the evolution of the CAP after enlargement and the adjustments in other agricultural sectors such as fruits and vegetables. As described in the research agreement, the specific objectives of the Michigan State project are as follows:

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The static adjustment of the Spanish economy will lead to some trade creation and trade diversion. Since the purpose of this research is not to assess the global welfare effects of integration, no attempt will be made to measure the extent of trade creation or diversion. The research will focus on the underlying supply and demand relationship and the structure of Spain's grain-oilseed-livestock economy. The results of the research will be useful in projecting production and consumption in Spain and will allow substantive comments on changes in trade patterns.

The specific objectives of this research are:

1. To describe the feedgrain-livestock subsectors in Spain and identify areas where integration is likely to bring about changes.

2. To construct a simulation model of the subsectors for use in analyzing the impact of price and policy changes.

3. To use the model to carry out projections of production, consumption and trade to 1990 on the basis of reasonable scenarios developed in collaboration with USDA and other researchers.

4. To make a preliminary assessment of the impact of Spain's accession to the EC on U.S. feedgrain and oilseed exports as a result of the adjustments analyzed in the projections.

The agricultural commodities dealt with in this study include beef, veal, milk, pigmeat, poultry meat, eggs, sheep and goat meat, wheat, rye, barley, oats, corn, sorghum and soybeans. Little reference to other agricultural sectors will be made in this study. In addition, the research is carried out at an aggregate level with no attempt to analyze regional differences within Spain. The greatest effort is devoted to the development of the production and human demand components of the model with relatively simple approaches being employed for the other parts.

The results of this study are presented in the next six chapters. Chapter II includes descriptions of the institutional and policy settings in Spain and the EC as well as an overview of the modelling approach. Chapters III to V are devoted to the description and validation of the estimated model. Human consumption is discussed in Chapter III, production in Chapter IV, and derived feed demand and trade in Chapter V. In Chapter VI the results of using the simulation model to forecast production, consumption and trade are presented and evaluated. The final chapter includes a summary of the results and some concluding comments.

CHAPTER II

DESCRIPTIVE BACKGROUND AND OVERVIEW OF THE MODELLING APPROACH

Introduction

The Spanish economy has grown rapidly since the early 1960s when the autarkic policies of the Franco regime began to be relaxed and Spain rejoined the world community. The agricultural sectors have shared in this growth although the level of development is still lower than in other parts of Europe. In the late 1970s economic growth has slowed somewhat as Spain experienced the high rates of inflation and unemployment common to most industrialized countries in recent years.

The climate and terrain in Spain are not particularly favorable for agriculture. Much of the land is semi-arid or mountainous. In addition, Spanish agriculture suffers from structural problems with 60 percent of the farms in 1972 having less than five hectares (52). The farm population has been decreasing and the age of those remaining in agriculture has increased. As a result of these and other problems, crop yields in Spain are generally lower than in the rest of Europe or North America. On the other hand, Spain has experienced impressive growth in agricultural productivity over the past 20 years, and there appears to be some potential for expanded output in the future through the adoption of better cultural practices, extension of irrigation and structural changes (15, 52).

The principal agricultural commodities produced in Spain include cereals, meat, fruits and vegetables, dairy products, wine and olive oil. Crops account for about 55 percent of the value of agricultural output, while livestock products account for about 45 percent (52). Spain is essentially self-sufficient in wheat, barley and rice but imports substantial quantities of corn and soybeans (mainly from the U.S.). Meat production in Spain has grown at an average annual rate of 7.7 percent over the past 18 years (52). The production of poultry meat in particular has expanded at a rapid rate.

The purpose of this chapter is to provide background information relevant to the objectives of the study and an introduction to the modelling approach. More complete descriptions of Spanish agriculture, agricultural policy and the CAP can be found in a variety of sources (1, 9, 18, 26, 64, 84). The brief remarks which follow are not intended to be exhaustive but rather to serve as an introduction to the institutions and policies which will be affected by enlargement.

I. Institutional and Policy Setting for Enlargement

Continental European nations have generally shown a philosophical predilection for self-sufficiency in food, probably as a result of the frequent wars and shifts in alliance in Europe. This orientation was reinforced in Spain following the Civil War since, until the late 1950s, the country was largely isolated from the rest of the world. Harrison traces the evolution of economic policy during the Franco regime (33). While the autarky of the early years was forced on Spain by the unpopularity of the Franco regime, the Spanish authorities clearly preferred isolation, rejecting offers of assistance and pursuing import substitution policies. In the early 1950s the goal of absolute self-sufficiency was abandoned as the impact of isolation from the world trading community began to be felt. The anti-communist orientation of the Spanish government led the U.S. to offer aid which was accepted at that time. Much of the U.S. assistance was in the form of grants of raw materials in surplus in the U.S. (33).

The opening of the Spanish economy in the 1950s resulted in some economic instability, including inflation and large government deficits. In response, a stabilization plan cutting public expenditure, raising taxes and freezing wages was implemented in 1959 at the same time that Spain began joining such international organizations as the International Monetary Fund (IMF) and the Organization for Economic Cooperation and Development (OECD). Following the initial stabilization plan, Spain embarked on a series of development plans modelled on the French system of indicative planning. While the performance of the Spanish economy in the 1960s and early 1970s may owe more to the growth of tourism than the development plans, Spain did record the highest levels of economic growth in Europe during this period (33).

Agricultural policy has developed within the framework of overall economic policies. During the period of autarky 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) was established. This national wheat board handled all aspects of the commercialization of the entire wheat crop. These functions have continued to be performed by the SNT, later renamed the Servicio Nacional de Cereales (SNC) and finally the Servicio Nacional de Productos Agrarios (SENPA), up until the present. Early agricultural policies were oriented toward self-sufficiency in staples such as wheat and olive oil at the expense of such export crops as citrus fruit (33).

Faced with inadequate food production, the Franco regime eliminated the Republican agrarian reform institutions in favor of national institutes directed toward colonization and land concentration. Along with these efforts to open new lands and achieve more efficient farm sizes, the government began to promote irrigation as a means to increase production (84). The colonization and irrigation policies of the regime were relatively ineffective in the early years. While the land concentration policy led to some increase in farm size in the Northern part of the country, little redistribution of land took place and large latifundias managed by absentee landlords still exist in the Southern regions. Irrigated acreage increased more rapidly in the 1960s and 1970s but the structural problems persist (33).

The early policies were actually detrimental to the production of staple crops. Wheat prices were set too low by the SNT and production fell dramatically. With the opening of the Spanish economy in the 1950s, food imports began to increase. Although the goal of absolute self-sufficiency had been abandoned the rise in imports was still disturbing to the regime. As a result, wheat prices set by the SNT were allowed to rise faster so that production stabilized at a higher level (55). At the same time, growth of the Spanish economy led to increased demand for livestock products. Since the livestock sectors had not expanded under the earlier policies, imports of these items began to increase. In the second development plan (1968-1971), agricultural policy was reoriented to encourage feedgrain production to support the expansion of the livestock sectors (18).

In general, the development plans were oriented more toward industrial development with agriculture receiving somewhat less emphasis. Agricultural policies were aimed at balancing production and consumption through price incentives, subsidies and a continuation of the land concentration and irrigation programs. It was during the 1960s that intervention prices for some cereal grains and livestock products were initiated (55). The Fondo de Ordenacion y Regulacion de los Precios y Productos Agrarios (FORPPA) was created by a 1968 law to establish indicative or guaranteed prices for certain products, regulate foreign trade and administer subsidies and other production aids (84). In the early 1970s the Instituto Nacional de Reforma y Desarrollo Agrarios (IRYDA) was established to coordinate the government irrigation, colonization and land concentration programs (84).

In 1977 a series of accords known as the Pact of Moncloa was adopted by the young democratic government. This pact 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 (84). Throughout the evolution of Spanish policy, the desire to increase domestic production and reduce dependence on foreign supplies has remained a dominant theme. The effect of the policies has been 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. Subsequently, imports of livestock products began to increase and the government responded by creating price incentives, premiums, subsidies and other policies to encourage production. This shifted the need for imports from livestock products to feedgrains and oilseeds. Close ties with the U.S. led to increased use of corn and soybeans, two commodities not extensively produced in Spain. With mounting wheat surpluses and feed imports, price policies have shifted to encourage feedgrain production. In recent years, the desire to join the EC has led to some harmonization of the market regulation and price policy mechanisms with those of the CAP. The current system is based on many of the same mechanisms as in the EC.

The regulation of the market for cereals is carried out by SENPA, now a part of FORPPA. For wheat, rye, barley and oats a guaranteed producer price is established with monthly increments to cover storage costs (9). In the case of wheat and rye, the entire crop is purchased at the guaranteed price and sold to first handlers at 105 percent of this price. The sale price for barley and oats is also set 5 percent above the guaranteed price. A lower intervention price for corn and sorghum is established and the market is allowed to function freely above this price (9).

Foreign trade in wheat is controlled entirely by SENPA. For all feedgrains an entry price is established and a variable levy, calculated as the difference between the entry price and the world market price, is assessed. The entry price varies from month to month and is established in relation to domestic cereal prices and transportation costs (1).

Government intervention in markets for livestock products is a more recent phenomenon than for cereals. The primary agency for implementing price policies in these sectors is the Comisaria General de Abastecimiento y Transportes (CAT). In the case of beef and veal, CAT establishes an indicative price which represents the expected producer price. Intervention prices are set above and below the indicative price and CAT purchases meat for storage, releases stocks or adjusts imports if the market prices are outside these bounds. A minimum guaranteed price is also set below the lower intervention price (1). Spanish policy in this sector has also included the payment of premiums for young cattle fed to heavier weights and minimum slaughter weights for calves. The premiums were eliminated in 1977. CAT has complete control of trade in beef and veal.

Market regulation for pigmeat is carried out in the same manner as for beef and veal. CAT establishes a similar set of intervention, target and minimum guaranteed prices and manipulates stocks and imports in order to keep the market price within these bounds. The support prices for poultry meat include a basic intervention price, a target price and a consumer protection price. No government support prices are established for sheep and goat meat. Trade in all the principal meat categories is controlled by the state (1).

Market regulation for eggs is similar to that for poultry meat with intervention, target and consumer protection prices. FORPPA sets a minimum guaranteed price, target price and upper intervention price for milk. For most livestock products the movement of market prices is followed by calculating a reference price based on average prices in various parts of the country. In the case of milk a maximum retail price is also set. Trade in most milk products is carried out by the state with minimum import prices or variable levies applied to certain cheeses (1).

The inflation of the 1970s has resulted in a desire on the part of the government to restrain the increases in retail food prices. Retail prices for eggs, poultry meat and milk have been regulated and the existence of upper intervention prices reflects the government's wish to keep food prices down. In addition, Spanish policy has relied heavily on the subsidization of agricultural inputs so that the increase in producer prices can be held back without reducing incomes or production. Most input subsidies consist of subsidized credit although prices of certain inputs such as diesel fuel have been directly controlled.

In joining the EC, Spain will have to accept the body of legislation, the acquis communautaire, already in force in the EC. This includes the CAP, although the transition period will allow a gradual adoption of these policies. The CAP will, of course, change as the new members are integrated into the community but the principle of accepting the totality of EC legislation means that these changes will not necessarily be made in response to the particular needs of the applicant countries. As noted elsewhere, the Spanish administration has already begun to harmonize agricultural policy with the CAP in anticipation of entry. Nevertheless, acceptance of the CAP will lead to important changes in the nature of Spanish policy. In order to assess these changes a brief review of the main elements of the CAP is in order.

The Treaty of Rome originally set out five objectives for agriculture: 1) to increase overall agricultural productivity; 2) to insure a fair standard of living for farmers; 3) to stabilize markets; 4) to guarantee supplies of agricultural products; 5) to insure reasonable prices to consumers. Given the diversity of agricultural systems and policies among the original six, agreement on agriculture proved to be difficult. Internal tariff reduction and a common external tariff for industrial products were achieved rapidly, but some five years elapsed before the mechanisms of the CAP were fully elaborated. Four policy areas form the basis of the CAP (26).

1. Market policy: the establishment within the EC of a common market organization and common prices, with prices playing the primary role in supply and demand adjustment.

2. Structural policy: increasing agricultural productivity through optimum factor use while insuring a fair standard of living for rural families.

3. Commercial policy: avoiding excessive internal price fluctuations as a result of world market variation while encouraging the orderly development of international trade.

4. Social policy: insuring a place in society for the rural population equivalent to that of workers in other sectors (26).

By far the greatest emphasis has been placed on managing agricultural markets through price and commercial policies. To accomplish this a wide variety of institutional prices and trade barriers are used. The target price set for cereals and liquid milk is intended to represent the internal wholesale price which should be obtained 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 since support prices and external protection levels are derived from them (26).

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 manage the internal market (26). 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 new sheep meat regime permitting the establishment of national intervention prices has recently been put in place.

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 cereal grains and milk products. The variable levy is applied 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, export refunds or restitutions are paid to exporters of cereals, beef, pigmeat, poultry meat, eggs and milk products in order to make up the difference between higher EC prices and the prices which can be obtained on world markets (26).

Only the institutional prices related to the commodities dealt with in this study have been noted. These prices are set each year as the marketing year for the relevant commodity begins, although it was originally intended that announcement of support prices be made early enough to allow farmers to base their planting and production decisions on the price levels. Decisions on the level of price support are based on the notion that prices should be set so as to allow modern, efficient farms to remain in that status. In order to accomplish this the cost structure of a set of representative farms is examined and used in determining the price levels required to maintain incomes (26).

Since the determination of the actual support prices is carried out in a political context there is a tendency for the prices to be higher than would be implied by strict application of the criterion that incomes on efficient farms should be maintained. In recent years this tendency has been countered in part by the growing problem of surplus disposal and the budgetary pressures resulting from substantial intervention purchases (47).

The goal of common agricultural prices has been compromised by the potential for manipulation of the common price set in European Currency Units (ECU) as it is translated into national currencies. The 1968 devaluation of the French franc and subsequent revaluation of the German mark would have had the effect of raising support prices in France and lowering them in Germany. To avoid this, France and Germany were allowed to translate the common support prices set in units of account into domestic prices at the pre-1968 exchange rates. This was the beginning of a multiple exchange rate system with special exchange rates, known as "green rates," applied to agriculture (80).

The effect of the green rates is to create a differential between support prices in the member countries. In order to avoid the disruption of trade flows that the price differentials might cause, border taxes and subsidies known as monetary compensatory amounts (MCA) were introduced. The MCAs offset the differences in prices due to exchange rate changes (80). The original purpose of the MCAs was to protect the intervention system since the currency received for selling products into intervention in another member country could have been converted back to the local currency at market exchange rates rather than at the green rates. 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 was created (26).

The abandonment of the Bretton-Woods monetary system in the early 1970s marked the beginning of a series of experiments with floating exchange rates in the EC. 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, thus, moved in harmony with these currencies. MCAs were determined by applying the percentage difference between the green rates and the market exchange rates to the intervention price for the commodity. Subsequently, a unit of account for agricultural commodities based on the strong joint float currencies was used to set the 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 1979, 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 (26). 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 ECU.

As an example of how this complex system works, suppose that the central rate for the German mark is 2.52 marks per ECU while an ECU is worth 5.85 French francs. Since the mark is an appreciating currency, the green rate would be higher. The franc is a depreciating currency so the green franc would be lower than the market rate. Suppose that the green rates for France and Germany are 2.75 and 5.75 per ECU respectively. The MCA percentages are calculated by dividing the central rate by the green rate and subtracting the result from one. 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 ton translates into 1150 French francs and 550 German marks using the green rates. Without MCAs, a speculator could purchase 1150 French francs at the market rate for 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 really a 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 (=0.0174*1150) to raise the price to 1170 francs which equals 200 ECUs at the market exchange rate. German importers receive a subsidy of 46 marks (=0.0836*550) to raise the price from 504 German marks (=200 ECUs at the market rate) at the border to 550 marks for sale in Germany.

Initially, the green rates and MCAs were intended to be temporary. However, monetary uncertainties and the addition of three new members in 1973 resulted in greater refinements of the system. At present, the agri-monetary system has become institutionalized and member nations have discovered that it can be used to achieve national policy objectives. Since elimination of these arrangements would be disruptive, they have become permanent fixtures of European agricultural policy. As a consequence, the original goal of common agricultural prices has not been achieved. Member nations are able to manipulate green rates and MCAs in order 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 (78). MCAs are also applied to third countries. The existence of various trade barriers maintains the principle of community preference but the common prices set by the Ministers of Agriculture in the EC serve only as a point of departure for national legislatures in establishing domestic target prices.

How the EC support prices will be translated into Spanish producer and consumer prices will depend on the specific nature of the green rate and MCA system adopted. In addition, accessionary compensatory amounts (ACA) as well as temporary dispensations from some of the EC policies may be allowed during the transition period. Since EC support prices vary widely from country to country, it is unlikely that Spain will actually institute the peseta equivalent of these prices. The gradual introduction of the CAP will undoubtedly have a greater impact on the structure of relative prices than on the absolute price level.

Since the mechanisms of Spanish market and price policies are already similar to those in the EC, including variable levies and the equivalent of target and intervention prices, implementation of the CAP will primarily affect intervention levels and the commodities covered rather than requiring the development of unfamiliar management methods. Intervention prices for poultry meat and eggs will probably have to be eliminated after entry but the other commodities relevant to this study benefit from price policies in the EC similar to those in Spain. The Spanish institutions which administer the price and market policies (FORPPA and its subdivisions 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.

In addition to the change in relative prices implied by accession some of the traditional Spanish policies will have to be modified to conform to the CAP. Input subsidies, for example, are not permitted under the CAP although direct production aids are allowed for a small number of products (26). The subsidy on the price paid for diesel fuel has already been removed, leading to a sharp increase in this price. The premium for heavier beef cattle was eliminated in 1977 (1). Other important subsidies to Spanish agriculture which will have to be modified include subsidized credit, the subsidized price for corn paid by users, the subsidized price of soybean seed and some export aids.

Perhaps the most dramatic change in the institutional and policy setting will concern the commercialization of wheat. The monopolistic role of SENPA in wheat commerce will be eliminated with entry. Rather than dealing with a single government agency producers and users will have to develop a network of marketing channels. At the same time this transition may be facilitated by the fact that the EC has a more highly developed policy on the improvement of commercialization structures (15).

Spain presently imports substantial amounts of soybeans for use as feed. The crushing capacity in Spain is quite large and maximum sales prices for soybean meal are set. In order to prevent soybean oil from competing with Spanish olive oil, an internal marketing quota is set with the excess oil being exported. This quota may be abolished following accession with the result that internal consumption could increase leaving smaller amounts for export to other countries (1).

As part of the EC customs union, trade barriers between Spain and the EC will be eliminated and protection levels with respect to third countries will have to be harmonized with those in the EC. In addition, preferential agreements between the EC and certain Third World countries will be introduced in Spain. The changes in the trade regime implied by Spanish accession to the community should lead to some shifts in trade patterns and lowered levels of protection for certain sectors. On the whole, however, the introduction of EC trade policies does not represent a significant departure from the historical levels of protection.

Discussions concerning the implications of Spanish membership in the EC have been pursued by interest groups, agricultural officials in Spain, within the EC Commission and in third countries, and a variety of scholars and other interested persons. Suggestions concerning the effect of Spanish entry have been made and, as would be expected, vary widely. The most controversial issues concern the enlargement impacts in the vegetable oil, fruit and vegetable and wine sectors. Most writers feel that accession will create problems for many of the sectors in the Spanish feedgrain-livestock economy (1, 9, 94).

While opinions vary greatly, the consensus appears to be that soft wheat production will decline since EC prices are generally lower. Durum wheat will receive more favorable prices under the CAP and production may expand although very little durum wheat is presently grown in Spain. Most writers feel that Spanish membership will add to the EC surplus in barley (1). Informants in Spain generally felt that the potential for increased corn production had already been reached and did not foresee growth in acreage or production even though the EC prices are higher.

Livestock sectors in Spain are expected to be hurt by higher feed costs following entry. Although beef prices in Spain are lower than EC prices, most writers feel that the structural problems of this sector will prevent it from competing effectively in the EC. On the other hand, hog production in Spain is carried out at an advanced technological level so that production of pigmeat may continue to expand despite the higher feed prices (1).

The situation for poultry meat, eggs and sheep meat is less easy to predict since price comparisons are more difficult in the absence of EC institutional prices. The major impact on the poultry sectors is likely to be the increase in feed costs. However, the broiler and egg industries in Spain are very modern and most writers feel that these sectors will be able to compete effectively in the EC (1, 53). Future developments in the broiler sector will also depend on the level of consumption since both Spain and the EC are largely self-sufficient in poultry meat and the potential for exports may be limited. Both production and consumption of sheep and goat meat have been relatively stable in Spain. Some potential for Spanish exports of these commodities to the EC exists but it does not appear likely that production will expand greatly due to the shortage of shepherds in Spain (1).

Producer prices for milk in Spain are higher than in the EC and this sector is characterized by small, inefficient farms. Accession is likely to adversely affect the dairy sector although several informants in Spain felt that the EC would not be able to dispose of its surpluses on Spanish markets. Changes in the market regime allowing dairy producers to deliver unlimited quantities for intervention purchases may mitigate the impact of lower prices (1). Imports of EC dairy products is expected by many to increase and some informants suggested that liquid milk exports from Southern France may capture some of the Spanish dairy market (1).

II. Overview of the Modelling Approach

In order to assess the impact of enlargement on Spanish production, consumption and trade, a model of the feedgrain and livestock sectors has been developed. The model includes five recursive production components, a complete system of demand equations, a derived demand component for feedgrains and soybean meal, and several sets of identities and equations to link the production and disappearance sides of the model. A complete description of the model is presented in Chapters III, IV and V. The purpose of this section is to provide a general description of the structure of the model as an introduction to the following chapters.

Complete models of agricultural sectors have been developed for many purposes and the approaches used involve a wide range of techniques. A study of the impact of the first enlargement of the EC was carried out at Michigan State University with models of production and consumption for the grain-livestock economies of the U.K., Denmark, and Ireland (27). The basic approach relied on the projection of exogenous prices according to various scenarios and assumptions (22). On the demand side, elasticities were estimated with ordinary least squares and used to project consumption to 1975 and 1980. Supply was estimated as a function of gross margin type variables and lagged dependent variables. The system was recursive and incorporated policy assumptions through the exogenous price projections, as well as within the structure of the model. The projections of supply and demand allowed the determination of surpluses and deficits in the three countries leading to an analysis of the probable impact of enlargement on trade flows. In a companion study by Sorenson and Hathaway, production and consumption patterns in the EC-6 were projected to 1970 and 1975 on the basis of coefficients taken from other studies. These projections allowed trade balances and the evolution of trade flows under various policy assumptions to be estimated (82).

A much larger study by Blakeslee, Heady and Framingham projected world food production, consumption and trade to 1985 and 2000 (8). Due to limitations in the availability of data and the length of the projection period, the study relied primarily on time trends to project population and income as explanatory variables for consumption of major food commodities. Acreage and yields were projected on the basis of time trends with total acreage subjected to constraints on cropland area. Feed demand was derived from the livestock component and projected demand for each commodity was compared with projected supplies to obtain estimates of excess demand or supply. The study included a linear programming model to estimate trade flows.

Two dissertations done at Michigan State University provide further examples of supply and demand models of grain-livestock sectors. Josling studied policies related to cereal grains in the U.K. (48). Total cereal acreage was estimated as a function of prices and wages and allocated between wheat and coarse grains.

Total production was determined by extrapolating yields. Grain demand was analyzed as the derived demand for inputs into livestock and industrial production. Using these relations Josling was able to estimate import demand for the U.K. and evaluate the effects of various grain policies and agreements. Kalaitzis developed five recursive submodels to describe the feedgrain-livestock economy of Greece (49). Each submodel included equations for domestic demand, acreage or number of animals, yields, domestic supply, import demand and total supply. In both dissertations, the relations were estimated with ordinary least squares.

McFarquhar and others present a complete food and agriculture model for the U.K. (57). The model has three components. The first is a consumer expenditure model with price and expenditure elasticities estimated simultaneously for all food products. The second component contains a series of supply response models. The final component is a physical input/output transformation matrix allowing intermediate demand to be computed. The demand model is a linear expenditure system while the supply model consists of standard, recursive acreage and yield equations estimated with ordinary least squares. The authors also develop a combined beef, veal and milk production submodel reflecting the interrelation of these industries. Other models in McFarquhar's book also use input/output techniques to project final demand and supply. The input/output matrix balances supply and demand and determine a vector of prices consistent with the balance (57).

The Spanish feedgrain-livestock model presented here is similar to the ones used for the earlier enlargement study. Policy adjustments are assumed to operate primarily through the exogenously introduced prices which drive the production and consumption sides of the model. The difference between domestic availability, derived mainly from the production components, and domestic disappearance, determined largely by the human demand and derived feed demand models, is taken to represent net trade. The estimates of net trade result from the combination of a large number of estimated relationships and are useful more as indicators of potential surpluses or deficits than as exact predictions of trade flows.

The global structure of the model is based on the variables normally found in agricultural balance sheets. Spanish production and, where relevant, change in stocks make up domestic availability. Domestic disappearance includes human and livestock consumption as well as various other uses such as seed and industrial processing. Important relationships are estimated econometrically and the model includes a large number of identities and proportionalities. The complete model contains 150 endogenous variables. About 60 of these are computed in the model from other variables and serve primarily to transform estimated variables or to aggregate them into the appropriate categories.

The data used in estimating the model were collected from a variety of sources. The author spent a month in Spain to gather data and consult with informed persons on the issues of enlargement. Complete descriptions of the data used are contained in the Appendices. Most of the production data were taken from publications of the Ministry of Agriculture (58, 59, 60, 61, 62). Other sources included the Instituto Nacional de Estadistica (INE), OECD publications and USDA data tapes.

The Spanish statistical services have improved in recent years but the earlier data are of dubious quality. Other researchers have noted data limitations including short time-series, inconsistent aggregation and differing sets of statistics reported by different sources (18). In addition, statistics on a great many useful variables have simply not been collected. This is the case for certain biological rates, government and private stocks, retail food prices and input use. Extensive discussions with researchers in Spain and the U.S. led to the conclusion that the data located during the visit to Spain constitute virtually all that are available.

Econometric models are only as reliable as the data used in their estimation. In the absence of certain crucial time-series, it was often necessary to create data on the basis of reasonable assumptions, descriptive information and through manipulation of the available statistical series. In combination with the inconsistency of some of the published statistics, this procedure means that the data base used in constructing the model is not as reliable as one would like. The errors in the statistical base result in somewhat larger standard errors and may bias the results in unknown directions.

Although some of the statistical series extend as far back as the 1940s, it was felt that the most representative base period would be 1960 to 1978. Not only are the data prior to 1960 likely to be unreliable but in addition, the relative isolation and low level of development in Spain during the 1950s probably do not reflect the current structure of production and consumption. Some of the time-series used in the model were begun in the mid-1960s but wherever possible the period 1960-1978 was used to estimate the model parameters.

The base period used for estimation was a period of very rapid growth in agricultural production and national income. These trends tend to be built into the estimated coefficients and carried into any projections made with the model. Since it is unlikely that the historical growth rates will continue indefinitely some of the model results may exaggerate the responsiveness of producers and consumers.

One of the objectives of this research is to project production, consumption and trade to 1990. The estimated simulation model is used to carry out these projections on the basis of alternative assumptions about the evolution of the exogenous variables. The projections are designed to allow analysis of the impact of accession on the Spanish feedgrain and livestock sectors. To this end, a baseline scenario is established on the assumption that past trends in prices and policies will continue over the projection period. Comparing the predictions from this scenario with those from two scenarios developed to reflect the changes which will occur when Spain joins the EC provides insights into the expected impact of accession as well as potential policy issues in Spain and the EC. These comparisons should be seen as an exercise in comparative static analysis rather than an investigation of the dynamic evolution of these sectors. A complete description of the development of the scenarios and the results of the projections is contained in Chapter VI. The simulations and projections described in this study were carried out using the General Analytical Simulation Solution Program (GASSP) developed originally at USDA. This program employs the Gauss-Seidel numerical method to solve systems of equations.

The next three chapters are devoted to a detailed description of the structure and estimation of the model components. Relevant policies and specific characteristics of each sector are noted in the presentation of the model structure and each component is validated by using it to simulate the base period. Full evaluation of the model will be made in the final chapter in light of its performance in the projections.

CHAPTER III

CONSUMER DEMAND FOR FOOD

Introduction

Rising incomes in Spain have led to changes in the kinds of food consumed as well as a decline in the share of the consumer's total budget allocated to food expenditures. The proportion of personal expenditure on all consumer goods devoted to food was 54 percent in 1960, falling to 33 percent in 1978. Expenditures on meat, milk products and eggs rose from approximately 29 percent of total food expenditures to about 38 percent over the same period. Per capita consumption of all categories of meat was 67.2 kilograms in 1978, only slightly lower than the European Community average of 75.8 kilograms (66).

Analysis of consumer demand is essentially a question of how consumers allocate their incomes to particular categories of goods. A complete model of consumer demand must reflect the interdependent and contemporaneous nature of these allocation decisions. Since this study concerns several commodities, a complete system of demand equations has been estimated. A great deal of research has been devoted to specifying and estimating such systems (6, 10). The advantage of this approach is that it specifically recognizes the interdependency of demand for various goods and relies on constraints from utility theory to facilitate empirical estimation of the behavioral relationships. This chapter includes a review of the relevant demand theory, a description of the specific model chosen and a discussion of the estimates for Spain.

I. The Allocation of Consumer Expenditures

The theory of consumer demand is based on the assumption that individuals maximize utility subject to a budget constraint. Utility functions are assumed to have continuous first and second-order derivatives with respect to the quantities of goods consumed, these quantities constituting the arguments of the utility function. Let q be a column vector of quantities, p a column vector of prices and m the total expenditure of a consumer with the utility function u. Then the problem can be stated as:

(3.1) Maximize $u = u(q)$

subject to $p'q = m$

p and m are assumed to be exogenously given. The familiar first-order conditions consist of a set or proportionalities of the marginal utilities and the budget constraint:

(3.2) $u_q = \lambda p$

(3.3) $p'q = m$

λ is a scalar lagrange multiplier often referred to as the marginal utility of income. Let U represent the matrix of second derivatives of the marginal utility equations with typical element $\partial^2 u/\partial q_i \partial q_j$. In order to ensure that the solution is indeed a maximum, this matrix must be negative definite. The assumption of strict quasi-concavity of u(q) guarantees this outcome. U is also symmetric and assumed non-singular.

Solving the first-order conditions for q and λ in terms of m and p results in a set of demand equations

(3.4) $q = q(p,m)$

In specifying a complete system of demand equations, the budget constraint, (3.3), is also included.

The first order conditions can be totally differentiated to examine the implications of the theory and assumptions for consumer demand. First, differentiate $p'q = m$ with respect to m.

(3.5) $p'q_m = 1$

where q_m is a vector of partial derivatives $\frac{\partial q}{\partial m}$. Differentiation of the budget constraint with respect to prices leads to the expression:

(3.6) $p'Q_p + q' = 0$

where Q_p is a matrix of partial derivatives $\frac{\partial q}{\partial p}$. These two expressions are referred to as the adding-up constraint and follow directly from the definition of m as the total expenditure on the goods figuring in the utility function.

The marginal utility equations are also differentiated with respect to prices and income.

$$\sum_{j=1}^{n} \frac{\partial^2 u}{\partial q_i \partial p_j} \frac{\partial q}{\partial m} = p_i \frac{\partial \lambda}{\partial m}$$

and

$$\sum_{j=1}^{n} \frac{\partial^2 u}{\partial q_i \partial q_j} \frac{\partial q}{\partial p_k} = p_i \frac{\partial \lambda}{\partial p_k} \quad \text{for } k \neq i$$

$$= p_i \frac{\partial \lambda}{\partial p_i} + \lambda \text{ for } k = i$$

or in matrix form:

(3.7) $Uq_m = \lambda_m p$

$$(3.8) \quad UQ_p = p\lambda_p + \lambda I$$

where I is the identity matrix, $\lambda_m = \partial\lambda/\partial m$, and λ_p is a vector of partial derivatives, $\partial\lambda/\partial p_i$. Expressions (3.5), (3.6), (3.7) and (3.8) can be combined into an expression referred to by Barten as the fundamental matrix equation of consumer demand theory.

$$(3.9) \quad \begin{bmatrix} U & p \\ p' & 0 \end{bmatrix} \begin{bmatrix} q_m & Q_p \\ -\lambda_m & -\lambda_p' \end{bmatrix} = \begin{bmatrix} 0 & \lambda I \\ \lambda & -q' \end{bmatrix}$$

Solving this equation requires the inversion of U which is why this matrix must be non-singular. The solutions for q_m, Q_p and λ_m are:

$$q_m = \frac{1}{p'U^{-1}p} U^{-1}p \qquad \lambda_m = \frac{1}{p'U^{-1}p}$$

$$Q_p = \lambda U^{-1} - \frac{\lambda}{p'U^{-1}p} U^{-1}p(U^{-1}p)' - \frac{1}{p'U^{-1}p} U^{-1}pq'$$

Using the expression for λ_m in the other two equations, we have:

$$(3.10) \quad q_m = \lambda_m U^{-1} p$$

$$(3.11) \quad Q_p = (\lambda U^{-1} - \frac{\lambda}{\lambda_m} q_m q_m') - q_m q'$$

Equation (3.11) is the decomposition of the response to prices into income and substitution effects. The expression in brackets in (3.11) is the Slutsky substitution matrix, S, which can be broken down into general and specific substitution effects. The general effect (λU^{-1}) is proportional to a symmetric matrix and the specific effect ($\lambda/\lambda_m \, q_m q_m'$) is symmetric by definition. Thus, the substitution matrix is symmetric. Equation (3.11) and the second-order condition for utility maximization mean that S is also negative semi-definite (10). This implies that the diagonal elements of the matrix are negative. The conditions of symmetry and negativity of the substitution matrix constitute additional sets of constraints on the demand equations.

The final constraint on the system of demand equations is that of homogeneity of degree zero in all prices and income. This condition is usually imposed to remove the effects of inflation and is achieved by deflating the explanatory variables. The homogeneity condition is based on the assumption that consumers respond to real prices rather than nominal prices. Thus, it reflects beliefs concerning consumer behavior. The symmetry and negativity conditions also reflect assumptions about individual behavior since they are derived from utility theory. The adding-up condition, on the other hand, results from the way in which the system of demand equations is structured (6).

The theoretical basis for a system of demand equations is utility theory as formulated for an individual agent. Since most empirical demand analysis is based on aggregate data and concerns demand for goods by all consumers, it is important to consider the extent to which micro-theory and the implied constraints can be expected to hold at the aggregate level. Let the subscript i indicate micro relations while the corresponding aggregate concepts are shown without subscript. Then by definition:

$$(3.12) \quad q = (1/N)\sum_{i=1}^{N} q_i$$

$$(3.13) \quad m = (1/N)\sum_{i=1}^{N} m_i$$

Substituting these definitions into the aggregate system of equations gives

$$(3.14)\quad q = (1/N)\sum_{i=1}^{N} q_i(m_i,p)$$

which is only equivalent to q=q(m,p) under fairly restrictive assumptions about the variation in m_i and $q_i(m_i,p)$ across individuals. The differential of (3.4) is

$$(3.15)\quad dq = q_m dm + Q_p dp$$

While for (3.14), one has:

$$(3.16)\quad dq = (1/N)\sum_i q_{m_i}(dm_i - q_i' dp) + (1/N)\sum_i S_i$$

Where $S_i = \lambda_i U_i^{-1} - \lambda_i/\lambda_{m_i} q_{m_i} q_{m_i}'$

If $q_{m_i} = q_m$ for all individuals, then the aggregate substitution matrix will indeed be symmetric and (3.16) will be identical to (3.15). In this case, all the micro-conditions can be expected to hold at the aggregate level (6).

Assuming that individual partial derivatives of income with respect to quantity are all the same as q_m ignores such sources of variation as changing marginal utilities of income at different levels in the income distribution. One way to handle this problem would be to treat relevant micro-characteristics, such as income distribution and demographic properties, as arguments in the demand equations (74). In the study reported in this chapter, adding up and homogeneity are imposed, symmetry is tested and the negativity condition is simply verified.

Before turning to a description of the model chosen for the analysis, one final property of systems of demand equations should be noted. Since m is defined as the sum of expenditure on all items, a problem arises in estimating the equations. Premultiplying the demand equations by p and adding a disturbance term (v) gives

$$(3.17)\quad p'q = p'q(p,m) + p'v = m$$

This implies that $p'v = 0$. Since $p'v$ is zero, the vector of disturbances is linearly dependent and the covariance matrix is singular. The problem results from the fact that one of the equations in the system is redundant. It is resolved by deleting one of the equations for estimation purposes. This equation can then be derived by employing the adding up condition (6).

II. The Rotterdam System of Demand Equations

A wide variety of demand systems is described in the literature (6, 10). One of the earliest to be described and estimated is the linear expenditure system which is still employed extensively (10). Other complete systems include the Rotterdam system, the quadratic expenditure system, the indirect addilog system as well as dynamic versions of these and other models. For this study, only the linear expenditure and Rotterdam systems were considered. The Rotterdam system was chosen because it is simpler to estimate and does not impose negative cross-price elasticities on the estimates as does the linear expenditure system. The disadvantage of the Rotterdam system is its relatively inefficient use of degrees of freedom. The following discussion of the Rotterdam system is taken primarily from the writings of Theil (85, 86).

The differential form of the generalized set of demand equations shown in (3.15) can be written with the income and substitution effects separated.

$$(3.18) \quad dq = q_m (dm - q'dp) + Sdp$$

A typical equation from the system can be written:

$$(3.19) \quad dq_i = \frac{\partial q_i}{\partial m} \left(dm - \sum_{j=1}^{N} q_j dp_j\right) + \sum_{j=1}^{N} \frac{\partial q_i}{\partial p_j} dp_j$$

$$i,j = 1 \ldots N, \text{ for } N \text{ commodities.}$$

Multiplying (3.19) by p_i/m and using the fact that $dx = x\, d(\log x)$ to express the equation in the form of logarithmic differentials leads to:

$$(3.20) \quad \frac{p_i q_i}{m} d(\log q_i) = \frac{\partial q_i}{\partial m} p_i \left(d(\log m) - \sum_j \frac{p_j q_j}{m} d(\log p_j)\right) + \sum_j \frac{\partial q_i}{\partial p_j} \frac{p_j p_i}{m} d(\log p_j).$$

Let

$$\mu_i = p_i \frac{\partial q_i}{\partial m}$$

$$\pi_{ij} = \frac{\partial q_i}{\partial p_j} \frac{p_i p_j}{m}$$

and

$$w_i = \frac{p_i q_i}{m}$$

Then (3.20) can be re-written:

$$(3.21) \quad w_i\, d(\log q_i) = \mu_i \left(d(\log m) - \sum_j w_j\, d(\log p_j)\right) + \sum_j \pi_{ij}\, d(\log p_j)$$

This is the form of the Rotterdam system of demand equations. The w_i are the value shares of the N commodities. The π_{ij} over all equations form a matrix which is related to the theoretically symmetric and negative semi-definite substitution matrix, S, by the expression $p_i p_j/m$. Imposing symmetry and negativity on the π_{ij} matrix is equivalent to imposing these conditions on S. The first term on the right-hand side of (3.21) is an index of change in real income and the μ_i are the marginal value shares of the commodities.

The adding up condition requires that $\sum_i p_i q_i = m$. Differentiating both sides of this constraint with respect to m gives the following property of the system:

$$(3.22) \quad \sum_i \mu_i = 1$$

The imposition of the homogeneity condition leads to the additional property of the system that:

$$(3.23) \quad \sum_j \pi_{ij} = 0$$

This property reflects the fact that proportionate changes in all prices and income do not lead to changes in demand. It also means that the π_{ij} matrix is singular.

In order to estimate this system of equations, it is necessary to express the variables in finite changes rather than the infinitely small differentials. This is accomplished by transforming the variables into first-differences in the logarithms. In order to make the value of w_i consistent with the finite-change form, an average of w_{it-1} and w_{it} is calculated, where t represents the current year. Finally, the real income term can be represented by the sum of the dependent variables. Let D signify the log change operator such that:

$$Dp_{jt} = \log p_{jt} - \log p_{jt-1} = \log \left(\frac{p_{jt}}{p_{jt-1}}\right)$$

$$Dq_{it} = \log q_{it} - \log q_{it-1} = \log \left(\frac{q_{it}}{q_{it-1}}\right)$$

and let:

$$w^*_{it} = \frac{w_{it-1} + w_{it}}{2}$$

and

$$Dq_t = \sum_i w^*_{it}\, Dq_{it}$$

Dq_t is the real income term in the demand equations. An alternative formulation of real income could be obtained by deflating income with a price index. Theil has shown that, while the two formulations are not identical, the difference is extremely small and the use of Dq_t guarantees that the sum of the disturbances in the equations is always zero (85).

Conditions (3.22) and (3.23) and the fact that the disturbances sum to zero allow one of the demand equations to be deleted for purposes of estimation. The redundancy of one of the equations has already been noted as the cause of the singularity of the covariance matrix. By deleting an equation, the singularity is removed and the system can be estimated. The deleted equation can then be constructed from conditions (3.22) and (3.23).

From (3.23) it is clear that $\pi_{ik} = - \sum_{j=1}^{N} \pi_{ij}$, $j \neq k$. Consider a typical equation in a system of N demand equations.

$$(3.24) \quad w^*_{it}\, Dq_{it} = \mu_i Dq_t + \pi_{i1}\, Dp_{1t} + \ldots + \pi_{ik}\, Dp_{kt} + \ldots$$

$$+ \pi_{in}\, Dp_{nt}$$

Substituting the expression for π_{ik} allows (3.24) to be written:

$$(3.25)\quad w^*_{it}\ Dq_{it} = \mu_i\ Dq_t + \pi_{i1}\ (Dp_{1t} - Dp_{kt}) + \ldots$$

$$+ \pi_{ik-1}\ (Dp_{k-1t}-Dp_{kt}) + \pi_{ik+1}\ (Dp_{k+1t}-Dp_{kt}) + \ldots$$

$$+ \pi_{in}\ (Dp_{nt}-Dp_{kt})$$

If the kth equation is the one deleted, the corresponding price variable can be used to deflate the other price variables. The final form of the system of demand equations is, thus:

$$(3.26)\quad w^*_{it}\ Dq_{it} = \mu_i\ Dq_t + \sum_{j=1}^{N} \pi_{ij}\ (Dp_{jt} - Dp_{kt})$$

$$j = 1\ldots,\ k - 1,\ k + 1,\ \ldots,\ N.$$

Assuming that the disturbances in these equations have zero means, constant contemporaneous covariances and zero lagged covariances, ordinary least square estimates applied to each equation are best linear unbiased. Each equation contains an identical set of explanatory variables and there is no gain to combining the equations for joint estimation. However, if the symmetry constraint is imposed on the π_{ij} matrix a constrained generalized least squares estimator is appropriate. An F-test can be formulated to test the hypothesis that the π_{ij} matrix is symmetric (85). Since the variables are in the form of first-differences over time, the introduction of a constant term is equivalent to the use of a time-trend to reflect changing tastes (3). The hypothesis that a trend in preferences is present can also be tested.

In summary, the structure of the Rotterdam system of demand equations incorporates the adding-up condition. The homogeneity condition is imposed by (3.23). The symmetry constraints can be tested and imposed on the system if the test shows that they are warranted by the nature of the data. The negativity condition can be verified by examining the point estimates of the π_{ij} and a constant term can be introduced if it is true that the data reflect changes in preferences over time. Rejection of the symmetry and negativity constraints implies that conditions derived from micro-theory do not hold at the aggregate level. In the case of symmetry, the implication is that a large number of symmetric substitution matrices do not add up to a symmetric aggregate matrix. In the case of negativity, rejection indicates that a large number of quasi-concave utility functions do not result in a quasi-concave aggregate welfare function.

III. The Rotterdam Model Applied to Spanish Consumption

Analysis of Spanish consumption is complicated by the inadequacy of consumption and price data. To remove the affects of population growth in Spain, the equations were estimated on the basis of per capita disappearance. Developing consistent series of consumption data for the various food categories required the use of several sources and reasonable assumptions when the sources disagreed.

Retail prices posed a far greater problem since there are no published statistical series on average, annual retail prices. The Spanish National Statistical Bureau (INE) has published reasonably complete series of wholesale prices (39). These prices are related to the intermediate demand of processors and marketing agents whose objective function is better described by the profit maximization problem of the firm than the utility maximization problem of the consumer. In addition, the use of wholesale prices leads to problems in aggregation since the sum of the expenditures on individual items would equal total expenditure at the wholesale, not consumer level. The relation between total wholesale expenditure and total consumer expenditure is probably very complex, involving inventory management, timing differences and changes in marketing margins which could obscure the effect of price changes on final consumption.

The wholesale price series and fragmentary information on retail prices were used to develop the retail prices used in the model. Details of the procedures employed are presented in Appendix A which also includes a description of the consumption data. The way in which the data were constructed insures that the adding-up condition holds.

In the original formulation of the model, 13 categories of consumer goods were identified for analysis. However, since the data base included only 19 observations, one of which is lost in the process of taking first-differences, the items were aggregated into nine final categories: beef and veal, liquid milk and milk products, pigmeat, poultry meat, sheep and goat meat, eggs, bread cereals, other food items, and non-food items. The complete system, thus, includes nine demand equations. The ninth equation, non-food items, was deleted for estimation and the non-food price index was used to deflate the other prices.

The eight equations were first estimated by ordinary least squares without imposing the symmetry condition. Symmetry restrictions were then imposed on the equations and the null hypothesis that the restrictions do not hold was tested. The calculated

F-statistic with 28 and 72 degrees of freedom was 2.43 leading to the conclusion that the symmetry constraint is inappropriate for the data used. The generalized least squares estimates calculated with the symmetry restrictions had larger standard errors and led to positive price elasticities for two of the commodities.

The equations were also estimated with a constant term to reflect changing tastes. The calculated t-statistic for the constant term in the pigmeat equation was 1.93 and it led to some improvement in that equation. In the other equations, however, there was no evidence that the constant term improved the estimates. An F-statistic for the entire system was calculated by summing the residual sum of squares for the equations with and without the constant term. The calculated F-statistic for eight and 64 degrees of freedom was 0.8 so the null hypothesis that the true value of the constant term is zero was not rejected.

Based on these tests, the ordinary least squares estimates of the eight equations with no constant term and without the imposition of the symmetry condition were chosen as best reflecting the information contained in the data. The deleted equation was derived by applying conditions (3.22) and (3.23). The estimates for the μ_i and π_{ij} and their standard errors are reported in Table 3.1. Standard errors for the ninth equation have not been computed. In general, the standard errors are relatively large compared to the estimated coefficients. This may be due to some multi-collinearity among the explanatory variables, the quality of the data and the number of degrees of freedom. In addition, the values of R^2 for the individual

TABLE 3.1

Parameter Estimates for the Rotterdam System of Demand Equations

	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
1. Beef-Veal	.015 (1.77)	-2.564 (1.20)	1.219 (1.04)	-.656 (.997)	-.802 (.883)	.474 (1.43)	-.321 (.64)	-.013 (1.215)	1.011 (1.2)	1.654	.56	9	1.94
2. 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
3. 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
4. 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
5. 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
6. 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
7. Bread 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
8. 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
9. Non-food Items	74.633	7.081	3.061	.883	.476	-2.147	-1.085	-1.293	10.077	-17.052			

1) Parameter estimates and standard errors should be divided by 100.

2) Standard errors in parentheses.

equations are fairly low ranging from .46 for the pigmeat and sheep and goat meat equations to .79 for the bread cereals equation.

The real parts of the characteristic roots of the π_{ij} matrix are: -.093, -.44, -.017, -.017, .0035, .0035, .0024, -.0049. Four of the roots are complex conjugates. These figures clearly indicate that the matrix is not negative semi-definite, although the elements in the principal diagonal are all negative as would be expected.

Recalling that π_{ij} is defined as $(\partial q_i/\partial p_j)\ (p_i p_j/m)$, dividing these coefficients by the w_i used in defining the dependent variables results in a compensated price elasticity. Dividing μ_i by w_i gives the income elasticity for the good i. Table 3.2 shows the compensated price elasticities calculated from the point estimates of the π_{ij} and the average value of the w_i over the estimation period. These elasticities show the effect of price changes when there is a compensating change in income to hold utility constant. While the magnitudes of most of these elasticities appear reasonable, it is difficult to interpret some of the signs. Negative compensated cross-price elasticities indicate that the goods are complements while a positive sign reflects substitutability between the goods. It is not clear why pork and beef should be considered complements while beef and sheep/goat meat are substitutes. Furthermore, rejection of the symmetry condition means that some of the cross-price elasticities ε_{ij} have the opposite sign from the corresponding ε_{ji}.

To obtain an approximation of the uncompensated price elasticities, the estimates in Table 3.2 must be corrected to include the income effect. Barten notes that the price coefficients can be written:

TABLE 3.2

Compensated Price Elasticities of Demand

	1	2	3	4	5	6	7	8	9
1. Beef	- .825	.392	-.211	-.258	.153	-.103	- .004	.325	.532
2. Milk	- .027	- .004	-.319	.189	.425	.053	- .329	-.144	.155
3. Pork	- .492	.153	-.317	-.288	.353	-.098	- .477	-.105	1.272
4. Poultry	.305	-1.648	-.577	-.201	-.017	-.100	1.313	.310	.615
5. Sheep-Goat	.185	.294	.082	.022	-.355	.034	- .347	-.093	.180
6. Eggs	-1.053	- .003	.269	-.551	-.435	-.033	1.024	.460	.323
7. Bread	.311	- .022	.369	.413	.064	-.073	- .522	-.331	- .210
8. Other Food	- .138	- .118	.047	.016	-.010	.118	.145	-.455	.395
9. Non-food Items	.121	.052	.015	.008	-.037	-.018	- .022	.172	- .290

Calculated at the average weights.

$$(3.27) \quad \pi_{ij} = \frac{p_i p_j}{m} \left(\frac{\partial q_i}{\partial p_j} + \frac{\partial q_i}{\partial m} q_j\right)$$

where the term in brackets is the price derivative when utility is held constant by a compensating change in income. Multiplying the right-hand side of (3.27) by mq_i/mq_i allows the price coefficients to be expressed as elasticities.

$$(3.28) \quad \pi_{ij} = w_i \, (e_{ij} + \eta_i \, w_j)$$

where e_{ij} is an uncompensated price elasticity of demand and η_i is the income elasticity. The compensated price elasticity, ε_{ij} is equal to π_{ij} divided by w_i or to the expression in brackets in (3.28). Solving for e_{ij} gives the expression:

$$(3.29) \quad e_{ij} = \varepsilon_{ij} - w_j \, \eta_i = \varepsilon_{ij} - \frac{p_j q_j}{m} \frac{m}{q_i} \frac{\partial q_i}{\partial m}$$

since $\mu_i = p_i \, \partial q_i/\partial m$, μ_i/p_i can be substituted for the derivative in (3.29) giving the formula used to approximate the uncompensated price elasticities,

$$(3.30) \quad e_{ij} = \pi_{ij}/w_i - \left(\frac{p_j q_j}{p_i q_i}\right) \mu_i$$

The uncompensated price elasticities and the income elasticities, computed at the average values of the w_i and the prices, are shown in Table 3.3.

It is clear from Tables 3.2 and 3.3 that the compensated and uncompensated own-price elasticities are all negative as would be expected. The income elasticity for beef is lower than expected while those for eggs and poultry meat appear to be too high. It is likely that these results are at least partly due to inadequate data.

TABLE 3.3

Uncompensated Price Elasticities and Income Elasticities

	Uncompensated Price Elasticities									Income Elasticities
	1	2	3	4	5	6	7	8	9	
1. Beef	- .825	.392	-.211	-.258	.153	-.103	- .004	.324	.529	.005
2. Milk	- .047	- .026	-.343	.179	.416	.044	- .350	-.350	- .242	.644
3. Pork	- .495	.149	-.321	-.290	.352	-.099	- .480	-.128	1.208	.104
4. Poultry	.176	-1.792	-.733	-.267	-.073	-.155	1.176	-.619	-1.949	4.203
5. Sheep-Goat	.189	.298	.086	.024	-.353	.036	- .343	-.067	.252	- .114
6. Eggs	-1.098	- .053	.215	-.574	-.455	-.052	.976	.136	- .572	1.326
7. Bread Cereals	.317	- .016	.376	.416	.067	-.071	- .516	-.289	- .095	- .158
8. Other Food	- .159	- .141	.022	.005	-.019	.109	.123	-.605	- .019	.686
9. Non-food Items	.084	.010	-.030	-.011	-.053	-.034	- .062	-.098	-1.036	1.271

Computed at average weights and prices.

Single equation estimates of beef demand using alternative functional forms frequently resulted in negative income elasticities although there is no evidence from other studies that beef is an inferior good in Spain (30). The negative income elasticities for sheep and goat meat and bread cereals are less worrisome, since consumption of bread has declined, while that of sheep and goat meat has remained virtually the same over the past 20 years.

In order to use the estimated equations for forecasts, it is necessary to transform the predicted dependent variables into per capita consumption. The procedure used to accomplish this transformation is described in Appendix D. The major disadvantage of the model for forecasting is that per capita consumption in the current year is a multiple of the previous year's consumption and any errors in the earlier estimates are compounded. As a result, the model is more reliable for short-term forecasts than long-term predictions.

To validate the model, the period 1968-1978 was simulated on the basis of the estimated equations. The actual lagged values of per capita consumption were used in the historical simulation so that the model corrected itself at each iteration. The results of this exercise are presented in Tables 3.4a to 3.4h, which include the percentage error of the estimates. Table 3.5 presents the values of Theil's U statistics which constitute one measure of the accuracy of forecasts. Let P_t represent the predicted value at time t, A_t the actual value, $p_t = (P_t - A_{t-1})/A_{t-1}$, and $a_t - (A_t - A_{t-1})/A_{t-1}$. Then the mean square error is defined as:

$$MSE = (1/N) \sum_t (p_t - a_t)^2$$

TABLE 3.4

Per Capita Consumption of Food Items
in Spain, 1968-1978

Year	Actual	Estimate	% Error
		a. Beef and Veal (kg./year)	
1968	10.8	10.2	- 5.64
1969	11.2	11.7	4.65
1970	12.1	11.7	- 2.96
1971	11.8	12.7	7.44
1972	11.3	12.1	7.34
1973	12.0	12.0	.119
1974	12.0	12.3	2.52
1975	14.0	13.3	- 4.98
1976	13.8	13.5	- 2.07
1977	13.0	14.2	9.48
1978	12.7	13.1	2.92
		b. Milk (kg./year)	
1968	115	114	- 1.45
1969	123	120	- 2.36
1970	123	126	2.22
1971	126	128	1.22
1972	129	129	.740
1973	138	137	- .229
1974	148	147	- .972
1975	145	148	1.89
1976	150	146	- 2.74
1977	150	152	1.34
1978	153	156	1.86

TABLE 3.4 (continued)

Year	Actual	Estimate	% Error
	c. Pigmeat (kg./year)		
1968	12.8	13.3	3.98
1969	13.1	14.1	7.74
1970	13.8	15.0	8.65
1971	14.9	14.9	- .280
1972	15.7	15.2	- 3.27
1973	17.8	17.4	- 2.15
1974	19.8	18.9	- 4.74
1975	18.8	21.2	12.6
1976	19.6	19.6	- .146
1977	20.4	20.5	.601
1978	22.7	21.9	- 3.41
	d. Poultry Meat (kg./year)		
1968	10.8	10.8	- .303
1969	11.7	12.8	9.82
1970	14.8	13.3	-10.4
1971	14.1	15.7	11.2
1972	16.4	18.0	9.45
1973	17.3	17.6	1.71
1974	17.1	19.0	11.3
1975	17.9	18.1	1.24
1976	19.6	22.5	14.7
1977	20.4	21.0	3.10
1978	20.7	23.7	14.5

TABLE 3.4 (continued)

Year	Actual	Estimate	% Error
	e. Sheep and Goat Meat (kg./year)		
1968	4.0	4.12	2.98
1969	3.9	4.05	3.95
1970	4.1	4.08	- .387
1971	4.0	4.28	7.04
1972	4.0	3.93	- 1.67
1973	4.2	3.98	- 5.18
1974	4.5	4.28	- 4.86
1975	4.2	4.27	1.76
1976	4.2	4.31	2.52
1977	4.0	3.96	- 1.02
1978	3.8	3.89	2.47
	f. Eggs (kg./year)		
1968	11.9	10.6	-10.7
1969	12.8	13.5	5.59
1970	13.9	14.1	1.69
1971	14.8	14.8	- .017
1972	16.4	18.3	11.6
1973	12.6	15.5	22.9
1974	13.8	12.7	- 7.87
1975	16.1	16.6	3.27
1976	17.0	16.0	- 5.95
1977	16.5	16.0	- 2.81
1978	15.4	15.6	1.04

TABLE 3.4 (continued)

Year	Actual	Estimate	% Error
	g. Bread Cereals (kg./year)		
1968	88.9	93.3	4.94
1969	76.4	80.6	5.49
1970	77.0	73.9	- 3.99
1971	75.3	74.4	- 1.24
1972	76.0	78.2	2.84
1973	77.5	78.1	.823
1974	77.6	77.3	- .332
1975	79.7	71.1	-10.8
1976	77.1	80.0	3.76
1977	76.9	86.4	12.3
1978	75.7	66.2	-12.6
	h. Other Food (kg./year)		
1968	493	501	1.61
1969	483	497	2.89
1970	497	519	4.33
1971	529	513	- 3.14
1972	561	547	- 2.48
1973	563	550	- 2.22
1974	595	593	- .215
1975	591	595	.675
1976	594	584	- 1.65
1977	547	555	1.43
1978	561	560	- .282

TABLE 3.5

U Statistics for Demand Equations

Equation	U1	U2	UM	UR	UD	R
Beef	.0259	.7929	.0966	.1316	.7717	.820
Milk	.0086	.4158	.0087	.0887	.9025	.985
Pigmeat	.0273	.7093	.0568	.0083	.9349	.956
Poultry Meat	.0478	1.1356	.4097	.2812	.3090	.956
Sheep/Goat Meat	.0182	.7849	.0269	.0661	.9070	.616
Eggs	.0416	.7293	.0362	.2766	.6872	.793
Bread Cereals	.0342	1.2799	.0006	.7366	.2629	.652
Other Food	.0107	.4899	0.0	.0923	.9077	.958

UM, UR and UD may not sum to one due to rounding.

The U statistics are defined:

$$U1 = \frac{(MSE)^{1/2}}{(\sum_t A_t^2)^{1/2} + (\sum_t P_t^2)^{1/2}}$$

$$U2 = \left(\frac{MSE}{\sum_t A_t^2/N}\right)^{1/2}$$

Maddala points to examples which indicate that U1 does not give a good ranking of forecasts and U2 is, thus, the preferred measure. Both are equal to zero in the case of a perfect forecast, although U1 is limited to values between zero and one, while the value for U2 ranges from zero to infinity (56).

The mean square error can be decomposed into two sets of error proportions. The preferred set breaks the MSE into the proportion of the error due to the mean (bias), regression and disturbance (56). These components are defined as:

$$UM = \frac{(\bar{p} - \bar{a})^2}{MSE}$$

$$UR = \frac{(Sp - rSa)^2}{MSE}$$

$$UD = \frac{(1 - r^2)Sa^2}{MSE}$$

where:

$\bar{p}$, $\bar{a}$ are the means of p_t and a_t

Sp is the variance of the predictions

Sa is the variance of the actual values

and r is the correlation between p and a.

If one regresses the actual on the predicted values in the equation

$$A_t = \alpha + \beta P_t$$

UM will equal zero if the estimate of α is zero and UR will be zero if the estimate of β is one. Since UM, UR and UD are proportions summing to one, a perfect forecast would result in UM and UR being zero and UD equalling one. These criteria can be used to evaluate the results presented in Table 3.5. The last column in this table is the correlation coefficient from the regression $A_t = \alpha + \beta P_t$.

The U statistics suggest that the poultry meat, egg and bread cereal equations are less reliable forecasters than the others. This indication is reinforced by the predictions to 1990 under alternative scenarios. In these predictions, the consumption of bread cereals tends to fall to unreasonably low levels while that of poultry meat and eggs reaches unrealistically high levels. The weakness of the poultry meat and bread cereal equations is also reflected in the results presented in Table 3.4 which show fairly large errors in the later years.

While some of the results of the consumption analysis are disappointing, it appears that the estimates accurately reflect the information contained in the data. The use of a different system of demand equations might have resulted in more robust estimates with lower standard errors since the Rotterdam system uses a great many degrees of freedom. Single equation estimates of the relationships based on the same data but using alternative functional forms are shown in Tables 3.6 and 3.7. The estimates in Table 3.6 are from equations of the form:

TABLE 3.6

Parameter Estimates for Demand Equations of the Form:

$$q_{it} = c_i + \alpha_i m_t + \sum_j \beta_{ijt} p_{jt}$$

	C	Beef Price	Milk Price	Pork Price	Chicken Price	Sheep-Goat Price	Egg Price	Bread Price	Other Food Price	Income	R^2	Degrees of Freedom	Durbin-Watson
Beef	10.9	-.063	.390	-.045	-.016	.032	-.053	.113	.309	-.00001	.97	9	1.82
	(12.8)	(.052)	(.248)	(.035)	(.030)	(.044)	(.072)	(.390)	(.365)	(.0002)			
Milk	68.1	-.036	.234	-.488	.339	.420	-.081	-1.661	-1.06	.002	.99	9	2.63
	(47.0)	(.191)	(.908)	(.127)	(.110)	(.163)	(.263)	(1.429)	(1.34)	(.0006)			
Pork	23.7	-.025	-.723	-.060	.004	.092	.090	- .808	- .738	.0004	.99	9	2.17
	(15.5)	(.063)	(.30)	(.042)	(.036)	(.054)	(.087)	(.472)	(.443)	(.0002)			
Chicken	22.9	.015	-.385	-.014	-.088	-.006	-.107	- .311	- .259	.0003	.99	9	3.19
	(8.7)	(.035)	(.169)	(.024)	(.021)	(.030)	(.049)	(.266)	(.249)	(.00012)			
Sheep-Goat	-2.89	.027	.035	-.00018	-.00027	-.014	.022	.068	.040	.00009	.70	9	2.12
	(3.2)	(.013)	(.062)	(.0087)	(.0076)	(.011)	(.018)	(.098)	(.092)	(.00004)			
Eggs	43.9	-.118	.218	.032	-.107	.0054	-.141	-.116	-.324	-.0002	.95	9	1.79
	(19.5)	(.079)	(.377)	(.053)	(.046)	(.068)	(.109)	(.593)	(.556)	(.0003)			
Bread	40.8	-.025	-.682	.404	.242	.134	-.005	-.063	-.579	-.00006	.96	9	2.29
	(65.6)	(.266)	(1.27)	(.177)	(.154)	(.228)	(.367)	(1.99)	(1.87)	(.0009)			
Other Food	181.4	-.120	-3.01	.535	-.649	.115	2.36	9.67	-18.6	.012	.94	9	2.16
	(261.6)	(1.06)	(5.05)	(.704)	(.614)	(.907)	(1.46)	(7.95)	(7.45)	(.0035)			

TABLE 3.7

Parameter Estimates for Demand Equations of the Form:

$$\log q_{it} = b_i + \gamma_i \log m_t + \sum_j \delta_{ij} \log p_{jt}$$

	C	Beef Price	Milk Price	Pigmeat Price	Poultry Price	Sheep-Goat Price	Egg Price	Bread Cereal Price	Other Food Price	Income	R^2	Degrees of Freedom	Durbin-Watson
Beef	3.61 (6.39)	-.629 (.432)	.376 (.273)	-.662 (.283)	-.186 (.314)	.240 (.441)	-.183 (.247)	.537 (.29)	.757 (.452)	.173 (.543)	.98	9	2.15
Milk	-.477 (2.37)	-.058 (.160)	.112 (.102)	-.466 (.105)	.210 (.117)	.551 (.164)	-.049 (.092)	-.295 (.108)	-.210 (.168)	.426 (.202)	.99	9	2.63
Pigmeat	.561 (6.98)	-.563 (.472)	.041 (.298)	-.097 (.309)	-.383 (.343)	.499 (.481)	.180 (.269)	-.602 (.317)	-.100 (.493)	.053 (.593)	.98	9	2.57
Poultry Meat	-102.83 (29.54)	3.160 (1.995)	-3.689 (1.263)	-3.923 (1.306)	1.159 (1.451)	.294 (2.036)	-.325 (1.14)	4.771 (1.34)	-.979 (2.087)	10.036 (2.508)	.96	9	2.31
Sheep-Goat	-.575 (5.217)	.252 (.352)	.119 (.223)	.092 (.231)	-.032 (.256)	-.278 (.360)	.275 (.201)	-.342 (.237)	.032 (.369)	.181 (.443)	.58	9	1.74
Eggs	-.376 (7.72)	-.558 (.522)	.115 (.330)	-.148 (.341)	-.516 (.379)	-.364 (.532)	-.500 (.298)	1.227 (.350)	.384 (.546)	.543 (.656)	.97	9	2.32
Bread Cereals	3.132 (3.97)	-.007 (.268)	-.170 (.170)	.310 (.173)	.198 (.195)	.289 (.273)	.104 (.153)	-.190 (.180)	-.265 (.280)	.023 (.337)	.96	9	2.30
Other Food	-.989 (2.74)	-.249 (.185)	-.106 (.117)	.233 (.121)	-.082 (.134)	.091 (.189)	.244 (.106)	-.119 (.124)	-.642 (.193)	.549 (.232)	.94	9	2.35

$$q_{it} = c_i + \alpha_i m_t + \sum_j \beta_{ijt} p_{jt}$$

Where

q_{it} = per capita consumption of good i at time t

m_t = real disposable income (deflated by the Consumer Price Index) at t

p_{jt} = real price of good j at t (also deflated by the CPI)

and c_i, α_i, β_{ij} are the estimated parameters.

The equations estimated in Table 3.7 are of the form:

$$\log q_{it} = b_i + \gamma_i \log m_t + \sum_j \delta_{ij} \log p_{jt}$$

where log refers to natural logarithms. There equations were deflated by the same non-food price as in the Rotterdam equations rather than the CPI.

Table 3.7 is more easily interpreted since the coefficients from the log-log equations are the estimated elasticities. Most of the own and cross-price elasticities are of the same sign and magnitude as in the Rotterdam system. The notable exceptions are the own-price elasticities for milk and poultry which are positive in Table 3.7 and the cross-price elasticities between chicken and the other items which are much larger. The income elasticity for poultry meat is extremely high in Tables 3.7 and 3.3. Elasticities for the additive demand equations have not been computed but it is clear that the own-price elasticity for milk is positive.

The Rotterdam specification is preferable to the additive and logarithmic formulations since all the own-price elasticities in that system are negative. Although the data used in these estimates have been derived under reasonable assumptions they are probably less reliable than is desirable. Single equation estimates of eleven demand relationships with deflated wholesale prices and income as explanatory variables resulted in five positive own-price elasticities and two negative income elasticities. This suggests that the basic wholesale price data, from which the retail prices were derived, may not reflect the reasons for the evolution of consumption in Spain.

An alternative source of data is provided by the periodic household expenditure surveys carried out by the INE (40, 41, 42, 43). Surveys have been conducted in 1958, 1964, 1967, 1968 and 1973 in various regions of Spain. Constantino Lluch has used the results of the 1958 and 1964 surveys to estimate a set of five demand equations for urban areas (51). The variables in Lluch's model are logarithmic differentials similar to those in the Rotterdam system. They are defined as the difference between the 1958 and 1964 values in 50 provinces so this is a cross-sectional rather than a time-series approach.

Using the survey data for the present study proved impossible since the price indices published by INE are not sufficiently disaggregated. While information on consumer expenditure for a great many items is contained in the surveys, the published price indices concern only the five categories presented in Lluch's model. In efforts to derive retail prices from the survey expenditure data, a great many anomalies were encountered. For example, the retail price implied by the expenditure data and information on per capita quantities consumed was often less than the wholesale prices reported in the statistical yearbook. In addition, the detailed information on consumer expenditures is not broken down by provinces as is the case for Lluch's five categories. As a result of these problems, the attempt to develop a model based on the survey data was abandoned.

Lluch estimates three alternative formulations of the logarithmic differential demand equations. For each formulation he presents unconstrained and homogeneity constrained estimates as well as estimates under both homogeneity and symmetry. In place of the Rotterdam income term, Lluch uses real expenditure so the income elasticities are not comparable to those presented earlier. His estimates of the Slutsky compensated price elasticities are similar, however, and are presented in Table 3.8, for the formulation most nearly corresponding to the model discussed in this chapter.

The adjusted R^2 presented by Lluch is fairly low or negative for several equations. The estimated elasticities are generally much larger than their standard errors and have the expected signs. Since Lluch has estimated only five equations on the basis of fifty observations, there are many more degrees of freedom leading to more reliable hypothesis testing. The own-price elasticities estimated in the Rotterdam model of Spanish consumption range, in absolute value, from .004 to .825 for the various food items compared with Lluch's estimates for all food of between .551 and .679. In general the own-price elasticities for the four non-food categories estimated by Lluch are close to or greater than one compared with the own-price elasticity for all non-food items from the Rotterdam system of only .29. Although Lluch's results cannot be directly compared with the estimates presented in this chapter, there is a suggestion that the food estimates are in the same range. The non-food elasticity in

TABLE 3.8

Compensated Price Elasticities for Spain Estimated by C. Lluch(32)

(Standard Errors in Parentheses)

		e*					
	E	1	2	3	4	5	R^2
		A. Unconstrained Estimates					
1. Food	.541	-.573	.275	.071	-.093	.234	.641
	(.073)	(.178)	(.138)	(.101)	(.137)	(.176)	
2. Clothing	1.247	-.406	-1.020	.175	.329	.910	.725
	(.152)	(.375)	(.289)	(.212)	(.287)	(.371)	
3. Housing	.928	1.229	.134	-.910	.558	.327	.573
	(.178)	(.437)	(.338)	(.247)	(.335)	(.433)	
4. Housing Maintenance	1.212	.337	.232	.261	-.490	.017	.656
	(.146)	(.359)	(.278)	(.203)	(.276)	(.356)	
5. Other	1.818	1.186	.125	-.218	.148	-1.625	.798
	(.147)	(.361)	(.279)	(.204)	(.277)	(.358)	

TABLE 3.8 (continued)

		e*					
	E	1	2	3	4	5	R^2
		B. Estimates Under Homogeneity					
1. Food	.493	-.551	.241	.113	-.034	.230	.635
	(.046)	(.168)	(.125)	(.085)	(.113)	(.167)	
2. Clothing	1.241	-.403	-1.025	.181	.337	.910	.429
	(.137)	(.501)	(.376)	(.252)	(.338)	(.502)	
3. Housing	1.666	.879	.664	-1.566	-.362	.385	-1.481
	(.268)	(.978)	(.733)	(.491)	(.660)	(.979)	
4. Housing Maintenance	1.410	.244	.374	.085	-.736	.033	.613
	(.097)	(.354)	(.265)	(.178)	(.239)	(.354)	
5. Other	1.607	1.286	-.026	.030	.411	-1.641	.780
	(.096)	(.349)	(.262)	(.175)	(.236)	(.349)	

TABLE 3.8 (continued)

	E	e* 1	2	3	4	5	R^2
	C. Estimates Under Homogeneity and Symmetry						
1. Food	.471	-.679	.012	.127	.020	.521	.599
	(.046)	(.211)	(.108)	(.086)	(.061)	(.122)	
2. Clothing	1.328	.041	-.809	.217	.233	.317	.448
	(.118)	(.365)	(.303)	(.172)	(.135)	(.272)	
3. Housing	1.748	.961	.487	-1.638	.095	.094	-1.503
	(.240)	(.651)	(.386)	(.446)	(.222)	(.460)	
4. Housing Maintenance	1.371	.106	.366	.066	-.759	.221	.603
	(.092)	(.324)	(.212)	(.155)	(.218)	(.266)	
5. Other	1.575	1.286	.232	.031	.103	-1.650	.768
	(.097)	(.302)	(.199)	(.150)	(.123)	(.312)	

E = Expenditure (Engel) Elasticity

e* = Slutsky Compensated Price Elasticities the Rotterdam model is lower than would be suggested by Lluch's results.

Concluding Comments

Further research on demand for food in Spain would be useful. Given the relatively small number of observations, a different specification using fewer degrees of freedom might result in improved estimates. The quadratic expenditure system would be preferable to the linear expenditure system since it does not impose negative cross-price elasticities on the parameters and allows for non-linear Engel curves. Deleting some of the variables from the Rotterdam, logarithmic or additive formulations might result in more robust equations although this ad hoc procedure is not grounded in economic theory.

The lack of published retail price series constitutes an impediment to research on consumer demand in Spain. The estimated equations in the Rotterdam system are better than alternative specifications estimated with the retail prices developed in this study. However, three of these equations lead to unreasonable forecasts and the entire system appears to perform better for short-term rather than long-term projections. Research leading to the development of reliable retail price series would be an important contribution to the analysis of consumer demand in Spain.

CHAPTER IV

LIVESTOCK AND CEREAL GRAINS PRODUCTION IN SPAIN

Introduction

Agricultural production in Spain has expanded rapidly over the past twenty years due to extensive technical innovation. In the early 1960s poultry meat and egg production were still largely traditional activities, involving little use of capital or scientific feeding methods. Today these two industries are among the most modern in Europe involving large production units which are frequently vertically linked to feed producers and markets (54). Hog production in Spain is also carried out employing modern techniques of feeding, breeding and with increased specialization in the production process. The modern, industrialized poultry, egg and swine industries account for the bulk of the production of these commodities. These industries are also concentrated in Northeast Spain where many of the major compound feed producers are located.

The expansion of irrigated acreage has contributed significantly to the growth in crop output. Crops such as corn can only be grown with irrigation except in some of the Northern regions which receive more rain than the rest of Spain. Irrigated crop yields are higher, and greater use of fertilizer and improved cultivation methods have also contributed to an expansion in average yields. Nevertheless, yields for cereal grains are still somewhat lower than in other parts of Europe and further significant increases may be limited by the ability to put more land under irrigation. Much of Spain's irrigation potential has already been realized and salinity problems have arisen in most of the river basins.

Separate components have been constructed to model the various livestock and crop enterprises. Each of these components is designed to reflect the sequential decisions and biological constraints inherent in the particular activity. In developing these models, it has been possible to order the equations so that the dependent variables are related only to the dependent variables from preceding equations and exogenous variables. They are, thus, recursive models in which the disturbances are assumed independent between equations. Assuming normally distributed disturbances, ordinary least squares estimates of each equation are the same as maximum likelihood estimates (84).

In the short run, assets such as physical and human capital are fixed for the individual producer. Aggregate short-run adjustments are slowed by this asset fixity and the inability of individual producers to instantaneously shift from one enterprise to another. In a longer time framework some individuals will cease to produce commodities for which the economic returns are too low to maintain the marginal producers. Some of these producers may cease to farm altogether, while others move into more viable enterprises.

These assumptions about the adjustment of production in response to changes in the economic framework suggest that, unlike the budget allocation problem of the consumer, farmers' decisions are not a simultaneous choice among all production activities. In the short run a dairy farmer is likely to remain a dairy farmer, adjusting the size of his herd in response to recent economic conditions. In the long run, further changes in aggregate dairy production may occur as a result of enterprise shifts and the elimination of marginal producers if the industry is declining or the entry of new producers if it is expanding. In this context, it is not necessary to develop a complete system of simultaneous supply equations. Each component can be modelled separately as a recursive subsystem in the Spanish grain-livestock sector. The five production components included in the model are described in the following sections of this chapter. All price variables used in these components have been deflated by the Consumer Price Index with base 1964=100.

I. Beef, Veal and Dairy Production

European cattle production is characterized by greater reliance on dual-purpose breeds and less specialization in production than in the United States. Spanish beef, veal and milk production are most appropriately seen as joint activities rather than independent enterprises. Much of the beef and veal consumed in Spain comes from dairy calves and cull cows, although there has been rapid growth in the production of beef from fattened yearlings. Most of the milk in Spain is still produced by small farmers with an average of five or six cows (9).

Government policy toward this sector has been aimed at stimulating meat production, using premiums and price incentives to encourage farmers to raise their animals to heavier slaughter weights. In addition, minimum slaughter weights for calves were established in the mid-1960s. These actions were largely in response to the rapid increase in imports of beef in the early 1960s. Dairy policy has largely been oriented toward regulating the distribution and marketing of milk products and improving the quality (9).

The model used to describe the cattle sector is based on assumptions concerning the nature of the decision process and the use of estimated biological constraints. The use of such biological information as calving rates, reduces the number of equations which need to be estimated. The data used to construct the model are taken from the livestock censuses and meat production statistics (58). Since little information on calving rates, death losses and replacement rates is available, these relationships had to be derived on the basis of reasonable assumptions. The model includes three estimated equations and several identities. To begin with, the size of the breeding herd and the number of cows on farms are estimated as functions of gross receipts for milk and cull beef and a real index of prices paid by farmers. Applying calving rates to the number of cows and adjusting for replacement and expansion, the number of calves available for slaughter is derived. The calves available in year t can either be slaughtered as calves in the same year or slaughtered as steers and heifers in subsequent years. The calves held for replacement or herd expansion are already accounted for in the derivation of the calves available for slaughter.

The third estimated equation in the model serves to allocate the calves available to slaughter for veal or slaughter for beef. The dependent variable is the proportion of the calves available for slaughter actually slaughtered as calves. Multiplying this proportion by the number of calves available gives the number of calves slaughtered for veal. The rest are held for slaughter as mature animals. Multiplying the number of animals slaughtered by the average dressed slaughter weight gives total production of beef and veal.

Milk production is estimated by multiplying the average amount of milk produced per cow by the number of cows milked. The number of cows milked in Spain has been a relatively constant proportion of the number of cows on farms.

Before setting out the structure of the model it is necessary to explain the way in which the various rates were derived. Initially, the calf crop was assumed to be given by the number of animals less than one year of age in September of year t plus the number of calves slaughtered in t. Dividing the calf crop by the number of cows on farms in September of year t gave an approximate calving rate. However, this rate proved to be inadequate since it resulted in calf crops that were too small to account for the number of animals slaughtered. On the basis of some simplifying assumptions an alternative calving rate was derived which insures that the calf crop is large enough to account for the number of animals slaughtered.

Part of the problem with estimating Spanish calving rates resides in the nature of the time series on cattle slaughter. Until 1970 three classes of animals slaughtered were reported: calves, young cattle and adult cattle. Since 1970, a fourth category, yearlings, has been reported. Prior to 1970, some of the yearlings were counted in the calf category while the others were classified as young cattle. The change in reporting results in a sharp increase in the steer and heifer category in 1970.

In order to develop a workable calving rate, it was assumed that calves are slaughtered in the year they are born, steers and heifers in the next year and cows and bulls in the second year. This is clearly not an accurate representation of the possible paths a calf may follow. It was necessary to adopt this procedure due to the length of the time series (1962-1978) and the lack of more detailed information. The assumption does not seriously bias the results since calving rates and the proportions slaughtered at various stages evolve slowly and collapsing a much longer process into three years introduces only minor errors into the estimates. Using this assumption an hypothesized calf crop in year t was derived as follows:

$$\text{Calf crop}_t = \text{calf slaughter}_t + \text{steer/heifer}_{t+1} + \text{cow/bull slaughter}_{t+2} + \text{change in herd size}_{t+2}$$

The calf crop was divided by the number of cows to estimate the calving rate. This rate varies from year to year, ranging from about 0.6 to 0.85. It should be noted that this rate implicitly includes death losses about which there is almost no information. Cow and bull slaughter in t + 2 is included as a measure of the number of calves held as replacements while the change in the breeding herd at t + 2 is included to account for animals held for purposes of expansion. Cow and bull slaughter is estimated by applying a culling rate derived by dividing the number of cows and bulls slaughtered by the size of the breeding herd. This rate varied only slightly over the historical period.

The notation used in describing the model is set out below followed by the estimated equations and identities. For the estimated equations the standard errors are reported in parentheses with R^2, the Durbin-Watson statistic (D.W.) and degrees of freedom (d.f.) noted below the equations.

BH = breeding herd, the number of cows and bulls held for breeding purposes in September of each year (1000 head)

COWS = the number of cows on farms in September (1000 head)

CA = calves available for slaughter (1000 head)

VSCA = the number of calves slaughtered divided by the number of calves available

CULL = culling rate, the number of cows and bulls slaughtered divided by the breeding herd

CR = calving rate

VS = number of calves slaughtered (1000 head)

SHS = number of steers and heifers slaughtered (1000 head)

CBS = number of cows and bulls slaughtered (1000 head)

BHC = change in breeding herd (BH_t - BH_{t-1})

DRET = gross dairy receipts defined as the real price (pts/liters) received for milk times the average yield per cow per year at t-1

BRET = gross cull beef receipts defined as the real price received (pts/kg.) for cows and bulls times average cow and bull slaughter weight at t-1

DCOST = index of prices paid by farmers deflated by the CPI

DPRV = real price received for veal (pts/kg.)

DPRN = real price received for steers/heifers (pts/kg.)

CP = premium for feeding yearlings to heavier weights (pts). Equal to zero after 1977

FD = real price of feed for calves

DG = DPRV - FD

YEAR = year

COWM = number of cows milked (1000 head)

VPROD = veal production (metric tons)

BPROD = beef production (metric tons)

BFS = number of mature animals slaughtered (1000 head)

DPROD = milk production (million liters)

1) $BH_t = \underset{(768)}{1412.31} + \underset{(.16)}{.568}*BH_{t-1} + \underset{(.023)}{.0091}*DRET_{t-1} - \underset{(.027)}{.0032}*BRET_t$

$- \underset{(286)}{599.03}*DCOST_t$

$R^2 = .94$ D.W. = 2.08 d.f. = 11

2) $COWS_t = \underset{(764)}{1384.28} + \underset{(.161)}{.565}*COWS_{t-1} + \underset{(.023)}{.0094}*DRET_{t-1} - \underset{(.027)}{.0008}*BRET_t$

$- \underset{(285)}{591.35}*DCOST_t$

$R^2 = .94$ D.W. = 2.08 d.f. = 11 h = -.005

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

4) $VSCA_t = \underset{(.29)}{.4056} - \underset{(.008)}{.0178}*CP_t + \underset{(.017)}{.00999}*DPRV_t - \underset{(.024)}{.0224}*DPRN_t$

$+ \underset{(.022)}{.0911}*FD_t$

$R^2 = .83$ D.W. = .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) $VPROD_t = VS_t * VSW_t$

11) $BPROD_t = BFS_t * BFSW_t$

12) $DPROD_t = COWM_t * DY_t$

In addition to the equations and identities listed above, equations for slaughter weights and milk yields were also estimated. These equations are essentially time trends designed to be used in the projections.

VSW = average calf slaughter weight (dressed kg.)

BFSW = average slaughter weight for adult cattle (dressed kg.)

DY = average milk per cow per year (liters)

$$VSW = \underset{(552)}{5760.28} + \underset{(.279)}{2.982}*YEAR + \underset{(.476)}{.522}*DG$$

$R^2 = .91$ D.W. = .97 d.f. = 14

$$BFSW = \underset{(541)}{9653.93} + \underset{(.275)}{5.012}*YEAR + \underset{(.425)}{1.15}*CP$$

$R^2 = .98$ D.W. = 1.36 d.f. = 14

$$DY = \underset{(8870)}{-104270.0} + \underset{(4.5)}{54.15}*YEAR$$

$R^2 = .91$ D.W. = 1.73 d.f. = 15

Since most of the breeding herd is made up of cows, the parameters and statistical properties of these equations are quite similar. The dependent variable lagged one year is used as an explanatory variable to reflect the assumption that radical adjustment of the number of animals in response to prices and costs is restricted by resource fixity, tradition and the lack of alternatives. Current herd size is largely determined by the number of animals on farms in the previous year. The use of lagged dependent variables means that the Durbin-Watson statistic is not reliable for tests of serial correlation. Maddala notes that the Durbin-Watson test is biased in favor of accepting the null hypothesis that there is no serial correlation. Thus, if the test leads to rejection of the null hypothesis it can be used (56). The D.W. statistics for the two equations do not lead to rejection of the null hypothesis so an alternative test is used. The h statistic is computed from the ordinary least squares residuals and is a standard normal deviate (see Maddala). The value of h has been calculated only for the cow equation and leads to the rejection of the hypothesis that there is serial correlation in the equation.

Both equations include gross dairy receipts lagged one period, gross cull beef receipts and a real index of prices paid by farmers. The equations indicate that increasing receipts from milk production lead to an increase in the number of animals while increasing cull receipts lead to heavier culling and a decline in herd size. Milk receipts are lagged one year since expectations concerning future returns are assumed to influence decisions which have an impact on cattle numbers in subsequent years. The response to higher cull beef receipts is assumed to be more immediate so this variable is not lagged. The standard errors for these variables are large relative to the parameter values. The coefficient for the index of prices paid, included to represent costs, has the expected sign and the standard error is relatively small.

The proportionality equation shows that the introduction of the yearling premium paid on heavier animals had a significant impact in encouraging producers to feed their animals to maturity rather than slaughter them as calves. This premium was phased out in 1977 (1). Although the standard errors for the two real price variables are relatively large, the signs are as expected. The cost of calf feed has a significant impact on the decision to slaughter calves or mature animals.

In order to obtain an initial evaluation of the model, the historical period was simulated on the basis of the equations and compared with the actual values of the variables. The results are presented in Tables 4.1a to 4.1k. In general, the simulated values are close to the actual values, most of the estimates deviating from the actual values by less than 5 percent. The exception is the estimated equation for the proportion of calves slaughtered as calves and the resulting estimate of calf slaughter. An examination of the actual calf slaughter figures reveals that there was a dramatic decrease in the number of calves slaughtered in 1972. It is difficult to account for this abrupt decline in terms of developments in Spain or in world markets. It is possible that the 1972 figure is a mistake, although this figure is reported in all the available sources. In addition, a rather substantial increase in steer and heifer slaughter in 1973 is consistent with the 1972 decline in calf slaughter.

The evolution of steer and heifer slaughter reflects the changes in classification in 1970. The number of animals slaughtered rose sharply in 1970 due to the introduction of the yearling category in the reported statistics. The proportionality equation predicts both this statistical anomaly and the 1973 increase quite well, a fact

TABLE 4.1

Beef, Veal and Milk Production
in Spain, 1968-1978

Year	Actual	Estimate	% Error
	a. Breeding Herd (thousand head)		
1968	2258	2263.879	.260
1969	2375	2295.291	- 3.36
1970	2420	2378.432	- 1.72
1971	2404	2419.590	.648
1972	2420	2437.168	.709
1973	2521	2459.822	- 2.43
1974	2454	2455.120	.046
1975	2413	2462.344	2.04
1976	2407	2478.958	2.99
1977	2553	2512.960	- 1.57
1978	2588	2599.639	.450
	b. Number of Cows on Farms (thousand head)		
1968	2234	2240.627	.297
1969	2352	2271.704	- 3.41
1970	2393	2352.996	- 1.67
1971	2379	2391.347	.519
1972	2394	2411.006	.710
1973	2494	2432.392	- 2.47
1974	2424	2427.080	.127
1975	2380	2431.314	2.16
1976	2375	2446.402	3.01
1977	2520	2478.804	- 1.63
1978	2552	2563.881	.466

TABLE 4.1 (continued)

Year	Actual	Estimate	% Error
	c. Cows Milked (thousand head)		
1968	1702	1716.318	.841
1969	1789	1740.124	- 2.73
1970	1827	1802.395	- 1.35
1971	1861	1831.778	- 1.57
1972	1870	1846.836	- 1.24
1973	1935	1863.218	- 3.71
1974	1852	1859.143	.386
1975	1811	1862.386	2.84
1976	1822	1873.944	2.85
1977	1950	1898.766	- 2.63
1978	1950	1963.931	.714
	d. Calves Available for Slaughter (thousand head)		
1968	1197.930	1180.701	- 1.44
1969	1511.232	1446.010	- 4.32
1970	1419.056	1392.053	- 1.90
1971	1451.461	1449.329	- .147
1972	1399.084	1406.839	.554
1973	1545.850	1514.921	- 2.00
1974	1689.964	1697.557	.449
1975	1607.080	1799.943	12.0
1976	1588.675	1623.232	2.18
1977	1473.620	1482.880	.628
1978	1451.184	1501.570	3.47

TABLE 4.1 (continued)

Year	Actual	Estimate	% Error
	e. Proportion of Available Calves Slaughtered as Calves		
1968	.669	.614	- 8.19
1969	.538	.518	- 3.73
1970	.457	.492	7.58
1971	.451	.479	6.25
1972	.337	.432	28.1
1973	.344	.399	15.9
1974	.351	.382	8.7
1975	.396	.360	- 9.14
1976	.379	.341	- 9.99
1977	.415	.395	- 4.78
1978	.423	.427	.947
	f. Calves Slaughtered (thousand head)		
1968	802	725	- 9.54
1969	797	749	- 6.08
1970	648	684	5.61
1971	655	695	6.03
1972	472	607	28.8
1973	532	604	13.5
1974	593	648	9.29
1975	637	648	1.74
1976	602	554	- 8.02
1977	611	586	- 4.08
1978	614	641	4.46

TABLE 4.1 (continued)

Year	Actual	Estimate	% Error
	g. Steer and Heifer Slaughter (thousand head)		
1968	343.0	343.581	.169
1969	396.6	396.515	- .022
1970	708.7	698.190	- 1.48
1971	771.3	770.548	- .098
1972	796.1	796.852	.095
1973	927.4	927.593	.021
1974	1012.6	1014.077	.146
1975	1098.2	1096.787	- .129
1976	971.4	970.676	- .075
1977	987.1	986.567	.054
1978	863.4	862.068	- .154
	h. Cow and Bull Slaughter (thousand head)		
1968	300	301	.232
1969	288	278	- 3.43
1970	310	304	- 1.70
1971	306	307	.290
1972	221	222	.399
1973	253	246	- 2.85
1974	310	309	- .276
1975	303	310	2.29
1976	282	290	2.89
1977	284	279	- 1.85
1978	298	299	.423

TABLE 4.1 (continued)

Year	Actual	Estimate	% Error
	i. Slaughter of Adult Cattle (thousand head)		
1968	643.3	644.677	.214
1969	684.2	674.245	- 1.45
1970	1018.9	1002.629	- 1.45
1971	1077.6	1077.836	.022
1972	1017.0	1018.634	.161
1973	1180.6	1173.575	- .595
1974	1322.8	1323.423	.047
1975	1401.5	1407.042	.395
1976	1253.2	1260.715	.600
1977	1271.3	1265.506	- .456
1978	1161.2	1161.027	- .015
	j. Veal Production (metric tons)		
1968	103005	93187.8	- 9.53
1969	109348	102681.8	- 6.10
1970	82006	86641.1	5.65
1971	80559	85425.7	6.04
1972	61939	79736.4	28.7
1973	74887	84987.0	13.5
1974	85891	93848.7	9.26
1975	92443	94040.4	1.73
1976	89512	82342.4	- 8.01
1977	92423	88659.4	- 4.07
1978	93664	97844.3	4.46

TABLE 4.1 (continued)

Year	Actual	Estimate	% Error
	k. Beef Production (metric tons)		
1968	138416	138712.5	.214
1969	146438	144307.3	- 1.45
1970	226154	222542.5	- 1.60
1971	243062	243115.5	.022
1972	240587	240973.2	.161
1973	296341	294577.9	- .595
1974	330091	330246.9	.047
1975	361233	362660.9	.395
1976	328610	330580.8	.600
1977	338413	336870.1	- .456
1978	297456	297412.1	- .015
	l. Milk Production (millions of liters)		
1968	4014.7	4048.794	.849
1969	4296.2	4181.518	- 2.67
1970	4321.8	4264.466	- 1.33
1971	4262.9	4191.110	- 1.68
1972	4511.7	4456.414	- 1.23
1973	4791.6	4613.328	- 3.72
1974	4930.9	4949.039	.368
1975	4983.9	5125.287	2.84
1976	5212.1	5361.354	2.86
1977	5353.6	5214.013	- 2.61
1978	5559.5	5599.166	.713

which may be due at least partly to accident as well as the way in which the variables have been derived.

For the purposes of the historical simulation, actual slaughter weights and milk yields were used rather than those predicted by the trend equations. Since veal production depends on calf slaughter, estimated production also shows a large error in 1972. Estimated total beef and milk production are generally very close to the actual values of these variables. U statistics, defined in Chapter III, are presented for the cattle model in Table 4.2. In general, they indicate that the model forecasts well.

The cattle model has been designed to reflect the interdependency of milk, beef and veal production in Spain. It is based on a number of simplifying assumptions which allowed the derivation of calving rates and other constants in the model. In the absence of more complete data, these assumptions were necessary in order to develop a model which provides reasonable forecasts. Despite the lack of information, the model results in relatively accurate production estimates.

II. Hog Production

The rapid expansion of the swine industry in Spain began in 1973 and was due to improved management techniques and feeding practices. In addition, new breeds which convert feed more efficiently than the indigenous animals were introduced (9). Guaranteed prices were first established for hogs in 1957. In 1970, upper and lower intervention prices and reference prices were added to the guaranteed prices which were raised substantially throughout the 1970s in an

TABLE 4.2

U Statistics for the Cattle Model

Equation	U1	U2	UM	UR	UD	R
Breeding Herd	.009	.599	.010	.101	.889	.88
Cow Numbers	.009	.602	.010	.096	.894	.86
Cows Milked	.011	.642	.061	.022	.916	.84
Calves Available for Slaughter	.022	.498	.049	.430	.521	.92
Calf Slaughter/ Calves Available	.050	.693	.026	.022	.952	.89
Calf Slaughter	.046	.769	.091	.074	.835	.79
Steer/Heifer Slaughter	.003	.045	.179	0.0	.821	.99
Cow/Bull Slaughter	.013	.220	.011	.098	.891	.96
Mature Cattle Slaughter	.003	.049	.055	.132	.813	.99
Veal Production	.045	.696	.093	.091	.816	.80
Beef Production	.031	.479	.070	.127	.802	.97
Milk Production	.011	.553	.041	.191	.768	.98

UM, UR and UD may not sum to one due to rounding.

effort to encourage production and reduce imports. Prices are maintained through intervention purchases coordinated with import restrictions. If prices on the open market rise above the upper intervention price, meat is released from storage and the import restrictions are reduced. Spain cannot export pigmeat to the EC due to the existence of African Swine Fever, although small amounts are exported to Portugal and Andorra (9).

Livestock census data provide a useful breakdown by age and sex although the complete series only exists from 1967 to 1978. The model used to describe the Spanish hog sector is similar to the cattle model in that various rates were derived from the census data and information on hog slaughter to reduce the number of estimated equations. The first equation in the model provides an estimate of the number of sows as a function of real prices received, a cereal price index and a cost index. Since no aggregate data were available on death losses, the average number of surviving pigs produced per sow was estimated. This rate implicitly takes account of death losses. Multiplying the average number of pigs per sow by the number of sows gives an estimate of the pig crop. The census data include a short series on pigs held for replacement. Subtracting replacements from the pig crop leaves the number of pigs slaughtered. About two percent of this total are slaughtered as suckling pigs, the rest being raised to maturity in about 200 days.

There are two pig crops per year and some pigs born in one year are not slaughtered until the next. It was not possible to determine the number of pigs born in a given year and slaughtered in the next. It has been assumed, therefore, that hogs slaughtered in year t were all born in that year. This assumption implies that the number of pigs born this year and slaughtered next year is similar to the number born last year and slaughtered in the current year.

With this assumption, the number of surviving pigs born during the year is equal to the number of suckling pigs and hogs slaughtered in that year plus the animals held for replacement. Dividing this number by the census figure for the number of sows on farms in September of the year gives the implicit number of surviving pigs per sow. The replacement rate is derived by dividing the number of two- to six-month old pigs held for replacement by the number of sows. The number of sows is taken as the number of females over six months of age. The basic data for these calculations are presented in Table 4.3.

For many hog producers the liveweight at which their animals are slaughtered is an economic decision, depending on relative prices. An equation was estimated to predict live slaughter weights as a function of a time trend and the ratio of hog to corn prices. The hog-corn ratio published in the Spanish agricultural statistics is based on the corn price received by producers. This is somewhat inaccurate since livestock producers historically received subsidies for corn used for feed paying less than the price received by corn producers. Unfortunately, time-series data on the price actually paid for corn by livestock producers are unavailable. Since the subsidy will be eliminated when Spain joins the EC, the hog-corn ratio may change more dramatically with entry than is reflected in the model. Average live slaughter weights have been declining as a result of the introduction of smaller breeds. In the mid-1960s,

TABLE 4.3

Basic Data Used in Hog Model

(thousand head)

Year	Total Hog Slaughter	Replacements*	Pig Crop*	Sows*	Pigs per Sow	Replacement Rate
1960	2986	510	3496	815	4.290	.625
1961	2678	501	3179	830	3.830	.604
1962	2676	505	3181	867	3.670	.582
1963	3403	468	3871	835	4.640	.561
1964	3586	384	3970	712	5.580	.539
1965	2957	383	3340	940	4.510	.518
1966	4160	451	4611	908	5.080	.497
1967	4916	346	5262	767	6.861	.475
1968	4953	338	5291	713	7.421	.454
1969	5266	423	5689	880	6.465	.432
1970	6024	345	6369	813	7.834	.411
1971	5912	357	6269	879	7.132	.389
1972	5666	404	6070	1026	5.916	.368
1973	7396	398	7794	1142	6.825	.347
1974	9464	317	9781	983	9.950	.325
1975	8031	306	8337	1044	7.986	.304
1976	8512	340	8852	1125	7.868	.282
1977	9816	333	10149	1202	8.443	.261
1978	10952	339	11291	1327	8.509	.239

*1960-1966 are author's estimates based on historical proportions.

government policy switched from higher guaranteed prices for animals slaughtered at greater weights to higher prices for the smaller animals with less fat. This policy encouraged producers to adopt the lighter breeds for which the prices were more advantageous (55). Since no complete series on the various government prices for different sizes of animals is available, a time trend has been included to reflect the transition from large, indigenous breeds to the smaller animals. The estimated live slaughter weights is translated into carcass weight with a constant of 0.8 in order to estimate pigmeat production. The model equations are presented below (standard errors in parentheses).

1) $$SOW_t = \underset{(208)}{2344.78} + \underset{(9.38)}{11.38}*DHPR_{t-1} - \underset{(4.46)}{11.57}*DPIC_t - \underset{(4.99)}{12.48}*DCOST_t$$

R^2 = .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) $$LSW_t = \underset{(101)}{2855.8} - \underset{(.052)}{14.0}*YEAR_t + \underset{(.385)}{1.82}*HCRAT_t$$

R^2 = .98 D.W. = 1.84 d.f. = 15

7) $HSLW_t = 0.8*LSW_t$

8) $HPROD_t = HSLW_t*LCW_t$

9) $LPROD_t = LESL_t*10.0$

Where:

SOW = number of sows on farms in September (1000 head)

DHPR = real price received for hogs (pts/live kg.)

DPIC = cereal price index deflated by CPI

DCOST = index of prices paid by farmers deflated by CPI

PIGS = pig crop (1000 head)

PPS = surviving pigs per sow

THSL = total slaughter (1000 head)

PREP = replacement rate

LESL = slaughter of suckling pigs (1000 head)

HCRAT = price received for hogs/price received for corn

HSL = mature hog slaughter (1000 head)

LSW = live slaughter weight (kg.)

HSLW = dressed slaughter weight (kg.)

HPROD = pigmeat production (metric tons)

LPROD = suckling pig production (metric tons)

YEAR = year

The use of the lagged price variable in the first equation is based on the presumption that current prices affect expectations about next year's prices. These expectations in turn influence the decisions which lead to changes in the number of sows in the next year. The other two explanatory variables in the first equation are included to capture the impact of declining real costs faced by hog producers. Real prices received also declined over the historical period, but due to technological change and innovation, costs have fallen more rapidly. This evolution is also shown in the increasing hog-corn ratio used in the other estimated equation.

The results of using the model to simulate the historical period are presented in Tables 4.4a to 4.4i and the U statistics are

TABLE 4.4

Hog Production in Spain, 1968-1978

Year	Actual	Estimate	% Error
	a. Sows (thousand head)		
1968	713	765.171	7.32
1969	880	786.152	-10.7
1970	813	876.402	7.80
1971	879	940.550	7.00
1972	1026	1030.289	.418
1973	1142	1093.640	- 4.23
1974	983	973.914	- .924
1975	1049	1015.437	- 3.20
1976	1125	1140.736	1.40
1977	1202	1253.429	4.28
1978	1327	1282.352	- 3.36
	b. Pigs (thousand head)		
1968	5291	5678.183	7.32
1969	5689	5082.314	-10.7
1970	6369	6865.733	7.80
1971	6269	6708.005	7.00
1972	6070	6095.397	.418
1973	7794	7463.986	- 4.23
1974	9781	9690.637	- .924
1975	8337	8108.870	- 2.74
1976	8852	8975.769	1.40
1977	10149	10583.203	4.28
1978	11291	10911.146	- 3.36

TABLE 4.4 (continued)

Year	Actual	Estimate	% Error
	c. Total Hog Slaughter (thousand head)		
1968	4953	5331.021	7.63
1969	5266	4742.456	- 9.94
1970	6024	6505.620	8.00
1971	5912	6341.752	7.27
1972	5666	5716.247	.887
1973	7396	7084.929	- 4.21
1974	9464	9374.018	- .951
1975	8031	7800.482	- 2.87
1976	8512	8653.734	1.67
1977	9816	10256.181	4.48
1978	10952	10604.142	- 3.18
	d. Suckling Pig Slaughter (thousand head)		
1968	47	107.0	127.0
1969	68	94.8	39.5
1970	107	130.0	21.6
1971	77	127.0	64.7
1972	58	114.0	97.1
1973	117	142.0	21.1
1974	205	187.0	- 8.55
1975	171	156.0	- 8.77
1976	180	173.0	- 3.85
1977	284	205.0	-27.8
1978	278	212.0	-23.7

TABLE 4.4 (continued)

Year	Actual	Estimate	% Error
	e. Hog Slaughter (thousand head)		
1968	4906	5224.413	6.49
1969	5198	4647.611	-10.6
1970	5917	6375.508	7.75
1971	5834	6214.924	6.53
1972	5608	5601.929	- .108
1973	7279	6943.238	- 4.61
1974	9259	9186.537	- .783
1975	7860	7644.472	- 2.74
1976	8332	8480.657	1.78
1977	9532	10051.045	5.45
1978	10674	10392.034	- 2.64
	f. Live Slaughter Weight (kg.)		
1968	107.0	107.0	.051
1969	105.0	105.0	.622
1970	104.0	103.0	- .691
1971	102.0	103.0	.885
1972	103.0	104.0	.927
1973	101.0	99.8	- 1.06
1974	95.6	96.5	.950
1975	95.4	97.8	2.53
1976	97.0	96.1	- .955
1977	96.0	94.5	- 1.59
1978	93.9	93.5	- .376

TABLE 4.4 (continued)

Year	Actual	Estimate	% Error
	g. Dressed Carcass Weight (kg.)		
1968	85.3	85.3	.051
1969	83.7	84.2	.622
1970	82.9	82.3	- .691
1971	81.3	82.0	.885
1972	82.1	82.9	.927
1973	80.7	79.8	- 1.06
1974	76.5	77.2	.950
1975	76.3	78.2	2.53
1976	77.6	76.9	- .955
1977	76.8	75.6	- 1.59
1978	75.1	74.8	- .376
	h. Pigmeat Production (metric tons)		
1968	418561	445868.7	6.52
1969	435337	391425.7	-10.1
1970	490792	524879.1	6.95
1971	474336	509745.5	7.47
1972	460692	464182.8	.758
1973	587540	554402.5	- 5.64
1974	708473	709445.5	.137
1975	599814	598013.7	- .300
1976	647101	651813.3	.728
1977	732289	759621.2	3.73
1978	801201	777506.9	- 2.96

TABLE 4.4 (continued)

Year	Actual	Estimate	% Error
	i. Suckling Pig Production (metric tons)		
1968	455	1066.077	134.0
1969	911	948.477	4.11
1970	957	1301.116	36.0
1971	728	1268.269	74.2
1972	550	1143.171	108.0
1973	972	1416.865	45.8
1974	1658	1874.786	13.1
1975	2105	1560.125	-25.9
1976	1711	1730.749	1.15
1977	2226	2051.271	- 7.85
1978	1823	2120.673	16.3

shown in Table 4.5. The forecast values are within relatively small percentage errors of the actual values. The simulation of suckling pig production is rather poor since it is based on the use of constants for the proportion slaughtered and the average slaughter weight. Suckling pig production is small and relatively unimportant for the purposes of this exercise. Predictions based on the live slaughter weight equation are highly accurate.

The cattle and hog models are not designed to account for the detailed, cyclical evolution of production. There is evidence that a four- to five-year hog cycle exists in Spain, although the existence of a cattle cycle is less clear. Since this model is primarily concerned with longer-term adjustments, the dynamics of livestock cycles are less crucial to the analysis. At the same time, the inclusion of biological constraints and the assumptions about the timing of decisions serve to incorporate the causes of livestock cycles into the structure of the models. In the case of the hog model, estimated slaughter and production reflect the apparently cyclical nature of the actual values quite well.

III. Sheep and Goat Production

The raising of sheep for meat, milk and wool is still an important activity, although this sector has been declining for many years. Since the number of goats in Spain is relatively small and production methods are similar to those employed for sheep the two sectors are treated together. Sheep and goat production has decreased due to a scarcity of shepherds, falling prices for wool and competition from other livestock products. In the case of sheep,

TABLE 4.5

U Statistics for Hog Model and Sheep and Goat Model

Equation	U1	U2	UM	UR	UD	R
Hog Model						
Sows	.024	.443	.001	.004	.994	.96
Pigs	.023	.322	.005	.000	.995	.98
Total Hog Slaughter	.023	.302	.012	.001	.987	.98
Mature Hog Slaughter	.029	.394	.019	.095	.886	.98
Live Slaughter Weight	.006	.506	.011	.066	.924	.97
Pigmeat Production	.033	.482	.027	.133	.840	.97
Suckling Production	.128	.992	.318	.067	.616	.86

TABLE 4.5 (continued)

Equation	U1	U2	UM	UR	UD	R
Sheep/Goat Model						
Female Sheep/Goats	.021	.799	.002	.033	.965	.90
Lamb/Kid Slaughter	.020	1.034	.019	.167	.814	.46
Sheep/Goat Slaughter	.032	.736	.015	.166	.819	.93
Lamb/Kid Meat Production	.020	.711	.017	.048	.935	.86
Sheep/Goat Meat Production	.034	.969	.021	.106	.873	.88
Sheep/Goat Milk Production	.014	.567	.016	.008	.976	.77

UM, UR and UD may not sum to one due to rounding.

production has become oriented more toward the market for meat than for wool. Guaranteed prices and premiums for the production of lamb have also encouraged the shift from wool to meat production (84).

Several methods are used to raise sheep and goats in Spain. Traditional transhumance systems based on grazing over large areas are still the most common. Since sheep and goat milk are used in some of Spain's most popular cheeses, lambs and kids are frequently weaned early to obtain greater quantities of milk (84). In these mixed systems, ewes and lambs are often fed concentrates for short periods, after which, they are raised in the more traditional manner. About 15 percent of the sheep in Spain are raised in intensive systems involving permanent stables and the feeding of concentrates (9).

Spanish policy toward sheep has been limited to price guarantees for lambs and premiums for finished lambs of higher quality. Along with the labor problems of the sector, these policies have encouraged the expansion of mixed and intensive systems of production involving the use of feed concentrates (9).

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 no attempt was made to replace estimated relationships with biological rates. Since this sector has less impact on the issues considered in this study than other sectors and biological data are scarce, it was decided that the simpler approach would be preferable. The disadvantage is that the separate equations are not as 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 on farms in September of each year to last year's prices for adult and immature animals, as well as a real index of wages paid to shepherds. The shortage of people willing to work as shepherds is a primary reason for the decline in the number of sheep and goats. This shortage is reflected in the rise of the real wage index.

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 milk production. Spanish meat statistics include two categories of young sheep and goats which have been aggregated in the estimated equation for the slaughter of immature animals. Weighted average prices were calculated to correspond to the various aggregate categories. These real price variables figure in the equation for the number of females as well as the specific slaughter and production equations. Average slaughter weight equations were estimated for use in calculating projected meat production. Since no information is available on the number of sheep and goats milked nor on the average yield in liquid milk, production of this commodity is estimated directly as a function of the number of females, prices and costs. The model structure and equations are presented below (standard errors in parentheses).

1) $$FEM_t = \underset{(2281)}{18413.4} - \underset{(120.5)}{196.7}*DADPR_{t-1} + \underset{(69.18)}{108.5}*DYOPR_{t-1} - \underset{(12.07)}{44.19}*DSSAL_t$$

$R^2 = .82$ D.W. = 1.40 d.f. = 13

2) $YM_t = \underset{(2380)}{6645.18} + \underset{(.113)}{.016}*FEM_{t-1} - \underset{(.476)}{.621}*ADULT_{t-1} + \underset{(45.56)}{147.42}*DYOPR_{t-1}$

$R^2 = .77$ D.W. = 1.77 d.f. = 10

3) $YMSW_t = \underset{(19.7)}{173.747} + \underset{(.01)}{.093}*YEAR_t$

$R^2 = .84$ D.W. = .96 d.f. = 17

4) $YMPROD_t = YM_t*YMSW_t$

5) $ADULT_t = \underset{(708)}{452.0} + \underset{(.044)}{.132}*FEM_{t-1} - \underset{(1.27)}{2.08}*DSSAL_t$

$R^2 = .86$ D.W. = 1.56 d.f. = 10

6) $ADSW_t = \underset{(45)}{269.9} + \underset{(.023)}{.145}*YEAR_t$

$R^2 = .70$ D.W. = 1.80 d.f. = 17

7) $ADPROD_t = ADULT_t*ADSW_t$

8) $MKPROD_t = \underset{(67.1)}{297.3} + \underset{(.006)}{.016}*FEM_t + \underset{(8.14)}{4.85}*DMKPR_{t-1} - \underset{(.91)}{.014}*DCOST_t$

$R^2 = .75$ D.W. = 1.89 d.f. = 6

Where:

FEM = number of females on farms in September (1000 head)

DADPR = real price received for adult sheep and goats, weighted average (pts/kg.)

DYOPR = real price received for lambs and kids, weighted average (pts/kg.)

DSSAL = index of shepherd's wages deflated by CPI

YM = lamb and kid slaughter (1000 head)

ADULT = sheep and goat slaughter (1000 head)

YMSW = lamb and kid dressed slaughter weights (kg.)

YMPROD = meat production from young animals (metric tons)

YEAR = year

ADSW = adult dressed slaughter weight (kg.)

ADPROD = sheep and goat meat production (metric tons)

MKPROD = sheep and goat milk production (millions of liters)

DMKPR = real price received for milk, weighted average (pts/liter)

DCOST = index of prices paid by farmers deflated by CPI

The first equation indicates that favorable prices for mutton and goat meat lead to greater slaughter and a fall in the number of females while favorable prices for lambs and kids cause producers to retain females for reproduction. The negative sign of the sheep and goat price coefficient reflects a short-term response. Both prices are lagged on the assumption that current prices affect expectations and decisions which will be manifested in the following year. The shepherd wage index reflects the shortage of shepherds and accounts for much of the long-term decline in the number of females.

The number of lambs and kids slaughtered is related to the number of females in the previous year as well as the real price received. This price is also lagged to reflect the formation of expectations and the consequent production decisions. The sheep and goat slaughter variable was included to reflect the shift in tastes and production away from mature animals to higher quality lambs. The proportion of animals slaughtered as adults has declined as the number of immature animals slaughtered has increased. Sheep and goat slaughter is also related to the number of females in the previous year while the wage index picks up the long-term decline in mutton and goat meat production. The average slaughter weight equations are time trends used primarily in the projections.

Milk production depends on the number of females available for milking. The lagged real milk price reflects the impact of the current price on decisions affecting the future production of milk. A real cost variable is also included in the milk production equation.

The estimated coefficients in this component generally have relatively large standard errors. This may be due in part to collinearity among the explanatory variables. A more complete model based on the disaggregated categories and specification of biological relationships might provide greater insights into the structure of the sector. However, the information required for a more complex model is not readily available and the simple model presented here appears to be adequate for the purposes of this study.

The results of the historical simulation are presented in Tables 4.6a to 4.6f and the U statistics are included in Table 4.5. In general, the model performs reasonably well in estimating the historical values. As noted earlier, the major defect of this component appears when it is used to make predictions into the future. In particular, the equation for lamb and kid slaughter is not sufficiently constrained by the number of females. Projections of the number of young animals slaughtered can easily reach unrealistically high levels in relation to the number of reproducing females. This problem is inherent in the structure of the model and the estimated coefficients which incorporate the historical decline in the number of females and the number of mature animals slaughtered as well as the increases in the number of lambs and kids slaughtered.

TABLE 4.6

Sheep and Goat Production in Spain, 1968-1978

Year	Actual	Estimate	% Error
	a. Female Sheep/Goats (thousand head)		
1968	11861	12537.685	5.71
1969	12714	12515.177	-1.56
1970	13073	12362.591	-5.43
1971	12752	12139.373	-4.80
1972	12227	12365.651	1.13
1973	12183	11558.721	-5.12
1974	10656	10603.480	- .493
1975	10548	11099.283	5.23
1976	10302	10909.101	5.89
1977	10236	10457.614	2.17
1978	10360	10113.930	-2.38
	b. Lamb/Kid Slaughter (thousand head)		
1968	10530	10564.470	.327
1969	10475	10766.691	2.78
1970	11089	11066.432	- .204
1971	10689	10563.971	-1.17
1972	10779	10699.198	- .740
1973	11320	11350.164	.266
1974	11970	11339.664	-5.27
1975	11549	11451.442	- .845
1976	11269	11559.556	2.58
1977	11376	11273.234	- .903
1978	11175	11008.987	-1.49

TABLE 4.6 (continued)

Year	Actual	Estimate	% Error
	e. Sheep/Goat Meat Production (metric tons)		
1968	30116	29694.221	-1.40
1969	29874	28212.663	-5.56
1970	30751	30194.253	-1.81
1971	32267	30726.507	-4.77
1972	29870	30401.503	1.78
1973	26577	29519.464	11.1
1974	26154	25549.557	-2.31
1975	26077	25446.585	-2.42
1976	26211	25254.376	-3.65
1977	25116	24944.527	- .683
1978	22235	23825.531	7.15
	f. Sheep/Goat Milk Production (million liters)		
1968	515	541	4.92
1969	558	547	-1.94
1970	573	546	-4.71
1971	537	541	.800
1972	533	549	2.99
1973	540	533	-1.30
1974	498	511	2.66
1975	520	527	1.25
1976	514	521	1.36
1977	524	508	-2.90
1978	493	501	1.63

IV. Poultry Meat and Egg Production

The poultry sector in Spain has experienced an extraordinarily rapid transformation. According to the yearbook of agricultural statistics (53), some 10 million barnyard chickens were slaughtered for a total production of only 13 thousand metric tons of meat in 1960. By 1978 meat production had reached 755 thousand metric tons with 92 percent of the birds slaughtered being broilers raised in modern intensive systems of production. Egg production has also expanded rapidly as the structure of the sector evolved from a traditional to a modern system based on selected laying hens.

Until 1971 there was little government intervention in these industries. In that year a systematic market regulation policy was established including intervention and guide prices for producers and regulation of retail prices to protect consumers (9).

The expansion of the mixed feed industry has contributed to the growth in modern broiler and egg operations. Many large feed companies control extensive flocks of broilers and layers through direct ownership or contractual arrangements. The industry is also highly concentrated with a relatively small number of large, automated operations accounting for the greatest part of production. Layer operations average about 11 thousand birds while the average broiler flock is around 14 thousand birds (53). Much of the technology used in these enterprises was borrowed directly from the United States and production is based on extensive use of corn in the feed rations. Since the climate in Spain is not favorable for corn production, large quantities of corn are imported. Some informants in Spain noted a consumer preference for the coloration of chickens and eggs produced with corn.

The rapid technological change which characterizes these industries makes them difficult to model. In addition, the accuracy of the data, particularly as they concern more traditional operations, is questionable. Statistical series on the number of broilers slaughtered and the number of selected laying hens appear more reliable but exist only for the periods 1963-1978 and 1964-1978 respectively. Production of poultry meat from barnyard flocks is set at a constant 70 thousand metric tons from 1968 to 1978 in the statistical yearbook (58).

Real prices for both meat and eggs declined throughout the historical period as did the cost of feed. However, feed prices appear to have fallen less rapidly than prices received so that regressions based on these variables consistently resulted in positive coefficients for the real price of feed and negative coefficients for real prices received. In an effort to obtain theoretically reasonable estimates, alternative functional forms and nominal prices rather than real prices were used. A two-stage least squares supply and demand model for broilers was also estimated on the assumption that the negative price coefficient resulted from supply shifts that actually traced out a demand curve. Another researcher attempted to estimate supply responses on the basis of quarterly rather than annual data (72). Finally, gross margins reflecting the difference between prices received for a kilogram of meat or a dozen eggs and the feed costs of producing the product, were used as explanatory variables. None of these approaches led to any improvement in the results.

The rapid expansion of the poultry sector in the face of apparently declining profit margins could be due to the fact that the data do not adequately account for the effects of technological innovation. However, there is a strong indication in the data that profit margins have fallen over the historical period and the introduction of a wide variety of proxies for technological change did not change the signs on the estimated coefficients. The model finally adopted for both sectors is based on concepts drawn from the theory of the firm. Since the poultry sectors are relatively new in Spain, it is reasonable to assume that they are still moving toward an equilibrium. In a perfectly competitive economy with perfect factor mobility, long-run 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.

Although this conceptualization of the problem overlooks the fact that markets in Spain are not perfectly competitive as well as the improbability of reaching equilibria, it provides a key to analyzing the Spanish poultry sectors. 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 profits are higher than alternative investment possibilities. Since much of the expansion in both the poultry and swine industries is due to investments by feed compounders in vertically integrated systems, investment in hog production was taken as the alternative to further investment in poultry enterprises. Profit margins in poultry production are higher than for hog production although they are declining much more rapidly. The model is, thus, based on the assumption that poultry meat and egg production will continue to expand until profitability in these sectors is the same as it is in the swine industry.

The central variable in poultry meat production is the number of broilers slaughtered. A time trend is used to represent the growth of this variable. Beginning in 1979 a measure of relative returns is calculated each year and, depending on this measure, broiler slaughter is projected to continue along this trend or to level off. Multiplying the number of broilers slaughtered by dressed slaughter weight gives the total meat production from broilers. To account for meat produced from barnyard fowl, for which the data are clearly inadequate, an equation for total meat production (broiler and barnyard chickens) was estimated. This equation has the number of broilers slaughtered and real corn prices as arguments.

Egg production is handled in a similar manner. The number of selected layers is estimated as a function of a time trend and the price of feed. A separate relative return measure for eggs is computed each year after 1978 and used to determine whether egg production will continue to expand. Egg production from selected layers is the product of the number of layers and the average number of eggs per hen per year. Total chicken egg production, from barnyard hens as well as selected layers, is then estimated as a function of the number of selected layers.

The relative return measures are based on gross margins per unit of product for poultry meat, eggs and hogs. The real price received for a kilogram of meat or a dozen eggs is compared with the feed costs of producing that quantity of product. Average feed conversion rates are used to determine the feed costs per unit of output. The feed conversion rates used are 4.125 kg. of compound feed per kg. of pork, 2.1 kg. of feed per kg. of poultry meat and 2.0 kg. of feed per dozen eggs. The gross margin for pork is subtracted from the gross margins for poultry meat and eggs. As long as this measure is greater than zero, the poultry sectors continue to expand. If the measure is less than or equal to zero, the number of broilers slaughtered or the number of layers is set at the previous year's level. The historical evolution of the two measures is presented in Table 4.7.

The relative return measures are not always positive in the historical period. Since they are not operative before 1979, this has no affect on production which is estimated by the trends and equations until 1978. The equations for total meat and egg production showed evidence of serial correlation and were re-estimated using the Cochrane-Orcutt procedure. The estimated equations and model structure are presented below, with standard errors for the estimated coefficients in parentheses.

A. Poultry Meat

$$1)\quad NBS_t = \begin{cases} \underset{(2965530)}{-47660800.0} + \underset{(1504)}{24345.4} * YEAR_t & \text{for } t \le 1978 \\ NBS_{t-1} + 24345.4 & \text{for } t > 1978 \text{ and } CHPI > 0 \\ NBS_{t-1} & \text{for } t > 1978 \text{ and } CHPI \le 0 \end{cases}$$

TABLE 4.7

Relative Return Measures for Poultry Meat and Egg Production

(in pesetas)

Year	Poultry Meat*	Eggs*
1964	20.40	10.80
1965	12.90	5.55
1966	12.40	4.33
1967	13.40	8.81
1968	12.70	6.06
1969	8.35	2.75
1970	9.56	5.91
1971	8.73	5.47
1972	3.95	-2.77
1973	6.23	3.11
1974	9.01	7.43
1975	1.92	-1.88
1976	-1.36	-3.65
1977	2.29	0.84
1978	1.85	0.85

* Relative return measures defined as:

1) meat: $(DPOPR_t - 2.1*DPCAM_t) - (DHPR_t - 4.125*DCONPR_t)$

2) eggs: $(DEGPR_t - 2.0*DPCAL_t) - (DHPR_t - 4.125*DCONPR_t)$

Where:

DPOPR = real price received per kg. poultry meat (pts)

DPCAM = real price of broiler feed (pts/kg.)

DEGPR = real price received per dozen eggs (pts)

DPCAL = real price of layer feed (pts/kg.)

DHPR = real price received per kg. pigmeat (pts)

DCONPR = real price of feed for hogs (pts/kg.)

R^2 (trend) = .96 D.W. (trend) = 1.75 d.f. = 12

2) $BRPROD_t = NBS_t * BRSW_t$

3) $$TPPROD_t = \underset{(161620)}{218657.0} + \rho TPPROD_{t-1} + \underset{(.193)}{1.345}*(NBS_t - \rho NBS_{t-1}) - \underset{(28028)}{39053.0}*(DCPR_t - \rho DCPR_{t-1})$$

R^2 = .98 D.W. = 1.52 d.f. = 11

ρ = .544 (.224)

Where:

NBS = number of broilers slaughtered (1000 head)

YEAR = year

CHPI = relative return measure for poultry meat (pts)

BRSW = average dressed slaughter weight for broilers (kg.)

BRPROD = meat production from broilers (metric tons)

TPPROD = total poultry meat production (metric tons)

DCPR = real price of corn (pts/kg.)

B. Eggs

1) $$SLAY_t = \begin{cases} \underset{(913893)}{-1929330.0} + \underset{(456.8)}{1003.9}*YEAR_t - \underset{(2750)}{3950.6}*DPCAL_t & \text{for } t \leq 1978 \\ SLAY_{t-1} + 1003.9 - 3950.6*(DPCAL_t - DPCAL_{t-1}) & \text{for } t > 1978 \text{ and } EGPI > 0 \\ SLAY_{t-1} & \text{for } t > 1978 \text{ and } EGPI \leq 0 \end{cases}$$

R^2 = .88 D.W. = 1.93 d.f. = 12

2) $SEPROD_t = SLAY_t * EGY_t$

3) $$TPEGPR_t = \underset{(84.4)}{91.92} + \rho TPEGPR_{t-1} + \underset{(.001)}{.019}*(SLAY_t - \rho SLAY_{t-1})$$

R^2 = .99 D.W. = 1.68 d.f. = 12

ρ = .939 (0.092)

4) $AEPROD_t = TPEGPR_t + OTEG_t$

Where:

SLAY = number of selected layers (1000 head)

YEAR = year

DPCAL = real price of layer feed (pts/kg.)

EGPI = egg relative return measure (pts)

SEPROD = selected egg production (millions of dozens)

EGY = dozens of eggs per selected layer per year

TPEGPR = total chicken egg production (millions of dozens)

AEPROD = all egg production (millions of dozens)

OTEG = exogenous goose, duck and other egg production (millions of dozens)

The trend equations for broiler slaughter and selected layers account for much of the variation in the observed values. The coefficients in the two equations for total meat and egg production were estimated using the Cochrane-Orcutt procedure since there was strong evidence of serial correlation in the residuals in the ordinary least squares estimates of these equations. The Durbin-Watson statistic was .967 for the total poultry meat equation and .719 for the layer equation. The standard errors for ρ in both equations indicate that the value of this parameter is significantly different from zero at a high level of confidence. Rao and Griliches have suggested that, as a rule of thumb for relatively small samples, an absolute value for the estimate of ρ greater than or equal to .3 can be taken as an indication that there is some gain in efficiency by using estimation procedures which take serial correlation into account (56). By this standard the estimated coefficients are more efficient than ordinary least squares estimates since the value of ρ in both equations is relatively large. The use of these estimates requires the assumption that the true residuals are first-order autoregressive rather than some more complicated structure.

The egg consumption variable includes not only chicken eggs but goose, duck and other eggs. In order to ensure a correspondence between the production and consumption variables these other eggs must be added to the total poultry egg production. The production of eggs from other fowl is small and has been relatively constant over the past twenty years so these eggs are simply added in as an exogenous variable set at the 1978 level for the projections. Average slaughter weights for broilers and the number of eggs per hen per year have not varied greatly over the base period. In the historical simulation actual values for these variables were entered exogenously. In the projections they are treated as constants set at 1.48 kilograms and 227 eggs respectively.

Since the full model only becomes operative in the projections its validation rests primarily on judgements concerning the plausibility of these projections. Nevertheless, it is useful to examine the results of the historical simulation which are presented in Tables 4.8a to 4.8g and Table 4.9 which contains the U statistics. The disadvantage of trend equations is that they miss significant turning points. Although the broiler slaughter equation tracks the expansion of the broiler industry quite well, it does not pick up

TABLE 4.8

Poultry Meat and Egg Production
in Spain, 1968-1978

Year	Actual	Estimate	% Error
a. Number of Broilers Slaughtered (ten thousand head)			
1968	24600.0	25094.72	2.01
1969	25880.0	27529.26	6.37
1970	30000.0	29963.80	- .121
1971	28500.0	32398.34	13.7
1972	33600.0	34832.88	3.67
1973	39600.0	37267.42	- 5.89
1974	40153.3	39701.96	- 1.12
1975	41901.4	42136.50	.561
1976	46719.8	44571.04	- 4.60
1977	49629.0	47005.58	- 5.29
1978	46150.2	49440.12	7.13
b. Total Poultry Meat Production (metric tons)			
1968	350540	365212	4.19
1969	385790	398109	3.19
1970	499000	446326	-10.6
1971	477000	521181	9.26
1972	554000	558583	.827
1973	600000	583530	- 2.75
1974	608000	589000	- 3.13
1975	631060	648670	2.79
1976	695578	676371	- 2.76
1977	734569	726429	- 1.11
1978	754598	756596	.265

TABLE 4.8 (continued)

Year	Actual	Estimate	% Error
	c. Broiler Meat Production (metric tons)		
1968	280540	286078	1.97
1969	315790	335855	6.35
1970	429000	428482	- .121
1971	407000	462638	13.7
1972	484000	501591	3.63
1973	530000	498646	- 5.92
1974	538000	532007	- 1.11
1975	561060	564208	.561
1976	625578	596813	- 4.60
1977	664569	629409	- 5.29
1978	684598	733176	7.10
	d. Number of Selected Layers (thousand head)		
1968	22578	24508.979	8.55
1969	23755	25515.684	7.41
1970	26404	26935.223	2.01
1971	29541	28411.255	- 3.82
1972	34660	30663.572	-11.5
1973	25334	30804.709	21.6
1974	28601	30405.806	6.31
1975	35923	34130.101	- 4.99
1976	38866	36373.332	- 6.41
1977	41672	39053.099	- 6.28
1978	38927	41164.776	5.75

TABLE 4.8 (continued)

Year	Actual	Estimate	% Error
	e. Total Poultry Egg Production (millions of dozens)		
1968	589	616	4.65
1969	620	641	3.40
1970	678	676	- .313
1971	722	711	- 1.46
1972	820	739	- 9.88
1973	635	743	16.9
1974	703	728	3.53
1975	839	805	- 4.10
1976	895	844	- 5.73
1977	899	895	- .465
1978	837	889	6.22
	f. Egg Production from Selected Layers (millions of dozens)		
1968	422	457	8.41
1969	453	487	7.49
1970	496	505	1.92
1971	562	540	- 3.90
1972	660	585	-11.4
1973	475	578	21.6
1974	543	578	6.33
1975	685	651	- 4.90
1976	741	694	- 6.34
1977	794	745	- 6.10
1978	737	779	5.71

TABLE 4.8 (continued)

Year	Actual	Estimate	% Error
	g. Total Egg Production (millions of dozens)		
1968	595	622	4.60
1969	625	646	3.37
1970	683	681	- .311
1971	727	716	- 1.45
1972	826	745	- 9.82
1973	641	748	16.8
1974	710	735	3.46
1975	846	811	- 4.07
1976	903	851	- 5.69
1977	906	902	- .461
1978	843	895	6.18

TABLE 4.9

U Statistics for Poultry Model

Equation	U1	U2	UM	UR	UD	R
Broilers Slaughtered	.027	.578	.020	.065	.915	.97
Broiler Meat	.028	.537	.023	.005	.972	.97
Total Poultry Meat	.021	.485	.002	.008	.990	.98
Selected Layers	.042	.571	.003	.070	.926	.92
Selected Eggs	.041	.545	.003	.084	.913	.92
Total Poultry Eggs	.032	.548	.008	.016	.976	.89

UM, UR and UD may not sum to one due to rounding.

the fall in slaughter in 1978. The estimates of total meat production are based on the predicted values for number of broilers slaughtered and are generally quite close to the actual values despite errors in the trend equation. The U statistics indicate that the poultry meat component does surprisingly well in forecasting despite the reliance on the trend equation.

The equation for the number of selected layers is not a pure trend since it includes the cost of feed as an explanatory variable. The errors are somewhat larger in this equation than for the poultry meat trend. Nevertheless, the U statistics suggest that the equations are good forecasters of selected layers and egg production from these hens. The equation for total poultry egg production, however, does less well in forecasting although most of the errors are within reasonable limits.

The poultry component could be improved by developing a more realistic approach to stopping the expansion when the relative return measure falls to zero or less. The evidence presented in Table 4.7 does not suggest that production immediately ceases to expand when the measure becomes negative. Although the number of cases where the measure was negative is insufficient to draw any sound conclusions, the variables seem to respond after a lag of one or two years. Regressions of the number of broilers slaughtered and the number of selected layers on the respective return measures resulted in negative coefficients for these explanatory variables. This is not surprising since the dependent variables increased over the historical period while the relative return measures declined. However, the results may also suggest that a more complicated aggregate response to relative returns is involved. In the case of broiler production unusually large amounts of subsidized credit were granted to broiler producers in 1976 with the result that production rose sharply and prices fell (72). This may explain the negative value of the relative return measure in 1976. Since the industry capacity is fixed in the short run the effects of this event may only have begun to be felt toward the end of the decade. Further investigation of this problem could lead to a more realistic formulation of the way in which expansion in these sectors will slow and eventually stop in response to the equalization of economic profits across industries.

V. Cereal Grain Production

Since most of the rain that falls over the Spanish countryside occurs during the winter months, the greatest proportion of cereal production comes from the winter crops. These consist primarily of wheat and barley and to a lesser extent rye and oats. Corn and sorghum are the major summer grains but are grown less extensively due to the need for irrigation in most parts of Spain. Spain also produces enough rice to meet consumer needs and has traditionally exported small quantities (84).

Spanish policy toward the cereal grains sector has been oriented toward maintaining prices at levels beneficial to the great many producers of these commodities. At the same time, cereal grains, particularly wheat, have a significant impact on consumer budgets and the Spanish government has attempted to balance the returns to farmers with the costs to consumers. In the case of wheat, the creation in 1937 of a national wheat board allowed the government to regulate prices and control the margins between the farm and first handlers. The Servicio Nacional del Trigo evolved into the Servicio Nacional de Productos Agrarios (SENPA) which has played a central role in Spanish cereal production. Since 1937, SENPA or one of its precursors has purchased the entire wheat crop at regulated prices, added a 5 percent margin and sold it to first users (9).

The cereal boards and SENPA set official prices for feedgrains as well as for wheat. In the early 1960s, meat imports rose and, in response, SENPA shifted from price policies favoring wheat to efforts to stimulate the production of feedgrains (84). Throughout the 1960s and 1970s, wheat acreage has declined while that of barley has increased. The decline in wheat acreage has been accompanied by a fall in the consumption of bread cereals as was seen in Chapter III.

Irrigation is applied in varying degrees on all cereal grains but is particularly important for corn. Yields from irrigated grain cultivation are considerably higher than those from dryland cultivation. Since irrigation is an important factor in Spanish crop production, dryland and irrigated acreage equations have been estimated for the major cereals, wheat, barley and corn. Multiplying dryland and irrigated acreage by the appropriate yields and summing these products gives total production. The separation of irrigated and dryland acreage allows greater insights into production changes and provides a mechanism for introducing alternative assumptions about the competition for irrigated land between cereals, forage and other crops.

The principal explanatory variables used in the acreage equations are the average prices received by farmers deflated by the CPI. In the case of wheat, these prices received are virtually identical to the government guaranteed prices. Average prices received for feedgrains have differed historically from the government prices depending on market conditions. In the case of corn, the guaranteed price was set at levels well below the market prices throughout most of the 1960s (55). Until the late 1960s, minimum guaranteed prices for barley also tended to be lower than the average market prices. As part of the effort to encourage feedgrain production, guaranteed barley and corn prices were raised more rapidly so that by 1978 average prices received by farmers for these products were essentially those set by the government as minimum guaranteed prices (61). Since no complete series of guaranteed prices was available, the average prices received were used in estimating the acreage equations.

Two variables representing costs are used in the corn and minor cereal grain equations. In the original specification of the wheat and barley models cost variables were also included. However, the original equations proved inadequate when projecting wheat and barley production to 1990. As a result they were re-specified to include the lagged dependent variable as an explanatory variable and the inclusion of cost variables did not add anything to the new equations. Real diesel fuel prices are used as a proxy for energy costs in the irrigated corn, oat and sorghum acreage equations. The real index of agricultural wages is used to represent production costs in the dryland corn and rye acreage equations. Many cost variables were tried in the various equations, generally with unsatisfactory results. The specifications retained represent the best equations among the alternative estimates.

Separate estimates of irrigated acreage for rye, oats and sorghum have not been made since the acreage devoted to these crops is relatively small. Production of rice and minor grains is not included in the model although irrigated and dryland acreage devoted to these crops is introduced exogenously in a land accounting component. The land accounting component of the crop model is based on estimated acreage equations for cereal grains and forage, exogenous land use variables and several identities. It does not set constraints on the evolution of land use but provides an easy way to verify that acreage devoted to different classes of crops in the projections is within reasonable bounds. This component will be described more fully after the major components of the crop model are presented.

A. Wheat

The principal objective of Spanish policy toward wheat during the 1960s was to stabilize supplies so as to avoid both surpluses and deficits (55). Since many Spanish farmers produce winter wheat, policy toward this sector has always included an important social element. The policies adopted in the early 1960s to encourage the production of feedgrains led many farmers to substitute barley for wheat. However, increasing yields and falling consumption led to large surpluses of wheat by the late 1960s (55). Through the 1970s price policies have encouraged the decline in wheat acreage and from 1975 to 1978, Spain was a net importer of wheat.

While average yields have risen in Spain they are still lower than in other European countries. In 1977, the average yield in Spain was 1.5 metric tons per hectare compared with 2.3 tons in Italy and 4.2 in France (58). Irrigated wheat yields are much higher, reaching 3.4 metric tons per hectare in 1978 compared with 1.6 for dryland cultivation. Since less than 10 percent of the cultivated wheat acreage in 1978 was irrigated the average for all wheat was only 1.75 tons per hectare.

Very little hard wheat is grown in Spain, most of the production being bread-quality soft wheats. Since prices in the EC favor hard over soft wheats, there may be some potential for changes in the kinds of wheat grown in Spain after entry. Since such a small proportion of the wheat grown in Spain is hard and this proportion has been virtually stable, it was not possible to establish a statistical relationship between hard and soft wheat prices and acreage devoted to these types of wheat. The amount of wheat fed to livestock is small and has been declining.

Five equations are used to forecast wheat production. Since barley is the major competing crop, real wheat and barley prices were taken as the principal explanatory variables. Since wheat and barley cultivation occupy large areas where there are few viable alternatives it is assumed that a large proportion of the acreage devoted to these crops will be carried over to the next year. To account for this effect, acreage lagged one year is used as an explanatory variable in the wheat and barley equations. The prices are also lagged one year since the announcement of support prices is made early in the year, affecting planting decisions in the fall with the actual harvest taking place in the next year. The yield equations are linear trends.

The use of the lagged dependent variable raises the possibility of serial correlation. Based on the ordinary least squares estimates, h statistics were computed for the irrigated and dryland wheat acreage relationships. The absolute value of these estimates was high enough to suggest the presence of serial correlation. The Hildreth-Lu estimation procedure is appropriate for equations with lagged dependent variables. The estimates of ρ are -.48 for dryland acreage and .89 for irrigated acreage. These values suggest that there is some gain in efficiency by taking serial correlation into account, according to the Rao/Griliches rule of thumb. The equations are presented below with the R^2, Durbin-Watson statistic and degrees of freedom from the Hildreth-Lu estimates, as well as the h statistic from the ordinary least squares estimates.

1) $$WDA_t = 338.65 + \underset{(.091)}{.749}{*}WDA_{t-1} + \underset{(104.8)}{364.37}{*}DWPR_{t-1} - \underset{(155.1)}{352.8}{*}DBPR_{t-1}$$

$R^2 = .97$ D.W. = 2.39 d.f. = 12

h = -2.24 $\rho = -.48$

2) $$WIA_t = \underset{(116.4)}{-46.05} + \underset{(.211)}{.384}{*}WIA_{t-1} + \underset{(31.6)}{77.36}{*}DWPR_{t-1} - \underset{(19.12)}{21.92}{*}DBPR_{t-1}$$

$R^2 = .90$ D.W. = 2.07 d.f. = 12

h = 2.43 $\rho = .89$

3) $$WDY_t = \underset{(9341)}{-73320.1} + \underset{(4.74)}{37.8}*YEAR_t$$

$R^2 = .79$ D.W. = 2.21 d.f. = 17

4) $$WIY_t = \underset{(16215)}{-124606} + \underset{(8.24)}{64.62}*YEAR_t$$

$R^2 = .78$ D.W. = 1.83 d.f. = 17

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

Where:

WDA = dryland wheat acreage (1000 hectares)

DWPR = real price received for wheat (pts/kg.)

DBPR = real price received for barley (pts/kg.)

WIA = irrigated wheat acreage (1000 hectares)

WDY = yield for dryland wheat (kg./hectare)

WIY = yield for irrigated wheat (kg./hectare)

YEAR = year

WPROD = total wheat production (1000 metric tons)

The results of historical simulation based on these equations are shown in Tables 4.10a to 4.10c. U statistics for all the cereal grain equations are presented in Table 4.11. The equation for dry wheat acreage forecasts the historical evolution quite well. The explanatory variables have the expected signs and small standard errors relative to the coefficients. The statistical properties of the estimated coefficients in the irrigated acreage equation are less robust. However, the coefficients have the expected signs and the U statistics indicate that the equation performs reasonably well as a forecaster. The predictions for total wheat production are based on actual yields and the predicted acreage from the estimated

TABLE 4.10

Wheat Production in Spain, 1968-1978

Year	Actual	Estimate	% Error
	a. Dryland Acreage (thousand hectares)		
1968	3686.1	3679.788	- .171
1969	3553.1	3596.392	1.22
1970	3525.5	3458.802	- 1.89
1971	3447.7	3351.400	- 2.79
1972	3390.8	3201.107	- 5.59
1973	2953.6	3204.315	8.49
1974	2979.9	3006.781	.902
1975	2495.7	2571.045	3.02
1976	2580.8	2551.009	- 1.15
1977	2492.4	2489.027	- .135
1978	2516.9	2494.857	- .876
	b. Irrigated Acreage (thousand hectares)		
1968	277	312	12.8
1969	214	256	19.3
1970	230	200	-12.8
1971	207	229	10.7
1972	196	186	- 5.29
1973	198	201	1.42
1974	184	181	- 1.24
1975	165	164	- .262
1976	191	182	- 4.83
1977	222	190	-14.4
1978	235	221	- 5.75

TABLE 4.10 (continued)

Year	Actual	Estimate	% Error
	c. Total Wheat Production (thousand metric tons)		
1968	5312	5400.809	1.67
1969	4624	4781.866	3.41
1970	4060	3986.074	- 1.82
1971	5455	5374.114	- 1.48
1972	4562	4307.097	- 5.59
1973	3966	4268.007	7.61
1974	4534	4564.305	.668
1975	4302	4415.587	2.64
1976	4436	4362.921	- 1.65
1977	4064	3958.401	- 2.60
1978	4806	4726.266	- 1.66

TABLE 4.11

U Statistics for Cereal Grain Equations

Equation	U1	U2	UM	UR	UD	R
Wheat						
Dry Acreage	.017	.486	.000	.005	.995	.97
Irrig. Acreage	.053	.857	.000	.517	.483	.83
Production	.031	.376	.002	.008	.989	.82
Barley						
Dry Acreage	.012	.388	.027	.127	.846	.99
Irrig. Acreage	.035	.562	.009	.093	.898	.96
Production	.051	.475	.092	.238	.670	.95
Corn						
Dry Acreage	.027	.794	.049	.076	.875	.93
Irrig. Acreage	.052	1.135	.005	.246	.748	.53
Production	.036	.636	.012	.368	.620	.89

TABLE 4.11 (continued)

Equation	U1	U2	UM	UR	UD	R
Rye						
Acreage	.041	1.190	.020	.149	.831	.90
Production	.068	1.194	.041	.430	.529	.73
Oats						
Acreage	.017	.778	.044	.047	.909	.83
Production	.036	.304	.003	.016	.981	.87
Sorghum						
Acreage	.072	.798	.081	.213	.706	.59
Production	.070	.616	.004	.360	.636	.89

UM, UR and UD may not sum to one due to rounding.

equations. The percentage errors are fairly small and the predictions catch the turning points in the actual evolution quite well. Total wheat production is dominated by dryland production so that the errors from the irrigated acreage equation are neutralized by the dryland equations which carries a heavier weight in the total and is more accurate.

B. Barley

SENPA has allowed the barley market to function freely, unlike the wheat market, as long as prices were above the minimum guaranteed price. In the 1970s the policy was changed to conform more closely with the wheat policy including the establishment of a sales price 5 percent above the basic guaranteed price. Nevertheless, SENPA has not traditionally handled the entire commercialization process for barley as has been the case for wheat (84).

Faced with growing needs for feedgrains and wheat surpluses, the Spanish government gradually adjusted the relative prices with the result that barley acreage has grown significantly over the past twelve years. In 1960 over four million hectares of wheat were harvested compared with 1.4 million hectares of barley. By 1978, the relative importance of the two crops had reversed with 3.5 million hectares of barley being harvested as contrasted with about 2.8 million hectares of wheat.

Barley is used primarily as livestock feed although 6 percent to 10 percent of the production is used for beer. Yields are somewhat closer to European levels but the situation is generally similar to that of wheat. The proportion of barley produced from irrigated land is less than 10 percent. Throughout most of the 1960s and early 1970s Spain was a net importer of barley. Since 1975, Spanish production has met domestic needs and exports have exceeded imports.

The estimated equations are similar to those for wheat. Irrigated and dryland acreage are estimated as functions of lagged wheat and barley prices and lagged acreage. The yield equations are linear trends and total production is obtained by summing the products of irrigated and dryland acreage and yields. The h statistics computed from the ordinary least squares residuals lead to the conclusion that the null hypothesis of serial correlation can be rejected. The ordinary least squares estimates are, thus, retained.

1) $BDA_t = \underset{(356)}{2027.76} + \underset{(.077)}{.631}*BDA_{t-1} - \underset{(75.4)}{332.34}*DWPR_{t-1} + \underset{(74.7)}{119.23}*DBPR_{t-1}$

$R^2 = .99$ D.W. = 2.08 d.f. = 14

h = -.173

2) $BIA_t = \underset{(66.8)}{246.66} + \underset{(.174)}{.448}*BIA_{t-1} - \underset{(14.4)}{37.12}*DWPR_{t-1} + \underset{(13.8)}{7.13}*DBPR_{t-1}$

$R^2 = .97$ D.W. = 2.06 d.f. = 14

h = -.875

3) $BDY_t = \underset{(14933)}{-80472} + \underset{(7.6)}{41.67}*YEAR_t$

$R^2 = .64$ D.W. = 2.31 d.f. = 17

4) $BIY_t = \underset{(20125)}{-121551} + \underset{(10.2)}{63.14}*YEAR_t$

$R^2 = .69$ D.W. = 1.55 d.f. = 17

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

Where:

BDA = dryland barley acreage (1000 hectares)

DBPR = real price received for barley (pts/kg.)

DWPR = real wheat price (pts/kg.)

BIA = irrigated barley acreage (1000 hectares)

BDY = dryland barley yields (kg./hectare)

YEAR = year

BIY = irrigated barley yield (kg./hectare)

BAPROD = total barley production (metric tons)

The results of historical simulation of barley production are presented in Tables 4.12a to 4.12c and U statistics are included in Table 4.11. The estimated coefficients in the equations have the expected signs and the barley model tracks the actual values quite well. The U statistics provide further indication that the estimated equations lead to good predictions of the actual values.

C. Corn

Dryland corn cultivation occurs almost exclusively in the northern part of the country. Elsewhere in Spain irrigation is necessary to obtain a harvest. Climatic conditions are generally not favorable for the production of corn and only about one-third of domestic disappearance is covered by Spanish production.

Until 1975 Spanish price policy toward corn was ineffective since the guaranteed prices set by the government were well below market prices (55). The use of corn as livestock feed has expanded rapidly and, given the limited potential for increases in production, prices and concomitant levels of protection would have had to

TABLE 4.12

Barley Production in Spain, 1968-1978

Year	Actual	Estimate	% Error
	a. Dryland Barley Acreage (thousand hectares)		
1968	1795.4	1648.826	- 8.16
1969	1943.2	1960.280	.879
1970	2092.7	2078.247	- .691
1971	2223.9	2243.759	.893
1972	2336.9	2432.429	4.09
1973	2581.4	2499.395	- 3.18
1974	2798.1	2764.704	- 1.19
1975	3023.7	3006.987	- .553
1976	3004.2	3062.980	1.96
1977	3114.9	3113.397	- .048
1978	3244.6	3235.775	- .272
	b. Irrigated Barley Acreage (thousand hectares)		
1968	128	130	2.15
1969	157	146	- 6.84
1970	131	162	23.7
1971	147	160	8.46
1972	183	179	- 1.74
1973	192	197	2.70
1974	229	214	- 6.21
1975	238	239	.388
1976	236	237	.661
1977	233	245	5.09
1978	274	251	- 8.54

TABLE 4.12 (continued)

Year	Actual	Estimate	% Error
	c. Barley Production (thousand metric tons)		
1968	3441	3200.674	4.49
1969	3877	3877.561	4.62
1970	3103	3171.928	1.71
1971	4785	4861.506	2.66
1972	4358	4506.284	- 1.94
1973	4402	4291.737	12.3
1974	5404	5304.369	.062
1975	6728	6697.509	8.4
1976	5473	5571.511	- 3.40
1977	6766	6801.364	.048
1978	8068	7961.797	- 1.97

have been set extraordinarily high to raise Spain's degree of self-sufficiency in corn. Prices paid by corn users have been less than the prices received by producers due to government subsidies. Information concerning the prices paid by corn users is extremely limited but this policy appears to have encouraged livestock producers to increase the use of corn as feed. The net result has been a rapid expansion in the amount of corn imported.

The structure of this component of the cereal grains model is similar to that of the wheat and barley components. Dryland corn acreage is estimated as a function of lagged corn price and the real index of agricultural wages. Sugarbeets were suggested as a competitor for irrigated land by informants in Spain so the lagged price of sugarbeets was included in the irrigated acreage equation. Finally, the real price of diesel fuel was used as a proxy for energy costs for irrigated corn.

1) $$CDA_t = \underset{(58)}{343.86} + \underset{(7.51)}{7.99}*DCPR_{t-1} - \underset{(.190)}{1.02}*DSI$$

$R^2 = .93$ D.W. = 1.17 d.f. = 15

2) $$CIA_t = \underset{(56)}{571.35} + \underset{(26.99)}{61.58}*DCPR_{t-1} - \underset{(91.53)}{334.94}*DSBPR_{t-1} - \underset{(30.92)}{94.71}*DGOPR_t$$

$R^2 = .75$ D.W. = 1.18 d.f. = 14

3) $$CDY_t = \underset{(17401)}{-93470.3} + \underset{(8.84)}{48.43}*YEAR_t$$

$R^2 = .64$ D.W. = 1.36 d.f. = 17

4) $$CIY_t = \underset{(17304)}{-293653} + \underset{(8.79)}{151.29}*YEAR_t$$

$R^2 = .95$ D.W. = .98 d.f. = 17

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

Where:

CDA = dryland corn acreage (1000 hectares)

DCPR = real price received for corn (pts/kg.)

DSI = index of agricultural wages deflated by CPI

CIA = irrigated corn acreage (1000 hectares)

DSBPR = real price received for sugarbeets (pts/kg.)

DGOPR = real price of diesel fuel (pts/liter)

YEAR = year

CDY = dryland corn yield (kg./hectare)

CIY = irrigated corn yield (kg./hectare)

CPROD = corn production (1000 metric tons)

Using these equations to simulate the base period led to the estimates presented in Tables 4.13a to 4.13c. Considering the statistical properties of these equations, the simulation results and the U statistics in Table 4.11, it is clear that these equations are somewhat weaker than the wheat and barley models. This is particularly true of the irrigated acreage equation which leads to relatively large forecasting errors in certain years. The pattern of the residuals for both acreage equations suggest the presence of serial correlation although the values of the Durbin-Watson statistics (1.17 for dryland and 1.18 for irrigated) fall in the inconclusive region. In the irrigated acreage equation, the pattern of the residuals differs substantially between the periods 1960-1969 and 1970-1978. It is possible that some structural or institutional change not accounted for in the equations occurred in the late 1960s leading to these results. Use of dummy variables or proxies for

TABLE 4.13

Corn Production in Spain, 1968-1978

Year	Actual	Estimate	% Error
	a. Dryland Corn Acreage (thousand hectares)		
1968	285	264	- 7.22
1969	246	255	3.66
1970	235	245	4.52
1971	223	241	8.29
1972	220	234	6.57
1973	207	222	6.84
1974	206	201	- 2.27
1975	202	204	1.02
1976	193	188	- 2.56
1977	180	181	.35
1978	176	165	- 5.96
	b. Irrigated Corn Acreage (thousand hectares)		
1968	238	249	4.48
1969	249	259	4.21
1970	305	251	-17.7
1971	321	283	-11.7
1972	314	292	- 7.12
1973	315	321	1.65
1974	295	283	- 4.11
1975	283	311	9.86
1976	239	223	- 6.41
1977	262	270	3.10
1978	267	323	20.7

TABLE 4.13 (continued)

Year	Actual	Estimate	% Error
	c. Corn Production (thousand metric tons)		
1968	1473	1476.559	.242
1969	1507	1568.198	4.06
1970	1823	1621.672	-11.0
1971	2058	1913.116	- 7.04
1972	1923	1848.358	- 3.88
1973	2038	2095.367	2.81
1974	1992	1919.863	- 3.62
1975	1794	1936.697	7.95
1976	1545	1458.747	- 5.58
1977	1892	1939.483	2.51
1978	1969	2252.605	14.4

possible structural changes added little to the equations, however.

D. Rye, Oats and Sorghum

Rye, oats and sorghum are the other grain crops included in the model. Sorghum has only recently been introduced in Spain and total acreage is still small. The number of hectares used for the cultivation of oats has declined and is similar to the number devoted to corn, much less than for wheat or barley. Rye production has been declining and in 1978 total acreage was only about one-half that of corn. Policy toward these crops is similar to the other cereal policies including guaranteed prices administered by SENPA.

For the purposes of estimating domestic disappearance and trade, these crops have been aggregated with the other cereal grains into bread cereals (wheat and rye), barley and oats, and corn and sorghum. Total acreage equations were estimated for these cereals rather than estimating separate dryland and irrigated acreage equations. The principal explanatory variables are the real prices received for the products. Cost variables used include the real agricultural wage index and real diesel fuel prices. The estimated equations are presented below (standard errors in parentheses).

1) Rye

$$RA_t = \underset{(114.8)}{314.0} + \underset{(14.97)}{41.89}*DRPR_{t-1} - \underset{(.397)}{1.21}*DSI$$

$R^2 = .95$ D.W. = 1.03 d.f. = 15

$$RY_t = \underset{(30954)}{56892} + \underset{(15.54)}{29.17}*YEAR_t + \underset{(4.77)}{5.08}*DPIC_t$$

$R^2 = .58$ D.W. = 2.18 d.f. = 16

$$RPROD_t = RA_t*RY_t$$

2) Oats

$$OA_t = \underset{(20.15)}{308.44} + \underset{(13.0)}{21.23}*DOPR_{t-1} + \underset{(16.04)}{35.89}*DGOPR_t$$

R^2 = .85 D.W. = 1.48 d.f. = 15

$$OY_t = \underset{(10688)}{-45335} + \underset{(5.43)}{23.53}*YEAR_t$$

R^2 = .53 D.W. = 2.28 d.f. = 17

$$OPROD_t = OA_t*OY_t$$

3) Sorghum

$$SA_t = \underset{(1385)}{-704.25} + \underset{(.696)}{.396}*YEAR_t - \underset{(6.91)}{16.65}*DGOPR_t$$

R^2 = .65 D.W. = 1.32 d.f. = 12

$$SY_t = \underset{(48369)}{416683} + \underset{(24.5)}{213.21}*YEAR_t$$

R^2 = .85 D.W. = 1.13 d.f. = 13

$$SPROD_t = SA_t*SY_t$$

Where:

RA = total rye acreage (1000 hectares)

RY = rye yield (kg./hectare)

DRPR = real price received for rye (pts/kg.)

DSI = agricultural wage index deflated by CPI

YEAR = year

DPIC = index of prices received for cereals deflated by CPI

RPROD = rye production (1000 metric tons)

OA = total oat acreage (1000 hectares)

DOPR = real oat price (pts/kg.)

DGOPR = real price of diesel fuel (pts/liter)

OY = oat yield (kg./hectare)

OPROD = oat production (1000 metric tons)

SA = sorghum acreage (1000 hectares)

SY = sorghum yield (kg./hectare)

SPROD = sorghum production (1000 metric tons)

Estimates of historical values based on these equations are shown in Tables 4.14a to 4.14f. As for the other simulations actual yields were used to estimate production. The estimated coefficients in the acreage equation for rye have the expected signs and relatively small standard errors. The Durbin-Watson statistic for this equation is 1.03 which indicates that the hypothesis that autocorrelation in the residuals is present cannot be rejected. As a result, the R^2 and t statistics may be overstated. The U statistics suggest that the rye equations are not very good as forecasters. The acreage equation has been retained despite these weaknesses since it is the best that could be obtained. The real cereal price index was included in the yield equation since it raised the value of R^2 substantially. The pure linear trend accounted for very little of the great variation in rye yields.

The oat acreage equation is somewhat better with no conclusive evidence of serial correlation. The sign on the coefficient for diesel fuel prices, which were included as a cost variable is unexpected. It is hypothesized that less energy is used in the cultivation of oats so that the positive sign for this variable reflects the cross effect of farmers switching from more energy intensive crops. Acreage estimates based on this equation are generally close

TABLE 4.14

Rye, Oats and Sorghum Production in Spain, 1968-1978

Year	Actual	Estimate	% Error
	a. Rye Acreage (thousand hectares)		
1968	366	360	- 1.56
1969	354	339	- 4.22
1970	313	321	2.55
1971	285	315	10.6
1972	278	305	9.68
1973	268	276	2.89
1974	249	246	- 1.38
1975	228	268	17.4
1976	224	232	3.78
1977	236	218	- 7.7
1978	230	187	-18.7
	b. Rye Production (thousand metric tons)		
1968	355	349	- 1.56
1969	320	306	- 4.22
1970	259	266	2.55
1971	269	297	10.6
1972	263	288	9.68
1973	252	259	2.89
1974	254	250	- 1.38
1975	241	283	17.4
1976	214	222	3.78
1977	228	210	- 7.7
1978	251	211	-16.1

TABLE 4.14 (continued)

Year	Actual	Estimate	% Error
	c. Oat Acreage (thousand hectares)		
1968	508	481	- 5.26
1969	493	475	- 3.58
1970	467	470	.61
1971	455	465	2.14
1972	467	457	- 2.12
1973	470	443	- 5.67
1974	475	471	- .815
1975	457	472	3.31
1976	455	455	- .047
1977	405	430	6.24
1978	420	415	- 1.22
	d. Oat Production (thousand metric tons)		
1968	539	511	- 5.26
1969	547	527	- 3.58
1970	395	397	.61
1971	582	594	2.14
1972	440	431	- 2.12
1973	425	401	- 5.67
1974	559	554	- .815
1975	609	629	3.31
1976	528	528	- .047
1977	418	444	6.24
1978	553	535	- 3.19

TABLE 4.14 (continued)

Year	Actual	Estimate	% Error
	e. Sorghum Acreage (thousand hectares)		
1968	31.5	33.3	5.63
1969	48.6	34.6	-28.9
1970	47.0	37.2	-20.9
1971	41.5	39.0	- 6.05
1972	44.3	42.0	- 5.19
1973	43.3	45.3	4.68
1974	36.6	32.1	-12.3
1975	34.7	35.7	2.97
1976	37.5	40.2	7.17
1977	41.3	48.2	16.7
1978	53.5	53.7	.314
	f. Sorghum Production (thousand metric tons)		
1968	91	96.1	5.63
1969	157	112.0	-28.9
1970	189	150.0	-20.9
1971	173	163.0	- 6.05
1972	177	168.0	- 5.19
1973	164	172.0	4.68
1974	157	138.0	-12.3
1975	144	148.0	2.97
1976	159	170.0	7.17
1977	192	224.0	16.7
1978	284	279.0	- 1.8

to the actual value and the U statistics suggest that the acreage and production relationships lead to sound forecasts.

Prior to 1964 sorghum acreage in Spain was so small that observations for these years were deleted in the estimation as unreliable. A variety of functional forms and alternative specifications were estimated all resulting in a negative coefficient for the price variable in the acreage equation. The equation retained does not include the price and is based primarily on a linear trend. Since rye, oats, and sorghum are of secondary importance in Spain in terms of both production and disappearance, the weaknesses of these equations do not seriously compromise the model as a whole.

E. Supply Elasticities of Cereal Grains

Acreage response elasticities based on the estimated coefficients and evaluated at the average price and acreage values are presented in Table 4.15. The total response is a weighted average of the irrigated and dryland acreage elasticities for wheat, barley, and corn. Wheat and corn acreage are more sensitive to price changes than barley. In addition, the cross-price effects between wheat and barley are not symmetric, a change in wheat prices having a greater impact on barley acreage than a change in barley prices on wheat acreage.

In the case of wheat and corn, the elasticities for irrigated acreage are higher than for dryland acreage. Wheat acreage probably depends on two price-related decisions. In the first instance, farmers may decide on the total acreage to be planted based on relative wheat and barley prices as well as tradition, preferences, and

TABLE 4.15

Elasticities of Acreage Response*

Crop	Price					
	Wheat	Barley	Corn	Sugar-Beet	Rye	Oat
Wheat						
Irrigated	1.52	-.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					.53	
Oats						.16

*Defined as $\alpha_{ij} = \frac{\partial A_i}{\partial P_j} \frac{P_j}{A_i}$ where A represents acreage and P, the relevant price. 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 CPI.

many other factors. The proportion of the total acreage to be irrigated is likely to be more sensitive to the absolute price level and the expected yield differential. In this context, the higher elasticity for irrigated acreage reflects the greater attention given to the absolute level of wheat prices in deciding on the amount of land to irrigate. Irrigated and dryland corn production are distinct activities carried out in different regions. In this case, the decision is not to irrigate a greater or lesser proportion of the total acreage but whether to grow corn at all in the areas where irrigation is required. The cross elasticity with sugarbeet prices is also high indicating that the use of irrigable land is highly sensitive to prices. The total acreage elasticities for the five cereal grains range from .16 (oats) to .64 (corn). These values are of the same order of magnitude as supply elasticities estimated for cereal grains in other European countries (95).

F. Land Accounting Component

The land accounting component serves to keep track of the allocation of land to various crops. It is not a land allocation model, but rather, provides a means to evaluate projections and introduce constraints if acreages predicted by the estimated equations appear to be evolving in an unlikely manner. Acreage forecasts from the estimated equations are aggregated and combined with exogenously introduced land use variables to ensure that total cereal, forage and other crop acreage are not greater than available land. Another part of this accounting component forces total irrigated and dryland acreage to sum to total land available.

The structure of this component will be set out with little comment. An equation for total forage acreage has been estimated and is included in this component. All the other relationships are identities based on exogenous variables and acreage estimates from the cereal grain equations. In the following presentation, exogenous variables are indicated by lower case letters. Standard errors for the estimated forage equation are in parentheses.

LAND ACCOUNTING (Variables in 1000 Hectares)

Cereals

WBCIA = WIA + BIA + CIA (irrigated wheat, barley, corn acreage)

WBCDA = WDA + BDA + CDA (dry wheat, barley, corn acreage)

RCRIA = rice + rosia + oica (other irrigated cereal acreage)

TICA = WBCIA + RCRIA (total irrigated cereal acreage)

ROSA = RA + OA + SA (rye, oats, sorghum acreage)

ROSDA = ROSA - rosia (dry acreage)

TDCA = WBCDA + ROSDA + odca (total dry cereal acreage)

TCA = TICA + TDCA (total cereal acreage)

Forage

$$TFOR_t = \underset{(5888)}{-58145} + \underset{(2.96)}{29.95}*YEAR_t + \underset{(23.3)}{51.66}*DGOPR_t \quad \text{(total forage acreage)}$$

R^2 = .96 D.W. = .74 d.f. = 16

DFOR = TFOR - forir (dry forage acreage)

Other Crops

TOCA = tclb - (TCA + TFOR) (total other crop acreage)

TOCIA = tia - (forir + TICA) (irrigated other crop acreage)

TOCDA = TOCA - TOCIA (dry other crop acreage)

Total Land Use

TDA = tclb - tia (total dry acreage)

TCLBF = tclb + fal (total cropland including fallow)

Where:

WBCIA = irrigated wheat, barley and corn acreage

WBCDA = dryland wheat, barley and corn acreage

RCRIA = irrigated acreage for all other cereals

rice = rice acreage (exogenous)

rosia = irrigated rye, oats, sorghum acreage (exogenous)

oica = other irrigated cereal acreage (exogenous)

TICA = total irrigated cereal acreage

ROSA = total rye, oat and sorghum acreage

ROSDA = total dryland rye, oat and sorghum acreage

TDCA = total dryland cereal acreage

odca = other dryland cereal acreage (exogenous)

TCA = total cereal acreage

TFOR = total forage acreage

DFOR = dryland forage acreage

forir = irrigated forage acreage (exogenous)

TOCA = total other crop acreage

tclb = total cropland base (exogenous)

tia = total irrigated acreage (exogenous)

TOCIA = total other crop irrigated acreage

TOCDA = total dryland other crop acreage

TDA = total dryland acreage

TCLBA = total cropland base including fallow

fal = land in fallow (exogenous)

These identities can be used to check the evolution of projected land use. For example, total irrigated acreage can be set exogenously according to alternative assumptions concerning the amount of land Spain will bring under irrigation. The use of available irrigated land for cereal production is determined by the irrigated acreage equations for wheat, barley and corn and several exogenous variables to reflect irrigation of other cereal grains. Irrigated forage acreage is introduced exogenously and with total irrigated cereal acreage is used to determine the amount of irrigated land planted to other crops, as a residual. By examining this residual as well as the other variables, adjustments in the cereal acreage estimates may be suggested. In a similar manner, the overall allocation of land to various uses as predicted by the model can be evaluated.

The forage equation also provides a useful check on predictions concerning feedgrain production. Increases in forage acreage imply that more forage is being used to feed livestock. If feedgrain disappearance is also projected to increase rapidly, adjustments in the model may be needed so that the apparent disappearance of feed and forage predicted by the model does not exceed the capacity of livestock to consume them. The positive coefficient for the real diesel fuel price implies that less energy is used in forage cultivation so that rising energy costs lead farmers to switch from other crops to forage. Spain has adopted policies to encourage the use of forage for feeding livestock as a way to reduce dependence on imported feedgrains. This orientation is likely to continue and is accounted for by the trend variable.

The land accounting component will be referred to in evaluating the projections. Development of this component into a true land allocation model would constitute a useful improvement in the overall model. At this stage, the accounting component has been included as a first step toward a more sophisticated allocation model and a simple way to examine projected land use.

Concluding Remarks

The various components included in the production model are based on whatever data and information are available. For the most part, production in Spain has expanded while real prices received have declined. This leads to difficulties in modelling production since highly significant estimates indicating a negative relationship between prices and outputs are frequently obtained. A variety of specifications as well as estimated biological relationships have been introduced to avoid these problems. With one or two minor exceptions, the coefficients in the equations retained in the model have the expected sign although the standard errors are often relatively large.

More time and effort has been devoted to constructing the cattle, hog, poultry, wheat, barley and corn models since these sectors are the most important in relation to the objectives of this study. The sheep and goat model, the equations for the minor cereal grains and the land accounting component are more rudimentary. Each of these sectors is sufficiently complicated to merit much more comprehensive and detailed study. Since the time available for building the simulation model of production was limited and full information and reliable data were not always available, a certain number of weaknesses in the model were unavoidable.

Despite the defects in the model, it performs fairly well in the historical simulations and generally leads to forecasts which appear reasonable. Very little can be done to improve the reliability of historical data and since more complete information on biological constraints, costs and technical relationships simply does not exist, it is unlikely that further efforts to restructure the model would lead to much more than marginal improvements.

One approach to improving the reliability of the model would have been to estimate relationships on a regional basis. The aggregation in this national model hides the variation in regional economic, ecological and institutional conditions. Responses to economic variables are influenced by the settings in which they are made. Aggregation obscures these variations and makes it more difficult to measure the effects of price and policy changes. Given the number of products included in this study, developing regional models would have led to an unreasonably large number of components. In addition, adequate regional data are scarcer than national statistics. The model presented in this chapter represents a compromise between the need for highly detailed analysis and the feasibility of constructing a very large model based on the available data. Although greater detail and precision would be useful, the model is adequate for the analysis of a wide variety of questions.

CHAPTER V

DERIVED DEMAND FOR FEED AND OTHER MODEL COMPONENTS

Introduction

The production and consumption components constitute the core of the model. Adjustments in production and consumption in response to changes in agricultural policies and prices will affect the use of agricultural inputs, the need for imported agricultural commodities and the potential for increased agricultural exports. For the purposes of this study, the inputs of interest are feedgrains and soybeans. The disappearance of these commodities depends on the number of livestock and the type of feed rations employed. As formulated in this model, net trade is calculated as the difference between domestic disappearance, determined primarily by human consumption and uses as feed, and domestic availability, which depends on production.

The purpose of this chapter is to describe the structure of the model components which estimate feedgrain and soybean meal disappearance, domestic availability, domestic disappearance and net trade. Few of the equations presented in this chapter are econometrically estimated and those that are have been ordered in a recursive system so that they can be estimated by ordinary least squares. Most of the relationships are identities which serve to compute the variables of interest from the estimates derived in other parts of the model.

Many of the symbols used to represent these variables have been presented elsewhere and will not be defined again in this chapter. For ease of reference, a complete list of variable names is presented in Appendix E.

I. Derived Demand for Feed

The derived feed demand component of the model is based on the use of feed conversion ratios defined as the number of kilograms of grain or soybean meal used to produce a kilogram of product. These conversion ratios are multiplied by the total amount of a given commodity produced, as estimated in the production component of the model to determine feed demand.

Some production processes can be represented by the assumption that inputs are used in fixed proportions. Others require the inclusion of mechanisms to allow for substitutability among the various inputs. In these cases, the specific mix of factors used to produce a given output will be varied in light of economic conditions, subject to constraints imposed by the nature of technical relationships. Livestock production can be carried out with a wide variety of specific feed elements serving as alternative sources of protein, energy and other biologically necessary nutrients. A common approach to estimating the derived demand for particular feed stuffs is to use linear programming methods to compute optimum rations given relative input and output prices and coefficients representing the technical constraints.

The derived demand component of this model is much simpler and does not allow the simultaneous calculation of optimum rations to determine feed demand. The use of feed conversion ratios implies that fixed relationships are assumed with no account taken of substitution possibilities. However, it is still possible to carry out simple analyses of ration changes using independent information and assumptions to vary the conversion rates in the model. For example, the feed conversion ratios used in the historical period are estimates of the Spanish ratios in the late 1970s. For the projections, these coefficients have been altered to conform more closely to the rates observed in EC member countries. Nevertheless, it should be emphasized that estimates from this component are only as accurate as the assumed conversion ratios and the model does not contain a formal method for computing price-determined changes in input use.

The number of feed elements considered has been limited to milk, soybean meal and three categories of cereal grains: bread cereals (wheat and rye), barley and oats, and corn and sorghum. Additional sources of protein or energy such as manioc, other oil meals or fish meal could be included in the model by the addition of equations with the relevant conversion ratios. These feeds have not been included in the present model due to limited information on the use of these elements in livestock feed and since the primary focus of this study is on feedgrains and soybean use. Manioc, for example, is not presently used for livestock feeding in Spain.

As noted in Chapter IV, the expansion in meat demand led to increases in meat imports in the 1960s. The Spanish government adopted price policies to encourage meat production which changed the nature of the imports from livestock products to feedgrains and oilseeds. Since the late 1960s, regulated prices for cereal grains have been set to encourage feedgrain production and there is some sentiment in Spain that measures should be taken to encourage greater use of forage resources in order to reduce dependence on imported feedgrains and soybeans.

While barley production has increased enough to satisfy domestic needs, Spain produces only about one-third of the corn used for feed and soybean production is almost non-existent. In 1978, 13,670 metric tons of soybeans (meal equivalent) were produced while more than two million metric tons were imported. Spain has a relatively large soybean crushing capacity. The soybeans are imported for the meal and sale of soybean oil in Spain is restricted by government regulations. The purpose of these restrictions is to prevent soybean oil from competing with olive oil which is in chronic surplus. The result is that Spain imports large amounts of soybeans and is the leading exporter of soybean oil in Europe.

The feedgrain conversion ratios used in the model are USDA estimates for Spain in 1975 (76). These conversion ratios relate the amount of all feedgrains used to produce certain livestock products. Little information is available on the use of specific feedgrains in particular livestock feeds. Since information on the demand for the various feedgrains as affected by the evolution of livestock production is needed, a two-stage process has been set up. First, the total use of all feedgrains in livestock rations is calculated by applying the conversion ratios to production levels. In the second step, three equations are used to estimate the disappearance of specific cereal grains as a function of total feedgrain use, prices and other exogenous variables.

The use of the estimated conversion ratios and livestock production over the historical period did not account for total feedgrain disappearance. This is due to the fact that conversion ratios are only available for beef, pork, milk, eggs, and poultry. Some grain is fed to other livestock, particularly work animals such as horses and oxen as well as rabbits, sheep and goats. To account for these other uses, the difference between actual feedgrain disappearance and the use predicted by the conversion ratios was calculated. This residual was regressed on a time trend and the estimated trend was added to the total feedgrain equation.

The three equations relating the use of bread cereals, barley and oats, and corn and sorghum to total feedgrain disappearance also include real prices received for the products as explanatory variables. These prices are weighted averages of the two cereal grains in each category. As noted elsewhere, prices paid by feed compounders and livestock producers were lower historically for corn than the price received by corn producers. It would have been preferable to use the actual prices paid by users in these equations but no time series data on the prices actually paid exists. Using prices received in these equations weakens the results since the relative cost of the alternative feedgrains to users was different from the relative prices received by producers.

By construction, the total use of feedgrains is identical to the sum of the dependent variables in the three estimated equations. Since one might expect some correlation among the residuals of these three equations, a generalized least squares estimation procedure would seem appropriate. However, the fact that the sum of the three dependent variables is identical to one of the explanatory variables means that the variance-covariance matrix is singular. Eliminating one of the equations removes the possibility of constraining the coefficients of the total feed use variable to sum to one and the unconstrained estimates are the same as the ordinary least squares estimates. The ordinary least squares estimates of the three equations were, thus, retained in the model.

Nevertheless, it is necessary to introduce a mechanism to force the predicted values from the three equations to sum to total usage. This was accomplished in the model by computing the difference between total feedgrain use and the sum of the specific feedgrain disappearances and allocating this difference to the three categories of feedgrains according to their relative weights. Table 5.1 contains the feedgrain and soymeal conversion ratios used in the historical period. The equations comprising the feedgrain component of the derived demand model are presented below (standard errors in parentheses).

1) $$FDEM_t = 4.0*THPROD_t + 3.5*TPPROD_t + 3.7*BVPROD_t + 0.3*DPROD_t + 3.5*TPEGPR_t + (\underset{(232)}{332.99} + \underset{(20.3)}{109.24}*T)$$

R^2 (Time Trend) = .63

2) $$BCFD_t = \underset{(118782)}{694998} - 349.5*YEAR_t + \underset{(.059)}{.051}*FDEM_t - \underset{(289.6)}{1390.8}*DBCPR_t$$

R^2 = .72 D.W. = 1.57 d.f. = 14

3) $$BOFD_t = \underset{(2453)}{-1262.6} + \underset{(.112)}{.521}*FDEM_t - \underset{(619.1)}{331.6}*DBOPR_t + \underset{(428.1)}{460.7}*DSCPR_t$$

R^2 = .92 D.W. = 1.01 d.f. = 15

4) $$SCFD_t = \underset{(1870)}{482.4} + \underset{(.086)}{.499}*FDEM_t + \underset{(471.8)}{274.9}*DBOPR_t - \underset{(326.3)}{390.6}*DSCPR_t$$

R^2 = .97 D.W. = 1.57 d.f. = 15

TABLE 5.1

Feedgrain and Soybean Meal Conversion Ratios for Spain

(kg of feed used per kg of product)

Product	1975 Feed-grain*	1978 Soybean Meal**
Beef and Veal	3.7	0.384
Pigmeat	4.0	1.09
Poultry Meat	3.5	1.01
Cow Milk	0.3	0.015
Eggs	3.5	0.455
Sheep/Goat Meat	---	0.685

* Source: (76)

** Author's estimates

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

Where:

FDEM = total feedgrain used as feed (1000 metric tons)

THPROD = total pigmeat production (1000 metric tons)

TPPROD = total poultry meat production (1000 metric tons)

BVPROD = beef and veal production (1000 metric tons)

DPROD = cow milk production (1000 metric tons)

TPEGPR = total poultry egg production (1000 metric tons)

T = time trend

BCFD = initial estimate of bread cereals fed (1000 metric tons)

YEAR = year

DBCPR = real weighted average wheat and rye prices received (pts/kg.)

BOFD = initial estimate of barley and oats fed (1000 metric tons)

DBOPR = real weighted average prices received for barley and oats (pts/kg.)

DSCPR = real weighted average prices received for corn and sorghum (pts/kg.)

SCFD = initial estimate of corn and sorghum fed (1000 metric tons)

X_t = residual defined as estimated feedgrain use less the sum of specific feedgrain use (1000 metric tons)

BCFDC = final estimate of bread cereals fed (1000 metric tons)

BOFDC = final estimate of barley/oats fed (1000 metric tons)

SCFDC = final estimate of corn/sorghum fed (1000 metric tons)

In calculating total grain use the units from the production side have been converted into thousands of metric tons. Meat production estimates in the production model are in metric tons, milk is in millions of liters and eggs in millions of dozens. In the operational model these conversions have been carried out by adjusting the conversion ratios so that the units conform. The coefficients in the three estimated equations have the expected signs although the standard errors are relatively large. The results of historical simulation based on these equations will be discussed after the rest of the derived demand component is presented.

Soybean meal disappearance was calculated by converting soybean production and imports into meal equivalent. The total availability of soybean meal was taken to represent the demand for meal by livestock feeders. No estimates of soybean meal conversion ratios for Spain were available although oilmeal conversion factors for Western Europe outside the EC have been estimated by USDA (76). In collaboration with another researcher (72), approximate conversion ratios for 1978 were derived from farm budget information and estimates of ration composition. Eighty-two percent of soybean meal disappearance is in the form of compound feeds. Information on the proportion of particular livestock feeds made up of soybean meal and the total production of these feeds in 1978 allowed estimates of total meal use for specific categories of livestock to be made. The livestock categories include broilers, laying hens, hogs, beef cattle, dairy cattle, and sheep and goats. The use of meal in compound feeds for these animals did not account for total meal disappearance. It was assumed that the difference was allocated in the same proportions as for the portion of meal use accounted for on the basis of compound feed composition. In this manner total meal use for feeding the five livestock categories was calculated and divided by total production in each category to estimate 1978 conversion ratios.

Total soybean meal use has expanded greatly since 1963. Applying the estimated 1978 conversion rates to livestock production over the historical period led to estimates of total disappearance greater than total availability for the years prior to 1978. These overestimates of total use were largest in the early years and declined throughout the historical period, converging in 1978. To correct for this factor, the overestimates are entered exogenously over the historical period and assumed to be equal to zero from 1978 on. The estimated conversion ratios are presented in Table 5.1. They are not unreasonable when compared with the USDA estimates for other Western European countries. Estimates of total soybean meal fed are, thus, based on the following equation:

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

Where:

SOYCON = soybean meal fed (1000 metric tons)

SGPROD = sheep/goat meat production (1000 metric tons)

RES = exogenous overestimate set to zero after 1978

and the other variables have been defined earlier.

To complete the derived demand component an equation was estimated to account for milk fed to calves, lambs and kids. The amount of milk fed has declined over the base period representing about 9 percent of total milk disappearance in 1978. The equation estimated includes a time trend to account for the historical decline in milk fed as well as the lagged real price received for calves.

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

$R^2 = .72$ D.W. = 1.26 d.f. = 15

The amount of milk fed is related to the number of young animals. As prices vary the number of young animals is adjusted with a lag and milk consumed for feed moves in the same direction as the adjustment. Since cow milk production constitutes about 92 percent of total milk production the real price for calves is the dominant factor in accounting for milk fed. This estimated equation is used because no information on average amounts of milk fed is available.

The simulation results and U statistics presented in Tables 5.2 and 5.3 show that there are some weaknesses in the derived demand component. The equations based on conversion ratios (total feedgrain and soymeal use) are highly accurate in the later years. The small error in 1975 in the feedgrain equation is to be expected since the conversion ratios are estimates for 1975. Predicted values for total feedgrain use are derived by applying the conversion rates to the estimates of production from the production component. If actual production values had been used in the simulation the errors would have been smaller. The estimates of specific feedgrain use are based on the estimate of total feedgrain use rather than the actual value. The errors in these predictions, thus, result from an accumulation of the errors in the production and total feedgrain use estimates as well as the inaccuracies in the estimated equations themselves.

The results presented for the specific feedgrains are the final estimates which are constrained to add up to the total use. The

TABLE 5.2

Derived Feed Demand in Spain, 1968-1978

Year	Actual	Estimate	% Error
	a. Total Feedgrain Use (thousand metric tons)		
1968	8251	7978.625	- 3.3
1969	8285	8141.175	- 1.74
1970	8305	9294.914	11.9
1971	10184	9740.217	- 4.36
1972	9627	9918.041	3.02
1973	10915	10751.220	- 1.5
1974	12310	11735.307	- 4.67
1975	12042	11966.623	- .626
1976	12352	12394.372	.343
1977	13055	13236.023	1.39
1978	13218	13514.454	2.24
	b. Bread Cereals Fed (thousand metric tons)		
1968	789	747.529	- 5.26
1969	584	574.008	- 1.71
1970	941	626.629	-33.4
1971	1005	749.827	-25.4
1972	730	631.207	-13.5
1973	708	787.493	11.2
1974	672	628.043	- 6.54
1975	196	256.433	30.8
1976	113	304.158	169.00
1977	122	368.887	202.00
1978	125	130.286	4.23

TABLE 5.2 (continued)

Year	Actual	Estimate	% Error
	c. Barley and Oats Fed (thousand metric tons)		
1968	3782	3510.949	- 7.17
1969	3838	3752.844	- 2.22
1970	3302	4320.801	30.9
1971	4959	4390.670	-11.5
1972	4243	4519.475	6.52
1973	4259	4957.219	16.4
1974	5399	5507.305	2.01
1975	5685	5751.811	1.18
1976	6340	5944.334	- 6.24
1977	6601	6210.807	- 5.91
1978	6818	6449.536	- 5.40
	d. Corn and Sorghum Fed (thousand metric tons)		
1968	3680	3720.147	1.09
1969	3863	3814.324	- 1.26
1970	4062	4347.485	7.03
1971	4220	4599.719	9.00
1972	4654	4767.360	2.44
1973	5948	5006.508	-15.8
1974	6239	5599.958	-10.2
1975	6161	5958.378	- 3.29
1976	5899	6145.881	4.19
1977	6332	6656.330	5.12
1978	6275	6934.632	10.5

TABLE 5.2 (continued)

Year	Actual	Estimate	% Error
	e. Soybean Meal Fed (thousand metric tons)		
1968	738.9	781.819	5.81
1969	821.2	796.979	- 2.95
1970	986.1	1022.023	3.64
1971	1050.6	1142.105	8.71
1972	1145.1	1147.353	.197
1973	1294.9	1264.030	- 2.38
1974	1463.9	1465.715	.124
1975	1599.6	1591.585	- .501
1976	2138.2	2099.443	- 1.81
1977	1899.7	1888.073	- .612
1978	2238.2	2280.530	1.89
	f. Milk Fed (thousand metric tons)		
1968	873	971.546	11.3
1969	912	913.190	.130
1970	931	993.708	6.74
1971	830	842.067	1.45
1972	838	770.252	- 8.08
1973	768	862.213	12.3
1974	747	761.780	1.98
1975	702	728.568	3.78
1976	596	621.442	4.27
1977	640	638.978	- .160
1978	565	505.157	-10.6

TABLE 5.3

U Statistics for Derived Demand Equations

Variable	U1	U2	UM	UR	UD	R
Total Grain Fed	.019	.454	.001	.005	.994	.98
Bread Cereals Fed	.134	.731	.010	.256	.734	.91
Corn/Sorghum Fed	.041	.926	.002	.046	.952	.91
Barley/Oats Fed	.046	.640	.000	.065	.434	.92
Soy Meal Fed	.013	.161	.059	.044	.898	.99
Milk Fed	.035	.877	.120	.356	.524	.95

UM, UR and UD may not sum to one due to rounding.

initial estimates for corn and sorghum use are relatively accurate so that the allocation of the difference to the three equations actually increases the percentage errors for corn and sorghum. On the other hand, the correction process reduces the percentage errors for barley and oats. The errors in the bread cereal estimates are frequently quite large. Since the amount of wheat and rye used for feed is a small proportion of the total disappearance of these cereals (about 3 percent in 1978, less than the amount used for seed), these errors do not seriously affect the estimates of total disappearance. The same comments apply to the estimates of milk fed. This variable is included primarily to make the balance sheet totals consistent.

Several alternative specifications of the bread cereal equation were estimated. The equation presented earlier has the best statistical properties but the inclusion of a time trend leads to some problems in the projections. The steep negative slope on the trend dominates the other variables so that the projections often become negative. The amount of bread cereals fed has been left at a constant level for the projections although the quantity of wheat used for feed may increase following accession to the EC.

Further development of the Spanish feedgrain-livestock model would require the design of an improved derived demand component. As presently specified, feedgrain demand is highly sensitive to assumptions concerning conversion ratios. The lack of information on prices actually paid by producers for different feedgrains may bias the estimated coefficients and an alternative specification might improve the results. Nevertheless, the U statistics indicate that the component is fairly reliable and it appears to be adequate for the purposes of this study.

II. Domestic Availability

The quantities of the various commodities available for consumption depend mainly on domestic production and trade. Net trade is estimated as the difference between the amounts available from Spanish resources and total disappearance into domestic uses. In order to determine domestic availability, the change in stocks must be added to Spanish production. The Spanish agencies, SENPA and FORPPA, have used government stocks as tools to regulate prices. However, there are no statistical series on the size of stocks of various commodities. Estimates of the change in stocks were derived on the basis of production, consumption and trade data (see Appendix B). In the case of livestock products the stock changes implied by the production, consumption and trade statistics have been very small. For the cereal grains, on the other hand, SENPA has held substantial stocks and it is necessary to account for these additions to and subtractions from domestic production.

Stock equations were estimated for bread cereals, barley and oats, and corn and sorghum. The estimated change in stocks of these commodities are added to production to obtain domestic availability. For the other commodities, stock changes are included in the net trade variables since they have been small, frequently due to rounding errors rather than conscious policy. Domestic availability of these commodities is taken to be identical to production. Several equations have been included to aggregate the production variables into categories corresponding to the variables for disappearance and to express all variables in terms of metric tons.

The dependent variable in the three estimated stock equations is the amount of the commodity released from or put into storage. The explanatory variables include the change in production, domestic disappearance and the institutional prices for the commodities. The institutional prices are weighted averages for the cereal grains in each category and differ from the prices received over the historical period. For the projections, the government prices are assumed to be the same as the prices received. In general, the estimated stock equations account for only a small proportion of the variation in the dependent variables. The three equations are presented below with the standard errors in parentheses.

1) $$BCSTK_t = \underset{(1140)}{3740.1} + \underset{(.112)}{.667}*(BCPROD_t - BCPROD_{t-1}) - \underset{(.302)}{.904}*BCCON_t + \underset{(99.8)}{125.5}*DBCPR_t$$

$R^2 = .73$ D.W. = 2.17 d.f. = 14

2) $$BOSTK_t = \underset{(1954)}{3355} + \underset{(.124)}{.471}*(BOPROD_t - BOPROD_{t-1}) - \underset{(.156)}{.310}*BOCON_t - \underset{(380.1)}{631.4}*DGBOP$$

$R^2 = .55$ D.W. = 2.59 d.f. = 12

3) $$SCSTK_t = \underset{(4446)}{-5092.3} + \underset{(88.9)}{193.5}*T - \underset{(.693)}{.156}*(SCPROD_t - SCPROD_{t-1}) - \underset{(.360)}{.233}*SCCON_t + \underset{(868)}{1067.7}*DGSCP$$

$R^2 = .37$ D.W. = 2.16 d.f. = 11

Where:

BCSTK = change in stocks of wheat and rye (1000 metric tons)

BCPROD = wheat and rye production (1000 metric tons)

BCCON = disappearance of wheat and rye (1000 metric tons)

DBCPR = real weighted average government price for wheat and rye (pts/kg.)

BOSTK = change in stocks of barley and oats (1000 metric tons)

BOPROD = barley/oat production (1000 metric tons)

BOCON = barley/oat disappearance (1000 metric tons)

DGBOP = real weighted average government price for barley and oats (pts/kg.)

SCSTK = change in corn and sorghum stocks (1000 metric tons)

T = time trend

SCPROD = corn/sorghum production (1000 metric tons)

SCCON = corn/sorghum disappearance (1000 metric tons)

DGSCP = real weighted average government price for corn and sorghum (pts/kg.)

The equation for corn and sorghum stocks is particularly weak. It is reasonable to expect that the domestic variables have less influence on the government stock policy than international prices. Spanish production is relatively small and government prices have only recently caught up with the market prices. It is likely that the government builds corn stocks when international prices are low and depletes them when these prices are high. Unfortunately, it proved impossible to locate an international corn price series for Spain so this hypothesis was not tested. The sign on the coefficient for production changes differs from the signs in the other equations and is somewhat unexpected. However, since Spain is far from self-sufficient in corn and sorghum production changes are probably absorbed without affecting stocks. The size of the standard error for this coefficient suggests that this may indeed be the case.

Since production of wheat, rye, barley and oats satisfies a much higher proportion of domestic needs, production changes appear to be related to decisions on building or releasing stocks. Production increases result in additions to the stocks of these commodities. Domestic disappearance is negatively related to stock changes in all three equations as would be expected. The price coefficient in the barley/oat stock equation is surprising since one would expect that higher government prices would lead to greater intervention purchases.

Compared with total production the additions or subtractions due to stock variations have been small. These equations have been included primarily for accounting purposes in the projections. In the base simulation, actual values of stock changes have been used. In the projections, judgment is required in using these equations. For example, in some of the projection scenarios, the predicted stocks of wheat and rye increased substantially at the same time that production was falling and imports were increasing. When problems of this nature are encountered the equation can be replaced by assumptions about stock changes introduced exogenously.

III. Domestic Disappearance

Domestic disappearance of livestock products is made up almost exclusively of human consumption. The difference between domestic production and total human consumption for these products is equal to net trade, with the small changes in stocks included in this residual.

The exception to this is milk disappearance which includes the amount fed to young animals from the derived demand component in addition to human consumption.

Cereal grains are used in a variety of ways including human consumption, feed and seed. Accounting equations are included in the model to calculate total disappearance on the basis of the various uses. Human consumption of bread cereals is estimated in the demand component. Since some of the grain is lost during processing an estimated extraction rate is used to convert actual human consumption into the raw product (see Appendix B). The small amounts of the other cereal grains used for human consumption or industrial uses are estimated with constants introduced exogenously. The derivation of these constants as well as the approach to estimating the amounts used for seed are described in Appendix B. Disappearance as feed is estimated in the derived demand component.

No additional equations have been estimated for this component. The domestic availability and domestic disappearance blocks serve primarily to aggregate the commodities into corresponding categories and account for secondary sources and uses not included in the production, consumption and derived demand components of the model.

IV. Net Trade

Net trade is computed as the difference between domestic availability and domestic disappearance. The categories for which net trade is calculated include bread cereals, barley and oats, corn and sorghum, beef and veal, pigmeat, poultry meat, sheep and goat meat, milk (cow, sheep and goat), and eggs. Imports of soybeans is determined by the consumption of soybean meal in the derived demand component. There appears to be little scope for expansion of soybean production in Spain so this source is not explicitly included in the model. Historical production levels can be subtracted from the total use over the base period. In the projections, Spanish production is assumed to have reached its peak in the late 1970s and this level can be used to adjust the estimated imports.

The relationship between domestic agricultural policies and agricultural trade policies has been very close. The philosophical preference for self-sufficiency in food production has combined with domestic policies designed to achieve various social and internal economic objectives to determine the nature of agricultural trade policies. Brief comments on the reaction of the Spanish government to increasing meat and feedgrain imports have been made in Chapter IV. The policies to encourage production of meat and feedgrains and to promote use of domestic resources have been complemented by barriers to trade similar to those employed in the EC. Variable levies are applied to cereal grain imports while producers of livestock products are protected by quantitative import restrictions and, in some cases, export subsidies (9). Imports of livestock products are regulated in conjunction with stock policies to maintain producer prices as well as to protect consumers from higher food price inflation.

Spain has generally been a net importer of most of the products considered in this study. With the exception of corn and soybeans, the size of these imports has been fairly small. Nevertheless, policy makers concluded that meat imports were too high in the 1960s and instituted policies to increase domestic production. In further efforts to reduce dependence on foreign sources of food, price policies have been designed to encourage feedgrain production to support the growing livestock sectors. The dominant concern in trade policies related to feedgrains and livestock has been the desire to reduce dependence on external suppliers. This differs from the situation in other sectors where the main issue has been surplus disposal and protection for large numbers of small producers who represent a potential source of social unrest.

The approach to analyzing Spanish trade in this model rests on the assumption that production and consumption adjust to relative domestic prices and any differences are made up by imports or exports. Thus, this component does not constitute a full model of trade. The assumption is that Spain faces infinitely elastic supplies of foreign exports and infinitely elastic foreign demand for Spanish exports. The volume of trade predicted by the model is a residual and is not dependent on relative international prices. The evolution of this residual sheds light on changes in the need for external sources of supply or external outlets for surplus production as the domestic grain-livestock economy adjusts to changing internal conditions. In reality, there are constraints on Spain's ability to import and export as well as a web of relationships between the domestic and international economies. International conditions will force adjustments in Spanish production and consumption since the Spanish economy is not perfectly insulated from the rest of the world.

In addition, there is no mechanism in the model to determine shifts in trading partners. Entry into the EC will clearly influence the direction of trade as barriers toward other European countries are removed and common external trade barriers are erected. Several informants in Spain felt that there would be some trade diversion in corn since Spanish producers may purchase more corn in Southern France and less from North America, the lower cost producer. Trade diversion and trade creation cannot be directly measured by this model although likely impacts on particular trading blocks can be subjectively evaluated on the basis of additional information.

The preceding comments are included to precisely indicate the scope of the model. As with any of the other components in the model, Spanish trade in livestock and cereal grains is a sufficiently large and complex topic to merit treatment by itself. The simple trade component described here allows the direct evaluation of the effects of adjustments in response to the imposition of a new regime of relative prices following entry.

The calculation of net trade also constitutes a kind of overall evaluation of the entire model. Each estimate of net trade is the result of the solution of several estimated equations and equations reflecting definitional or constant relationships. For example, estimated net trade in bread cereals is derived from eight production equations, one stock equation, a complex set of human demand equations, three derived demand equations and an accounting equation for domestic disappearance. In many cases the net trade estimates are quite inaccurate. This is due in part to the number and complexity of the relationships required to compute the trade estimates. In addition, trade in several of the commodities has been quite small so that relatively small errors on the production and consumption sides of the model lead to very large errors in the trade estimate relative to the actual value. For example, domestic availability of barley and oats in 1978 was 7.751 million metric tons and total disappearance was 7.749 million metric tons leaving net trade (exports minus imports) of 2000 metric tons. Errors of one percent in the estimates of availability and disappearance would normally be considered quite small. However, if estimated availability is one percent higher than the actual value while estimated disappearance is one percent lower, estimated net trade would be 157,000 metric tons, a huge error when compared with the actual value of 2000.

This problem is inherent in the nature of the model. However, the estimates for commodities which are extensively traded are less sensitive to the errors accumulated in the derivation of availability and disappearance. This fact is important since corn and soybeans, two commodities of central interest to this study, are imported in large quantities. Estimates of net trade in these goods are fairly precise in relation to the amounts consumed in Spain.

Actual and predicted net trade values are presented in Table 5.4. The percentage errors of the estimates are quite large for all categories except corn and sorghum, soybean meal, and beef and veal. Although the estimates of net trade in livestock products are imprecise, most of them tend to follow the evolution of trade fairly well. It should be recalled that these measures of net trade also include small variations in stocks and are determined as the difference between production and human consumption, except for milk which includes estimates of milk fed. Due to the difficulties in estimating both production and consumption of poultry meat and eggs, net trade estimates for these products are not very good. However, trade estimates for beef and veal are not far from the actual values.

TABLE 5.4

Net Trade (Exports-Imports) in Spain, 1968-1978

(in thousand metric tons, figures rounded)

	Corn and Sorghum		Soybean Meal*	
Year	Actual	Estimate	Actual	Estimate
1968	-2335	-2366	- 739	- 782
1969	-2367	-2302	- 821	- 797
1970	-2169	-2675	- 984	-1020
1971	-2676	-3211	-1049	-1140
1972	-2510	-2707	-1143	-1145
1973	-2911	-1904	-1285	-1254
1974	-4493	-3945	-1433	-1435
1975	-4710	-4360	-1589	-1581
1976	-3955	-4277	-2134	-2095
1977	-4688	-4933	-1893	-1881
1978	-4874	-5555	-2225	-2268
	Barley and Oats		Wheat and Rye	
1968	- 10	25	774	700
1969	253	320	901	857
1970	82	- 871	413	808
1971	- 221	417	- 164	78
1972	- 8	- 167	213	4
1973	71	- 705	200	296
1974	- 121	- 288	54	136
1975	28	- 88	- 3	484
1976	254	772	- 37	- 426
1977	4	436	- 150	- 938
1978	2	256	- 64	292

*Soymeal disappearance less Spanish production in meal equivalent.

TABLE 5.4 (continued)

Year	Beef and Veal**		Milk**	
	Actual	Estimate	Actual	Estimate
1968	-114	-103	0	17
1969	-117	-143	- 5	- 39
1970	- 99	- 85	- 35	-277
1971	- 77	-103	-177	-311
1972	- 86	- 97	- 62	- 68
1973	- 46	- 37	- 47	-321
1974	- 7	- 8	-363	-296
1975	- 51	- 16	-177	-148
1976	- 76	- 71	- 53	228
1977	- 40	- 90	- 9	-241
1978	- 79	- 88	- 6	- 4
	Pigmeat**		Poultry Meat**	
1968	- 2	9	- 4	11
1969	0	- 78	- 4	- 30
1970	28	22	- 2	1
1971	- 32	6	2	- 12
1972	- 79	- 57	- 10	- 59
1973	- 29	- 49	0	- 27
1974	15	49	8	- 79
1975	- 65	-152	- 4	5
1976	- 53	- 47	- 6	-129
1977	- 3	19	- 3	- 35
1978	- 37	- 32	- 11	-120

TABLE 5.4 (continued)

	Sheep/Goat Meat**		Eggs**	
Year	Actual	Estimate	Actual	Estimate
1968	-1	- 5	0	60
1969	0	- 4	6	- 4
1970	2	2	4	- 5
1971	0	-12	- 2	- 9
1972	-1	2	6	-116
1973	-2	9	5	- 21
1974	-3	- 3	6	61
1975	-1	- 5	12	- 30
1976	-4	- 6	14	15
1977	-1	- 1	34	48
1978	1	- 2	17	48

**Includes small variations in stocks.

Concluding Remarks

The components described in this chapter complete the model of the Spanish feedgrain-livestock economy. The derived demand for feedgrains, soybean meal and milk fed to animals is determined by several estimated equations and the use of feed conversion ratios which link feed use directly to livestock production. The other components are made up primarily of accounting equations which serve to aggregate the commodities into corresponding categories which can be compared to estimate net trade. The validity of the predictions from these components depends largely on the accuracy of estimates developed in the production and consumption parts of the model.

The estimates from the historical simulation of the base period presented in Chapters III, IV and V reveal some areas of weakness in the Spanish feedgrain-livestock model. On the whole the model appears to perform relatively well despite the difficulty of estimating some of the relationships on the basis of the data available. The true test of the model will be carried out in subsequent chapters where it will be used to analyze the effects of Spanish membership in the EC. Evaluation of the projections requires judgments concerning the likely paths of Spanish agricultural development in the future. In some instances, the weaknesses of the estimated relationships may lead to improbable predictions. In these cases the estimated equations can be constrained to remain within certain bounds or replaced entirely by plausible assessments of the likely evolution of the relationship.

CHAPTER VI

PROJECTION OF PRODUCTION, CONSUMPTION AND TRADE

Introduction

The simulation model described in the preceding chapters is designed to be used as an analytical tool in assessing the adjustment of the Spanish feedgrain-livestock economy to changing conditions. In the present chapter, the model will be used to evaluate the impact of Spanish entry into the EC under alternative assumptions concerning the evolution of the exogenous variables. Three scenarios reflecting different sets of assumptions and projections of the exogenous variables are used to examine the likely paths of adjustment. The first scenario is designed to show the expected evolution of the endogenous variables if Spain does not join the EC and historical relationships continue into the future. It serves primarily as a base for comparison with the projections derived from the other two scenarios which are constructed to reflect possible conditions if Spain is a member of the EC.

It is expected that Spain and the EC will sign a treaty of accession in 1983 or 1984 with the latter date considered more likely. A transition period of seven to ten years is envisioned so that the full application of the CAP in Spain may not be realized until the mid 1990s. Since it is impossible to foresee all the events which may occur over the next 15 years, attempting to create an exact simulation of entry and the transition period would be overly ambitious. As a compromise it was decided to carry the projections to 1990 with the EC price regime imposed gradually in Spain beginning in 1980. In fact, Spanish policy is presently being adapted to conform more closely to the CAP so that the assumption that Spanish prices begin to move toward the EC prices in 1980 is in line with the actual situation. Although the model is designed to provide estimates of the year-to-year evolution of production, consumption and trade the results presented in this chapter should be seen as an exercise in comparative statics. It is not expected that the estimates for 1990 will turn out to be exact since too many unanticipated events may occur over the next ten years. Comparing the baseline projections with those from the two EC scenarios provides insights into potential changes and their relative importance rather than exact magnitudes.

The simulation model includes 155 endogenous and 90 exogenous variables. Many of the endogenous variables are created in the model for accounting purposes. The exogenous variables fall into one of three categories: those projected according to different scenarios, those for which the same trend projections are used in all scenarios, and those which are left at the 1978 level in all projections. The most important scenario variables are prices for inputs and outputs. Variables which have the same values in all the scenarios include salary and cost indexes, certain biological rates, some of the slaughter weights and other variables not likely to be affected by entry. The exogenous variables and their treatment in the scenarios are outlined in Table 6.1.

TABLE 6.1

Exogenous Variable Projections

Variable	Symbol
I. Variables Projected According to Scenario	
A. Real Prices Received by Farmers	
1. dairy gross receipts	DRET
2. cull beef gross receipts	BRET
3. calf price	DPRV
4. cow/bull price	DPRCB
5. steer/heifer price	DPRN
6. calf margin	DG
7. cow milk price	DPRD
8. wheat price	DWPR
9. barley price	DBPR
10. corn price	DCPR
11. rye price	DRPR
12. sorghum price	DSPR
13. sugar beet price	DSBPR
14. oat price	DOPR
15. hog price	DHPR
16. lamb/kid price	DYOPR
17. sheep/goat price	DADPR
18. poultry price	DPOPR
19. egg price	DEGPR
B. Food Prices	
1. beef and veal	NBRP
2. all milk	NMKRP
3. pigmeat	NPRRP
4. poultry meat	NCRP
5. sheep/goat meat	NSGRP
6. eggs	EGRP
7. bread cereals	BCRP

TABLE 6.1 (continued)

Variable	Symbol
C. Cost Variables	
1. calf feed price	FD
2. cereal price index	DPIC
3. hog/corn ratio	HCRAT
4. broiler feed price	DPCAM
5. layer feed price	DPCAL
6. hog feed price	DCONPR
7. diesel fuel price	DGOPR
II. Trend Variables Projected the Same in all Scenarios	
1. consumer expenditure	PCE
2. other food price	OFP
3. non-food price	NFP
4. irrigated acreage	TIA
5. irrigated forage	FORIR
6. population	POP
7. cost index	DCOST
8. agric. wage index	DSI
9. shepherd wage index	DSSAL
10. land in fallow	FAL
11. sheep/goat milk price	DMKPR
12. total cropland	TCLB
III. Constants	
1. cattle replacement rate	BREP
2. cattle cull rate	CULL
3. calving rate	CR
4. rice acreage	RICE
5. irrig. rye/oat/sorghum	ROSIA
6. other irrig. cereals	OICA

TABLE 6.1 (continued)

Variable	Symbol
III. Constants (continued)	
7. other dry cereals	ODCA
8. hog replacement rate	PREP
9. broiler slaughter weight	BRSW
10. eggs per hen	EGY
11. bread extraction rate	BCEXT
12. non-feed corn use	CNSDO
13. eggs per kilogram	EGCON
14. cattle premium	CP
15. non-chicken eggs	OTEG
16. pigs per sow	PPS

In addition to the variables in Table 6.1, eight variables are added in the simulations for membership in the EC. These variables include the projected inflation rate, exchange rate (pesetas per ECU), the EC guide prices for beef and veal, cereal grains, pigmeat, and milk, and a price for soybean meal. The cattle model contains two variables at time t + 2, the size of the breeding herd and the change in the breeding herd. Projecting the relevant equations to 1992 allowed these exogenous variables to be determined.

Projected food prices are linked to farm prices in the in-EC scenarios by adding a constant margin to average farm level prices for the appropriate categories. These prices are used to determine the deflated log change price variables used in the demand model. Other food and non-food prices are projected on the basis of trends. Farm prices used in the sheep and goat component are weighted averages of the eight relevant prices presented in the statistical yearbook (58). The exogenous variables have been precisely defined in the descriptive chapters.

Many policy changes that will occur as Spain enters the EC are not explicitly recognized in the model. The major impact of adopting the CAP is assumed to derive from the change in price policies as reflected by the evolution of the price and cost variables. Some of the non-price effects of entry could be introduced by changing the assumptions concerning such variables as per capita personal expenditure, the technical relationships embodied in the biological rates, population, agricultural wages and land use. In the present study, these variables are treated the same in all the projections in order to isolate the impact of the price changes. The feed conversion ratios used in the derived demand component are not exogenous but must be varied between the scenarios. The conversion ratios used in the baseline projection are the same as in the historical model. They are changed in the EC scenarios to reflect assumptions about the effect of entry on the composition of feed rations. Details of these procedures, as well as the way in which feed prices for the changed rations are computed, will be presented in the discussions of each scenario.

I. Baseline Scenario

The first set of projections is based on the continuation of historical trends reflecting the expected evolution of the endogenous variables if Spain were to remain outside the EC and maintain the policies of the late 1970s. This scenario is included for purposes of comparison only. The outcomes forecast in the baseline scenario will not occur even if Spain does not enter the EC since these projections are based on historic policies and trends. Spanish agricultural policy has already begun to change and would follow a different evolution from that implied by the baseline scenario even if Spain were not part of the EC. The usefulness of this scenario relates to the comparative static nature of the study. Comparing this set of projections with the forecasts from the EC scenarios will provide insights into the direction and magnitude of the most important changes resulting from entry.

In order to make the baseline forecasts, the exogenous variables were projected on the basis of historical trends. Real prices received were projected rather than deflating nominal price trends.

This led to problems with some of the prices since they had been declining over the historical period and the slope was steep enough to lead to negative prices after a few years. In these cases an average rate of decline was used rather than the linear trend.

Some of the other exogenous variables were adjusted when the initial results proved unreasonable. This was necessary, particularly, in the demand projections. It will be recalled that nominal retail prices are deflated in the demand model by the non-food price index. Projecting this index along the line of recent inflation rates led to such low real prices for food that consumption rose to physically impossible levels. The projected non-food price index was thus adjusted so that it rises more slowly than projected inflation rates. While this procedure may appear somewhat suspect, it is justifiable since it is not likely that real food prices will actually fall as much as was implied by the initial projections.

Adjustment of the non-food price index did not solve all the problems inherent in the demand model. As noted in Chapter III, operationalization of the model is effectuated by multiplying last year's consumption by a factor generally slightly greater or less than one. Errors are therefore compounded in the projections and the longer the projection period the greater the inaccuracies. The equations for poultry meat, egg and bread cereal consumption performed poorly in many of the projections. To overcome this problem, per capita consumption of these food items was constrained in all of the scenarios so that the quantities consumed would be similar to those observed in other European countries.

Several other equations led to inconsistencies in the projections. For example, the stock equations for bread cereals and corn and sorghum predicted large stock build-ups as production fell with the result that domestic availability of these cereals became negative. The change in wheat stocks was left at the 1978 value in the projections while the corn and sorghum stock variable was set at zero. As a result of the negative trend in the equation for bread cereals used as feed, this variable also became negative and was left at the 1978 level in the projections. The same was done for projections of milk fed. Slaughter weights for beef cattle and calves appeared too high when projected by the trend equations so these variables were also set at constant levels comparable to the weights observed in the EC. The equation for live hog slaughter weights includes a trend which led to predictions of excessive decline in average slaughter weights. Live slaughter weight was constrained so that it would not fall below 85 kilograms. For consistency these variables were treated in the same manner in all of the scenarios.

Crop yields, milk yields and sheep and goat slaughter weights are determined endogenously by the trend equations in the model. Trend projections of these variables appeared reasonable when compared with yields and slaughter weights in the rest of Europe. Alternative assumptions concerning technological progress in Spain could be introduced by using different values for these variables. Projections of the exogenous price variables according to the three scenarios are presented in Appendix C. Appendix C also includes the projections for variables treated the same in all scenarios as well as the constants used in the model.

The essential results of the baseline projections are summarized in Tables 6.2a to 6.2c which are presented in the form of balance sheets. Production of livestock products increases in all cases. Production of barley and oats continues to increase while production of other cereal grains declines or remains the same. These developments are generally consistent with recent historical trends. Per capita consumption of livestock products rises greatly except in the case of milk. Poultry meat consumption is constrained so that it does not increase beyond 25 kilograms per capita. Without the constraint per capita consumption is projected to reach 34.6 kilograms per year in 1990. A similar problem arose with the egg demand equation which suggested per capita consumption of 31.9 kilograms in 1990. Considering the average consumption levels in Europe, egg consumption was constrained at 18 kilograms per year. In the case of bread cereals, per capita consumption was projected to fall to unreasonably low levels. A constraint was set at 65 kilograms per year.

The introduction of these constraints on consumption results in the projection that Spain will need to import small amounts of bread cereals by the late 1980's. Poultry meat surpluses are projected to develop in the middle of the decade while small egg deficits persist until 1989 at which point small surpluses appear. The rapidly rising levels of consumption of beef and pork lead to the prediction that these commodities will be in deficit throughout the projection period. Expanded milk production results in substantial surpluses since consumption levels remain about the same.

TABLE 6.2

Balance Sheet Projections to 1990: Baseline Scenario

(thousand metric tons)

Year	Production		Domestic Availability	Per Capita Consumption	Total Human Consumption	Feed	Domestic Disappearance	Surplus/ Deficit
BEEF	Veal	Beef	a. Livestock Products Balance Sheets					
1980	90	334	424	13.5	504	--	504	- 80
1982	87	362	449	14.7	560	--	560	-111
1984	85	376	462	15.8	616	--	616	-154
1986	84	391	475	16.9	670	--	670	-195
1988	83	406	489	18.0	725	--	725	-236
1990	82	420	502	18.9	778	--	778	-276

TABLE 6.2 (continued)

Year	Production		Domestic Availability	Per Capita Consumption	Total Human Consumption	Feed	Domestic Disappearance	Surplus/ Deficit
	a. Livestock Products Balance Sheets (continued)							
MILK	Cow*	Sheep/ Goat*						
1980	5849	502	6541	154	5767	565	6332	210
1982	6170	493	6863	152	5807	565	6372	491
1984	6519	484	7213	151	5857	565	6422	791
1986	6884	474	7579	149	5914	565	6479	1100
1988	7261	464	7957	148	5976	565	6541	1416
1990	7648	455	8345	147	6047	565	6612	1733

*millions of liters

TABLE 6.2 (continued)

Year	Production		Domestic Availability	Per Capita Consumption	Total Human Consumption	Feed	Domestic Disappearance	Surplus/ Deficit
			a. Livestock Products Balance Sheets (continued)					
HOGS	Pigmeat	Suckling						
1980	818	2.3	820	24.0	898	--	898	- 78
1982	856	2.5	859	25.0	955	--	955	- 96
1984	890	2.7	893	26.1	1013	--	1013	-121
1986	944	2.8	847	27.1	1073	--	1073	-126
1988	998	3.0	1001	28.1	1134	--	1134	-133
1990	1052	3.2	1055	29.1	1195	--	1195	-140

TABLE 6.2 (continued)

Year	Production		Domestic Availability	Per Capita Consumption	Total Human Consumption	Domestic Disappearance	Surplus/ Deficit
SHEEP/GOAT	Young	Mature	a. Livestock Products Balance Sheets (continued)				
1980	130	23	153	3.9	144	144	8.5
1982	132	22	154	3.9	148	148	5.4
1984	136	20	156	3.9	153	153	3.6
1986	141	18	159	4.0	157	157	1.6
1988	145	16	161	4.0	162	162	-1.0
1990	150	14	164	4.1	167	167	-3.2

TABLE 6.2 (continued)

Year	Production	Domestic Availability	Per Capita Consumption	Total Human Consumption	Domestic Disappearance	Surplus/ Deficit
POULTRY MEAT		a. Livestock Products Balance Sheets (continued)				
1980	780	780	22.5	840	840	- 60
1982	863	863	24.9	951	951	- 89
1984	940	940	25.0	972	972	- 32
1986	1016	1016	25.0	990	990	25
1988	1091	1091	25.0	1009	1009	82
1990	1166	1166	25.0	1028	1028	139

TABLE 6.2 (continued)

Year	Production	Domestic Availability	Per Capita Consumption	Total Human Consumption	Domestic Disappearance	Surplus/ Deficit
EGGS		a. Livestock Products Balance Sheets (continued)				
1980	843**	590	17.4	652	652	-62
1982	842	589	18.0	686	686	-97
1984	902	631	18.0	700	700	-69
1986	961	673	18.0	713	713	-40
1988	1021	715	18.0	726	726	-12
1990	1080	756	18.0	740	740	16

**millions of dozens

TABLE 6.2 (continued)

Year	Production		Domestic Availability	Per Capita Consumption	Total Human Consumption	Feed	Domestic Disappearance	Surplus/ Deficit
BREAD CEREALS	Wheat	Rye	b.	Cereal Grains Balance Sheets				
1980	4820	172	4164	65.6	2453	128	3828	336
1982	4851	145	4169	65.0	2479	127	3846	323
1984	4790	117	4080	65.0	2527	127	3889	191
1986	4684	89	3946	65.0	2575	127	3929	16
1988	4555	60	3788	65.0	2623	127	3970	-181
1990	4433	30	3636	65.0	2672	127	4012	-376

TABLE 6.2 (continued)

Year	Production		Domestic Availability	Per Capita Consumption	Total Human Consumption	Feed	Domestic Disappearance	Surplus/ Deficit
			b. Cereal Grains Balance Sheets (continued)					
BARLEY/OATS	Barley	Oats						
1980	7874	541	8711	--	--	6827	7770	941
1982	8632	575	9438	--	--	7210	8221	1217
1984	9431	610	10241	--	--	7629	8710	1532
1986	10242	642	11071	--	--	8084	9234	1837
1988	11048	667	11896	--	--	8536	9753	2144
1990	11833	686	12690	--	--	8987	10266	2424

TABLE 6.2 (continued)

Year	Production		Domestic Availability	Per Capita Consumption	Total Human Consumption	Feed	Domestic Disappearance	Surplus/ Deficit
CORN/SORGHUM	Corn	Sorghum	b. Cereal Grains Balance Sheets (continued)					
1980	1628	258	1886	--	--	7078	7503	-5617
1982	2021	243	2264	--	--	7547	7972	-5708
1984	1836	224	2060	--	--	8054	8479	-6419
1986	1693	211	1903	--	--	8607	9032	-7129
1988	1628	212	1840	--	--	9163	9588	-7748
1990	1644	228	1872	--	--	9722	10147	-8275

The balance sheets constitute an efficient way to summarize the projections. In some cases the columns do not add up since conversion rates, stock changes and disappearance as seed or other uses have been included in the computations. In addition, many of the figures have been rounded. The way in which these balance sheets are constructed is the same as for the historical balance sheets described in Appendix B. Some variables of interest do not appear in the balance sheets. Acreage and livestock number projections, as well as all the other endogenous variables projected, are presented in Appendix F.

Total cereal grain acreage is projected to increase slightly in the baseline scenario although irrigated acreage declines over the projection period. Total production of cereal grains is projected to be somewhat higher as a result of the increased barley production. Livestock numbers are projected to increase with the exception of sheep and goats. The increase in the number of hogs and chickens leads to greater use of cereal grains as feed although bread cereals fed remain at the same level. Despite the greater consumption of barley, the baseline projections indicate that Spain would become a large barley exporter as production outpaces the use as feed. The amount of corn and sorghum fed increases suggesting greater dependence on imported feed.

Since these projections are based on historical trends with no allowance made for policy changes in response to the evolving situation it is to be expected that some inconsistencies would appear. For example, the policy to encourage cereal production at the expense of wheat is reflected in the evolution of wheat and barley production in this scenario. In response to the large imports of corn and exports of barley it is likely that the Spanish government would adjust price policies to discourage the use of corn as feed and encourage barley use. Since policy changes are exogenous to this model, different assumptions could be introduced to simulate policy responses to the pressures highlighted by predictions of developments such as the use of barley and corn as feed. For the purposes of this study the policy changes are included in the two EC scenarios. The baseline projections simply carry historical trends into the future.

II. Projections for Spain as a Member of the EC

Two scenarios were used to analyze the impact of entry into the EC on the Spanish feedgrain-livestock economy. Entry implies the gradual harmonization of Spanish agricultural policies with the CAP, and particularly the movement to the European regime of relative prices. In order to predict the likely evolution of the relevant Spanish sectors it is necessary to project prices in the EC and develop methods to translate these prices into pesetas. In a study by Josling, inflation rates, exchange rates and green rates were projected to 1990 for the EC, Greece, Spain and Portugal (47). EC institutional prices for beef, pigmeat, cereal grains, milk, sugar and other products were projected in the study according to three Community pricing rules. The information in this study provided the basis for projecting Spanish feedgrain and livestock prices following accessing to the EC.

The details of Josling's approach and methods will not be repeated here. Essentially, Josling develops a method for predicting common price decisions and exchange rates on the basis of exogenous assumptions about inflation rates and the use of the purchasing power parity concept which links inflation to exchange rates. Given projected inflation rates, exchange rates can be estimated on the assumption that they move to offset differences in inflation between countries. Using the exchange rate projections the value of the European Currency Unit (ECU) and its relation to national currencies can be computed on the basis of historical currency weightings in the ECU and assumptions about the effect of enlargement on these weightings. Common institutional prices are established in ECUs but the ECU-national currency exchange rates are not sufficient to translate these prices into local currencies due to the existence of Monetary Compensatory Amounts (MCA) and green rates. Josling estimates the green rates and MCAs for each country and this information is used to express the common institutional prices in local currencies.

Three price rules are developed to project the pricing decisions of the community. The first assumes that prices are set so that nominal prices are maintained in all countries but there is no compensation for the previous year's inflation. The second rule sets prices at levels that would provide total compensation for inflation in all countries. The third price decision rule sets prices so that one country is fully compensated for inflation and nominal prices are maintained in all countries (47). These rules lead to three sets of institutional price projections.

Price projections for Spain are based on the EC projections derived by applying the first and third pricing rules, referred to by Josling as the maxmin and minmax rules respectively. In the first EC scenario the minmax prices are used to determine the relevant Spanish prices. Josling's method does not allow for shifts in relative prices within the Community, since projections based on one decision rule increase by equal increments for all commodities. In order to introduce relative price shifts and take EC budget pressures into account the second EC scenario retains the minmax prices for pigmeat with the lower maxmin price projections used for milk, cereal grains and beef. Table 6.3 includes the projected variables from Josling's study used to develop the two scenarios.

The projected common agricultural prices in Josling's study do not correspond exactly to the large number of price variables used in the Spanish model. Using the exchange rates and green rates allows one to express the institutional prices in pesetas. These prices are then deflated using the projected Spanish inflation rate to extend the CPI to 1990. The specific real prices in the production model must be derived from the real peseta institutional prices on the basis of historical relations between prices received for particular commodities and the institutional prices. Since these derivations involve a large number of computations, a price generating component was added to the model so that the necessary price variables would be automatically calculated on the basis of the data in Table 6.3. The resulting price series are included in Appendix C.

The specific formulas used in the price generating component were developed in discussions with USDA representatives. The grain cereal price projected by Josling is assumed to be the target price for bread wheat. Theoretically, a common intervention price for all cereals will be instituted in 1982/83 (87). The target price for bread wheat will be 30 percent above the intervention price while target prices

TABLE 6.3

EC Prices, Exchange Rates and Inflation Rate in Spain

Year	Inflation Rate	Exchange Rate	Green Rate	Cereal Price	Beef Price	Milk Price	Pigmeat Price
			a. First EC Scenario				
	%	Pts/ECU	Pts/ECU	ECU/kg	ECU/kg	ECU/kg	ECU/kg
1980	18.5	100.75	0.00	.214	1.61	.223	1.59
1981	20.3	114.90	0.00	.228	1.71	.237	1.69
1982	17.5	128.22	0.00	.243	1.83	.253	1.80
1983	17.7	144.76	0.00	.259	1.94	.269	1.92
1984	13.4	155.86	150.31	.273	2.05	.284	2.02
1985	12.9	165.32	160.59	.290	2.18	.301	2.15
1986	12.4	174.52	169.92	.309	2.32	.322	2.29
1987	12.1	184.04	179.28	.330	2.48	.343	2.44
1988	12.2	194.35	189.19	.351	2.63	.365	2.60
1989	12.0	205.02	199.68	.373	2.80	.388	2.77
1990	12.0	216.49	210.75	.397	2.98	.413	2.94

TABLE 6.3 (continued)

Year	Inflation Rate	Exchange Rate	Green Rate	Cereal Price	Beef Price	Milk Price	Pigmeat Price
			b. Second EC Scenario				
	%	Pts/ECU	Pts/ECU	ECU/kg	ECU/kg	ECU/kg	ECU/kg
1980	18.5	100.75	0.00	.214	1.61	.223	1.59
1981	20.3	114.90	0.00	.218	1.64	.227	1.69
1982	17.5	128.22	0.00	.226	1.70	.235	1.80
1983	17.7	144.76	0.00	.233	1.75	.242	1.92
1984	13.4	155.86	150.31	.239	1.80	.249	2.02
1985	12.9	165.32	160.59	.246	1.84	.255	2.15
1986	12.4	174.52	169.92	.253	1.90	.263	2.29
1987	12.1	184.04	179.28	.261	1.96	.271	2.44
1988	12.2	194.35	189.19	.268	7.01	.278	2.60
1989	12.0	205.02	199.68	.274	2.06	.285	2.77
1990	12.0	216.49	210.75	.281	2.11	.292	2.94

Source: (47)

for feedgrains will be 20 percent higher. Actual market prices for cereal grains will lie somewhere between the target and intervention prices depending on whether the commodity is in surplus or deficit. Using the projected intervention price derived from Josling's figures, specific cereal grain market prices can be calculated as some proportion above the intervention price. The proportions used are 15 percent for wheat, 2 percent for barley, 18 percent for corn, 4 percent for rye, 2 percent for oats, and 17 percent for sorghum. Corn and sorghum are in deficit in the EC so their prices are expected to be closer to the target price. Wheat prices are assumed to lie half way between the target and intervention prices while the other cereal grain prices are expected to be close to the intervention price since these commodities are generally in surplus.

The lower intervention price for beef in the EC has been about 90 percent of the guide price projected by Josling. Initially, it was assumed that farm gate prices in Spain would be close to the lower intervention price. However, the projections indicated that Spain is likely to develop deficits in beef and it was felt that the actual prices received would be higher than the intervention price. The average farm level price was, thus, assumed to be 95 percent of the guide price. The guide price applies to all beef while the Spanish model requires separate prices for veal, steers and heifers, and cows and bulls. Based on historical relations in Spain, it is assumed that prices received for calves are 17 percent above this average farm level price, those for steers and heifers 11 percent above and those for cows and bulls 34 percent lower. These relations were derived by calculating a weighted average Spanish price and comparing it with the three prices. The projected proportion of total beef and veal production from the three categories shifts by 1980 so that the disaggregation of the guide price leads a slight break in the transition from Spanish to EC prices.

The intervention price for milk is about 94.6 percent of the target prices projected by Josling. These prices are in terms of currency units per kilogram while the price variable in the cattle model is in liters. Thus, the peseta intervention price is converted to pesetas per liter. Prices for sheep and goat milk are projected separately. The pigmeat intervention price is assumed to be 90 percent of the projected target price. All the prices received are deflated by the projected CPI.

Retail prices are calculated by aggregating the appropriate farm level prices, reflating them with the CPI and adding a margin. Margins between average nominal farm prices and retail prices were calculated for the period 1960 to 1978 on the basis of the data used in estimating the model. The size of these margins increased over the base period. However, since retail food prices in the EC scenarios are generally higher than in the baseline, a fixed rather than increasing margin was used in the projections of EC retail prices. Increasing margins would have made the difference between EC and baseline retail prices unrealistically large. The margins added are the 1978 values: 305 pesetas per kilogram for beef and veal, 25 for milk, 265 for pork, 75 for poultry meat, 435 for sheep and goat meat, 40 for eggs and 25 for bread cereals. The prices for other food and non-food items were left the same as in the baseline projections.

Retail prices derived in this component are then converted into the Rotterdam price variables described in Chapter III.

Prices paid for calf, broiler, layer and hog feed are also used in the model. To project these prices it was necessary to incorporate expected changes in feed ration composition. The first step was to estimate the proportions of present Spanish rations made up of corn, barley and soybean meal. Multiplying these proportions by the corresponding prices for the products gives a figure less than the actual price paid for the feed since there are other elements used. This residual is assumed to be constant in the projections and is added to the feed prices determined by imposing average EC ration proportions. The relevant feed prices are thus computed in the pricing component by multiplying average EC proportions by the projected prices for cereal grains and soybean meal and adding the residual.

Since the EC prices will only be imposed after a period of transition, all of the prices were forced to move gradually to the EC levels. This was accomplished by determining the difference between EC and Spanish prices in 1980 and applying the following formula:

$$SP_t = ECP_t - (ECP_{1980} - SP_{1980})*((1990 - t)/10)$$

Where:

SP = the Spanish price

ECP = the EC price in pesetas

t = 1980 ... 1990

This procedure causes the projected Spanish prices to move toward the EC level with equality between these prices reached in 1990. As can be seen in Appendix C, the 1980 prices received are the same in all three scenarios except for the beef and veal prices. The reason for the break in these price series is that the disaggregation of the guide price into the separate prices is based on 1978 production proportions which are not the same as in 1980.

Institutional prices are not set for poultry meat, eggs, sheep meat or goat meat. It was assumed that Spanish prices for these commodities would be similar to those prevailing in France and Italy. Average French and Italian prices for these products in 1980 were obtained from EC publications (24), and projected at the same rate as the beef and pigmeat prices in the minmax price projections. Spanish prices were then made to move to these levels by 1990. The same procedure was used to project sugarbeet prices except that the average EC price was used rather than French and Italian prices. Two other variables used in the model, the price of diesel fuel and the cereal price index, had to be projected differently from the baseline scenario. Projected cereal prices were converted to an index used to carry out the cereal price index. Diesel fuel prices were made to rise more rapidly than in the baseline reflecting the required removal of subsidies as Spain implements the CAP.

The other exogenous variables affected by entry can all be computed from the price and cost variables projected according to the procedures outlined above. To complete the EC scenarios, it is necessary to change the feed conversion ratios in the derived demand component. Average conversion ratios for feedgrains and soybean meal were supplied by USDA researchers and are shown in Table 6.4. These

TABLE 6.4

Feedgrain and Soybean Meal Conversion Ratios in EC*
(kg. feed per kg. of product)

Product	Feedgrains	Soybean Meal
Pigmeat	3.05	0.820
Poultry Meat	2.06	1.144
Beef	0.6	0.090
Milk	0.182	0.036
Eggs	2.28	0.54
Sheep/Goat Meat	--	0.685

Source: USDA
*Average EC ratios 1977-1979.

values were introduced into the feedgrain and soybean meal equations to reflect the likely changes in feed ration composition.

The results of the projections from the first EC scenario are summarized in Tables 6.5a to 6.5c. These projections as well as those from the second EC scenario will be compared with the baseline results in the final section of this chapter. The first EC scenario is based on projected EC prices which are set at levels which maintain nominal prices in all countries while compensating one country fully for inflation. There are no shifts in relative prices since the minmax institutional prices all rise by the same proportions.

The projections in Table 6.5 indicate that grain production will increase due to projected yield increases since total cereal acreage is projected to decline in this scenario. Bread cereal

TABLE 6.5

Balance Sheet Projections to 1990: First EC Scenario

(thousand metric tons)

Year	Production		Domestic Availability	Per Capita Consumption	Total Human Consumption	Feed	Domestic Disappearance	Surplus/ Deficit
	Veal	Beef						
BEEF			a. Livestock Products Balance Sheets					
1980	76	334	409	13.9	520	--	520	-111
1982	81	384	465	14.8	565	--	565	-100
1984	86	384	470	15.5	601	--	601	-131
1986	92	384	476	15.8	627	--	627	-151
1988	98	385	482	15.9	641	--	641	-158
1990	104	385	489	15.6	641	--	641	-152

TABLE 6.5 (continued)

Year	Production		Domestic Availability	Per Capita Consumption	Total Human Consumption	Feed	Domestic Disappearance	Surplus/ Deficit
MILK	Cow*	Sheep/ Goat*	a. Livestock Products Balance Sheets (continued)					
1980	5848	502	6541	158	5891	565	6456	85
1982	6196	489	6885	140	5333	565	5898	987
1984	6551	470	7232	128	4991	565	5556	1676
1986	6905	454	7579	117	4624	565	5189	2390
1988	7282	438	7951	106	4283	565	4848	3103
1990	7674	423	8340	96	3938	565	4503	3837

*millions of liters

TABLE 6.5 (continued)

Year	Production		Domestic Availability	Per Capita Consumption	Total Human Consumption	Feed	Domestic Disappearance	Surplus/ Deficit
HOGS	Pigmeat	Suckling	a. Livestock Products Balance Sheets (continued)					
1980	815	2.3	817	24.5	917	--	917	-100
1982	901	2.6	904	23.7	905	--	905	- 1
1984	956	2.9	959	23.4	909	--	909	50
1986	1005	3.0	1008	22.6	894	--	894	114
1988	1057	3.2	1060	21.3	858	--	858	202
1990	1104	3.3	1107	19.5	800	--	800	307

TABLE 6.5 (continued)

Year	Production		Domestic Availability	Per Capita Consumption	Total Human Consumption	Domestic Disappearance	Surplus/ Deficit
SHEEP/GOAT	Young	Mature	a. Livestock Products Balance Sheets (continued)				
1980	130	23	153	4.0	148	148	5
1982	124	22	146	4.0	153	153	- 7
1984	116	19	135	4.1	160	160	-25
1986	114	15	129	4.2	167	167	-38
1988	112	12	124	4.3	173	173	-49
1990	111	9	120	4.4	180	180	-60

TABLE 6.5 (continued)

Year	Production	Domestic Availability	Per Capita Consumption	Total Human Consumption	Domestic Disappearance	Surplus/ Deficit
POULTRY MEAT		a. Livestock Products Balance Sheets (continued)				
1980	780	780	18.5	691	691	89
1982	815	815	22.5	859	859	- 44
1984	817	817	24.9	968	968	-150
1986	815	815	25.0	990	990	-176
1988	878	878	25.0	1009	1009	-131
1990	941	941	25.0	1028	1028	- 87

TABLE 6.5 (continued)

Year	Production	Domestic Availability	Per Capita Consumption	Total Human Consumption	Domestic Disappearance	Surplus/ Deficit
EGGS*		a. Livestock Products Balance Sheets (continued)				
1980	863	604	15.6	582	582	22
1982	863	604	18.0	686	686	- 82
1984	863	604	18.0	700	700	- 96
1986	863	604	18.0	713	713	-109
1988	863	604	18.0	726	726	-123
1990	1062	743	18.0	740	740	3

*millions of dozens

TABLE 6.5 (continued)

Year	Production		Domestic Availability	Per Capita Consumption	Total Human Consumption	Feed	Domestic Disappearance	Surplus/ Deficit
BREAD CEREALS	Wheat	Rye	b.	Cereal Grains Balance Sheets				
1980	4820	172	4164	73.3	2741	130	4217	- 53
1982	4912	152	4236	65.0	2479	130	3853	383
1984	5050	144	4367	65.0	2527	130	3909	459
1986	5098	128	4400	65.0	2575	129	3958	441
1988	5152	117	4442	65.0	2623	129	4009	433
1990	5186	104	4462	65.0	2672	129	4059	403

TABLE 6.5 (continued)

Year	Production		Domestic Availability	Per Capita Consumption	Total Human Consumption	Feed	Domestic Disappearance	Surplus/ Deficit
BARLEY/OATS	Barley	Oats	b. Cereal Grains Balance Sheets (continued)					
1980	7874	554	7928	--	--	4499	5442	2486
1982	8513	603	8885	--	--	4833	5830	3055
1984	8860	653	9472	--	--	5049	6065	3407
1986	9259	692	10062	--	--	5261	6302	3760
1988	9571	731	10609	--	--	5547	6602	4006
1990	9864	772	11175	--	--	5990	7057	4118

TABLE 6.5 (continued)

Year	Production		Domestic Availability	Per Capita Consumption	Total Human Consumption	Feed	Domestic Disappearance	Surplus/ Deficit
CORN/SORGHUM	Corn	Sorghum	b. Cereal Grains Balance Sheets (continued)					
1980	1461	231	1691	--	--	4858	5283	-3592
1982	1477	194	1671	--	--	5180	5605	-3934
1984	1630	164	1793	--	--	5430	5856	-4062
1986	1644	145	1790	--	--	5653	6078	-4289
1988	1723	134	1857	--	--	5954	6379	-4522
1990	1733	118	1850	--	--	6402	6827	-4977

disappearance is projected to rise more slowly than production so that Spain becomes a net exporter. Feedgrain use increases slowly with corn and sorghum constituting the more important source of feedgrains. Historically more corn has been used for feed than barley although this situation was reversed from 1976 to 1978.

The relatively slow increase in feedgrain consumption predicted by the model is primarily due to the change to EC feed conversion ratios. The number of cattle and hogs increases over the projection period while the number of sheep and goats declines. Broiler slaughter is projected to increase slowly while the number of laying hens remains at the same level until the end of the decade. Overall, livestock numbers are larger than in 1978 so the slow growth in feedgrain disappearance is the result of the shift to EC feed conversion ratios.

The growth in the number of cows predicted for this scenario combined with increased milk yields leads to rapid expansion of milk production. Beef and veal production also increases but at a relatively slow rate. The sheep and goat sectors continue their historic decline in importance.

Hog production is projected to expand in the EC since the predicted prices received increase sufficiently to offset the higher EC feed costs. However, higher feed costs act as a restraint on poultry meat and egg production. The relative returns measure for broiler and egg production, the difference between the gross margins for broilers or eggs and the gross margin for hogs, are negative for most of the projection period. Thus, the prices used in these projections lead to the result that gross margins for hog production are greater than for the poultry sectors which expand more slowly than during the base period.

Increases in consumption of poultry meat and eggs combined with slower production growth leads to the prediction that deficits will develop. Consumption of sheep and goat meat changes very little but the projected fall in production results in predicted deficits. On the other hand, the favorable prices for hog producers used in this scenario translate into higher retail prices which serve to restrain consumption.

Beef consumption is projected to increase moderately. The model results suggest that the relative meat prices will cause consumers to switch from pork to poultry meat and beef. The decline in milk consumption combined with large production increases results in the prediction of large milk surpluses by 1990.

As noted in Chapter IV, both the poultry meat and egg production components could be improved by developing a mechanism to slow expansion when the relative profitability measure falls to zero rather than simply stopping it. This is apparent in the case of eggs where production remains at the 1980 level until 1989 with the result that imports expand rapidly in both sets of projections until the later years. Several informants in Spain felt that the modern broiler industry would compete effectively in the EC market and expressed the belief that Spain would become an important exporter of chicken meat. The results of the projections suggest that the shift in feed costs may put more pressure on these sectors than expected by Spanish experts.

Table 6.6 contains projections of soybean meal use for all three scenarios. Since the shift to EC feed conversion ratios implies greater use of soybean meal, the relatively slow increases in disappearance are due primarily to the slower expansion of the poultry sectors. The conversion ratio for pigmeat is lower in the EC than the estimated Spanish rate so that the rapid expansion of pork production does not lead to large increases in soybean meal use. In fact, comparison of the three scenarios reveals that the model predicts slightly lower levels of soybean meal use in the EC scenarios than in the baseline projections.

TABLE 6.6

Projections of Soybean Meal Disappearance in the Three Scenarios (thousand metric tons)*

	Soybean Meal Disappearance		
Year	Baseline	First EC	Second EC
1980	2272	2331	2332
1982	2402	2457	2465
1984	2543	2509	2526
1986	2706	2559	2565
1988	2869	2696	2692
1990	3032	2934	2870

*Estimates of meal equivalent imports can be obtained by subtracting assumed Spanish production levels from the disappearance figures. Spain produced about 13,000 metric tons of soybeans in meal equivalence in 1978.

The second EC scenario differs from the first in that relative prices are allowed to change. The lower maxmin price projections are used for beef and veal, cereal grains, and milk while all the other prices are the same as in the first EC scenario. The second set of EC projections are presented in Tables 6.7a to 6.7c. Despite the lowered prices for cereal grains, total cereal acreage falls less than in the first EC scenario. This is due to greater irrigated and dryland barley acreage. Irrigated and dryland acreage devoted to all the other cereal grains is less than in the first EC scenario. Total wheat production is less since there is a decline in the proportion of total acreage which is irrigated.

Barley production expands substantially while feed use increases somewhat less than in the first EC scenario. As a result, the projections suggest that Spain would develop very large barley surpluses in this scenario. Corn production is less than in the other scenarios and there is a modest increase in the proportion of feedgrains made up of corn and sorghum. Soybean meal use is slightly lower in this scenario.

Livestock production evolves in a manner similar to that of the first EC scenario. Beef and milk production increase over the projection period but remain slightly below the levels of the first EC scenario. Beef consumption increases more than in the other EC scenario while milk consumption declines less. The result is somewhat larger beef deficits and smaller milk surpluses. Pigmeat production rises at about the same rate as in the first EC scenario. Lower feed costs in the second EC scenario allow poultry meat production to

TABLE 6.7

Balance Sheet Projections to 1990: Second EC Scenario

(thousand metric tons)

Year	Production		Domestic Availability	Per Capita Consumption	Total Human Consumption	Feed	Domestic Disappearance	Surplus/ Deficit
BEEF	Veal	Beef	a. Livestock Products Balance Sheets					
1980	76	336	412	13.9	520	--	520	-108
1982	81	386	467	15.0	572	--	572	-105
1984	86	386	472	15.9	619	--	619	-147
1986	91	385	476	16.6	658	--	658	-183
1988	96	384	480	17.0	688	--	688	-209
1990	101	383	484	17.2	707	--	707	-223

TABLE 6.7 (continued)

Year	Production		Domestic Availability	Per Capita Consumption	Total Human Consumption	Feed	Domestic Disappearance	Surplus/ Deficit
MILK	Cow*	Sheep/ Goat*	a. Livestock Products Balance Sheets (continued)					
1980	5848	502	6541	158	5891	565	6456	85
1982	6187	489	6876	142	5415	565	5980	896
1984	6514	470	7194	133	5153	565	5718	1477
1986	6835	454	7508	123	4879	565	5444	2064
1988	7172	438	7838	115	4632	565	5197	2641
1990	7519	423	8180	107	4379	565	4944	3237

*millions of liters

TABLE 6.7 (continued)

Year	Production		Domestic Availability	Per Capita Consumption	Total Human Consumption	Feed	Domestic Disappearance	Surplus/ Deficit
HOGS	Pigmeat	Suckling	a. Livestock Products Balance Sheets (continued)					
1980	815	2.3	817	24.5	917	--	917	-100
1982	911	2.6	914	24.4	931	--	931	- 17
1984	978	2.9	981	24.8	963	--	963	18
1986	1015	3.0	1018	24.9	985	--	985	34
1988	1057	3.2	1060	24.6	992	--	992	69
1990	1104	3.3	1107	23.9	982	--	982	125

TABLE 6.7 (continued)

Year	Production		Domestic Availability	Per Capita Consumption	Total Human Consumption	Domestic Disappearance	Surplus/ Deficit
SHEEP/GOATS	Young	Mature	a. Livestock Products Balance Sheets (continued)				
1980	130	23	153	4.0	148	148	5
1982	124	22	146	4.0	152	152	- 6
1984	116	19	135	4.1	158	158	-23
1986	114	15	129	4.1	163	163	-34
1988	112	12	124	4.2	167	167	-43
1990	111	9	120	4.2	171	171	-50

TABLE 6.7 (continued)

Year	Production	Domestic Availability	Per Capita Consumption	Total Human Consumption	Domestic Disappearance	Surplus/ Deficit
POULTRY MEAT		a. Livestock Products Balance Sheets (continued)				
1980	780	780	18.5	691	691	89
1982	824	824	22.6	860	860	- 36
1984	833	833	25.0	971	971	-138
1986	838	838	25.0	990	990	-153
1988	908	908	25.0	1009	1009	-101
1990	978	978	25.0	1028	1028	- 50

TABLE 6.7 (continued)

Year	Production	Domestic Availability	Per Capita Consumption	Total Human Consumption	Domestic Disappearance	Surplus/ Deficit
EGGS*		a. Livestock Products Balance Sheets (continued)				
1980	863	604	15.6	582	582	22
1982	863	604	18.0	686	686	- 82
1984	863	604	18.0	700	700	- 96
1986	863	604	18.0	713	713	-109
1988	863	604	18.0	726	726	-123
1990	951	666	18.0	740	740	- 74

*millions of dozens

TABLE 6.7 (continued)

Year	Production		Domestic Availability	Per Capita Consumption	Total Human Consumption	Feed	Domestic Disappearance	Surplus/ Deficit
BREAD CEREALS	Wheat	Rye	b.	Cereal Grains Balance Sheets				
1980	4820	172	4164	73.3	2741	130	4217	- 52
1982	4875	146	4194	65.0	2479	130	3850	344
1984	4911	131	4216	65.0	2527	130	3899	316
1986	4849	107	4129	65.0	2575	129	3942	186
1988	4767	86	4027	65.0	2623	129	3985	41
1990	4653	64	3890	65.0	2672	129	4027	-138

TABLE 6.7 (continued)

Year	Production		Domestic Availability	Per Capita Consumption	Total Human Consumption	Feed	Domestic Disappearance	Surplus/ Deficit
BARLEY/OATS	Barley	Oats	b. Cereal Grains Balance Sheets (continued)					
1980	7874	554	7929	--	--	4500	5443	2485
1982	8589	600	8800	--	--	4820	5826	2973
1984	9166	645	9500	--	--	5029	6080	3420
1986	9827	680	10231	--	--	5195	6299	3932
1988	10452	713	10973	--	--	5437	6588	4385
1990	11083	748	11738	--	--	5760	6959	4779

TABLE 6.7 (continued)

Year	Production		Domestic Availability	Per Capita Consumption	Total Human Consumption	Feed	Domestic Disappearance	Surplus/ Deficit
CORN/SORGHUM	Corn	Sorghum	b. Cereal Grains Balance Sheets (continued)					
1980	1461	231	1691	--	--	4859	5284	-3593
1982	1423	194	1618	--	--	5243	5668	-4050
1984	1491	164	1655	--	--	5544	5969	-4314
1986	1427	145	1573	--	--	5786	6211	-4638
1988	1409	134	1543	--	--	6104	6529	-4985
1990	1318	118	1436	--	--	6499	6924	-5488

expand more rapidly than in the other EC scenario although egg production is lower.

The evolution of per capita consumption is of interest since it suggests that total food consumption would be higher in this scenario than in the first EC scenario. The higher consumption levels for beef and milk are expected since the retail prices of these commodities are lower. However, the higher relative prices for pork do not result in lower predicted consumption levels. This is due to an income effect which is reflected in the higher levels of consumption of all meats despite the shift in relative prices. In 1990, the projected weight of food items in the consumer budget is higher in the second EC scenario than in the first as a result of the generally lower food prices.

The other sets of projections are similar to those in the first EC scenario. It is likely that the second EC scenario will prove to be closer to what actually happens in the future since it constrains the rise in prices of certain critical surplus items in the EC. The first EC scenario more nearly approximates pricing practices in the recent past. The growing budget problems make it unlikely that these practices will be continued indefinitely.

III. Comparison of the Projections

Comparing the three sets of projections provides greater insight into the impact of accession to the EC than simply examining the magnitudes of the predictions.

Tables 6.8 to 6.13 contain some of the variables already presented in the balance sheets for each scenario as well as other variables of interest not shown earlier. The discussion of the three

TABLE 6.8

Comparisons of Model Projections: Livestock and Feed

Variable	Year	Baseline Scenario	First EC Scenario	Second EC Scenario	(B - A)/A	(C - A)/A
		A	B	C		
	a.	Livestock Variables (thousand head)				
Cows	1980	2592	2592	2592	0	0
	1985	2719	2729	2708	.004	-.004
	1990	2863	2873	2815	.003	-.017
Calf Slaughter	1980	567	478	482	-.157	-.150
	1985	535	563	558	.052	.043
	1990	517	656	638	.269	.234
Beef Slaughter	1980	1061	1060	1066	0	.005
	1985	1218	1221	1225	.002	.006
	1990	1334	1223	1215	-.083	-.089
Sows	1980	1323	1323	1323	0	0
	1985	1569	1668	1668	.063	.063
	1990	1799	1888	1888	.049	.049
Pig Crop	1980	11903	11903	11903	0	0
	1985	14117	15013	15013	.063	.063
	1990	16188	16995	16995	.050	.050
Total Hog Slaughter	1980	11605	11606	11606	0	0
	1985	13764	14638	14638	.063	.063
	1990	15783	16570	16570	.050	.050
Female Sheep and Goats	1980	9916	9934	9934	.002	.002
	1985	8418	7371	7371	-.124	-.124
	1990	6920	4981	4981	-.280	-.280
Lamb/Kid Slaughter	1980	11870	11870	11870	0	0
	1985	12173	10087	10087	-.171	-.171
	1990	12655	9390	9390	-.258	-.258

TABLE 6.8 (continued)

Variable	Year	Baseline Scenario	First EC Scenario	Second EC Scenario	(B - A)/A	(C - A)/A
		A	B	C		
a. Livestock Variables (thousand head) (continued)						
Mature Sheep/	1980	1283	1283	1283	0	0
Goat Slaughter	1985	1014	904	904	-.108	-.108
	1990	720	483	483	-.329	-.329
Broiler	1980	51019	51019	51019	0	0
Slaughter	1985	63192	53454	53454	-.154	-.154
	1990	75365	63192	63192	-.162	-.162
Selected	1980	38927	40020	40020	.028	.028
Layers	1985	43610	40020	40020	-.082	-.082
	1990	51415	50456	44669	-.019	-.131
b. Feed Disappearance (thousand metric tons)						
Feed Grain	1980	14033	9488	9489	-.324	-.324
Consumption	1985	16313	10810	10898	-.337	-.332
	1990	18836	12520	12388	-.344	-.342
Soymeal	1980	2272	2331	2332	.026	.026
Consumption	1985	2624	2530	2543	-.036	-.031
	1990	3032	2934	2870	-.032	-.053
Wheat/Rye	1980	128	130	130	.016	.016
Fed	1985	127	129	129	.016	.016
	1990	127	129	129	.016	.016
Barley/Oats	1980	6827	4499	4500	-.341	-.341
Fed	1985	7856	5147	5108	-.345	-.350
	1990	8987	5990	5760	-.333	-.359
Corn/Sorghum	1980	7078	4858	4859	-.314	-.314
Fed	1985	8330	5534	5660	-.336	-.321
	1990	9722	6402	6499	-.341	-.332

TABLE 6.9

Comparison of Livestock Production, Disappearance and Trade

(thousand metric tons)

Variable	Year	Baseline Scenario	First EC Scenario	Second EC Scenario	(B - A)/A	(C - A)/A
		A	B	C		
		a. Production				
Beef and	1980	424	409	412	-.035	-.028
Veal	1985	468	474	474	-.013	-.013
	1990	502	489	484	-.026	-.036
Cow, Sheep,	1980	6541	6541	6541	0	0
Goat Milk	1985	7394	7401	7348	.001	-.006
	1990	8345	8340	8180	-.001	-.020
Pigmeat	1980	818	817	817	0	0
	1985	917	978	978	.067	.067
	1990	1052	1107	1107	.052	.052
Sheep and	1980	153	153	153	0	0
Goat Meat	1985	157	132	132	-.159	-.159
	1990	164	120	120	-.268	-.268
Poultry	1980	780	780	780	0	0
Meat	1985	978	816	835	-.166	-.146
	1990	1166	941	978	-.193	-.161
Eggs	1980	590	604	604	.024	.024
	1985	652	604	604	-.074	-.074
	1990	756	743	666	-.017	-.119

TABLE 6.9 (continued)

Variable	Year	Baseline Scenario	First EC Scenario	Second EC Scenario	(B - A)/A	(C - A)/A
		A	B	C		
		b. Disappearance				
Beef and	1980	504	520	520	.032	.032
Veal	1985	643	615	639	-.044	-.012
	1990	778	641	707	-.176	-.091
Cow, Sheep,	1980	6332	6456	6456	.020	.020
Goat Milk	1985	6449	5382	5590	-.165	-.133
	1990	6612	4503	4944	-.319	-.252
Pigmeat	1980	898	917	917	.021	.021
	1985	1043	904	975	-.133	-.065
	1990	1194	800	982	-.330	-.178
Sheep and	1980	144	148	148	.028	.028
Goat Meat	1985	155	163	160	.052	.032
	1990	167	180	171	.078	.024
Poultry	1980	840	691	691	-.177	-.177
Meat	1985	981	981	981	0	0
	1990	1028	1028	1028	0	0
Eggs	1980	652	582	582	-.107	-.107
	1985	706	706	706	0	0
	1990	740	740	740	0	0

TABLE 6.9 (continued)

Variable	Year	Baseline Scenario	First EC Scenario	Second EC Scenario	(B - A)/A	(C - A)/A
		A	B	C		
		c. Net Trade				
Beef and	1980	- 80	- 111	- 108	-	-
Veal	1985	- 175	- 142	- 165	-	-
	1990	- 276	- 152	- 223	-	-
All Milk	1980	210	85	85	-	-
	1985	945	2019	1758	-	-
	1990	1733	3837	3237	-	-
Pigmeat	1980	- 78	- 100	- 100	-	-
	1985	- 123	75	22	-	-
	1990	- 140	307	125	-	-
Sheep and	1980	8.5	5	5	-	-
Goat Meat	1985	2.5	- 31	- 29	-	-
	1990	- 3.2	- 60	- 50	-	-
Poultry	1980	- 60	89	89	-	-
Meat	1985	- 3	- 165	- 146	-	-
	1990	139	- 87	- 50	-	-
Eggs	1980	- 62	22	22	-	-
	1985	- 54	- 102	- 103	-	-
	1990	16	3	- 74	-	-

sets of results is organized by commodity with some more general comments on land use, feed consumption, and consumer budget allocation at the end of this section.

A. Beef and Veal

The size of the cattle breeding herd increases moderately in all three scenarios. Since the number of animals slaughtered depends on the number of calves available for beef or veal, a variable which in turn depends on the size of the breeding herd, total slaughter numbers also increase in the three scenarios. In 1990 the projected number of cows is similar in all three scenarios. However, the structure of relative prices leads to a reversal of the decline in the proportion of calves slaughtered for veal. In the baseline scenario, 34 percent of the calves available in 1990 are slaughtered as calves while the proportion in the EC scenarios is about 42 percent.

The calf slaughter weight used in the projections (158 kg.) is somewhat higher than the EC average while the beef slaughter weight is about the same as in France (314 kg.). Since a greater proportion of beef and veal production is derived from the slaughter of calves in the EC scenarios, the total quantities produced are 3 percent to 4 percent less than in the baseline projections in 1990. Beef and veal consumption rises in all three scenarios but by 1990 it is 9 percent to 18 percent lower in the EC scenarios than in the baseline. This results from the higher EC guide prices which are used in the computation of the retail price. Since production is similar in the three scenarios, the lower consumption after entry reduces the size of the deficit compared with the baseline.

The analysis indicates that, while production is likely to expand slightly more rapidly than has been the case historically, consumption levels may rise sufficiently to lead to deficits. Per capita consumption in the first EC scenario is projected to increase from an average of about 13 kilograms in the late 1970s to 15.6 in 1990, a rate of growth similar to that of the preceding decade. Yet even this modest increase in consumption leads to a predicted deficit of 152,000 metric tons in 1990.

It is unlikely that the substantial imports implied by the model predictions will actually materialize. The results should be interpreted as indicating an important policy issue for the Spanish government. Like most European governments, the Spanish administration has had a traditional preference for self-sufficiency in food. The predicted evolution of beef production and consumption suggests that Spain may demand even higher EC prices for beef producers or, within the changing rules of the EC, attempt to manipulate green rates, monetary and accessionary compensatory amounts and other mechanisms to reduce consumption and increase production.

B. Pigmeat

The swine industry is projected to continue the rapid expansion of recent years in all three scenarios. However, relatively higher EC prices lead to predictions of greater pigmeat production after entry. Since the same prices are used in both EC scenarios, the number of sows, pig crop and total slaughter are the same in the two projections. These three variables are all predicted to be about 5 percent to 6 percent greater in the EC than in the baseline scenario.

Higher feed costs in the EC, reflected in the real cereal price index used in the equation for the number of sows, are offset by the higher prices received for hogs. Live slaughter weight is determined by a trend and the hog-corn price ratio. The downward trend dominates the other variables so that the predicted live slaughter weight declines too much. The constraint on this variable becomes operative in the early 1980s in all three scenarios so that the live slaughter weight predictions are essentially the same. However, the evolution of the hog-corn price ratio provides further evidence that the prices received for hogs rise more rapidly than the cost of feed. This variable falls from 6.63 in 1980 to 6.35 in 1990 in the baseline while it rises from 6.45 in 1980 to 7.35 in the first EC scenario and 10.4 in the second in 1990.

While the favorable price relationships lead to predictions of greater production after entry the higher retail prices lead to forecasts of consumption 18 percent to 33 percent lower in the EC scenarios. These predictions lead to the conclusion that there will be large surpluses in 1990 following entry. The baseline projections indicate that Spain would import pigmeat while net exports reach 125 to 300 thousand metric tons in the EC projections by 1990. Spain will be unable to export these large quantities unless African Swine Fever is eliminated since the present trading partners could not absorb them. Even if sanitary conditions are improved, other EC countries may not be able to soak up the predicted surplus. This suggests that there may be pressures to institute lower producer prices after entry.

C. Sheep and Goats

Entry into the EC is projected to hasten the decline of the sheep and goat sectors. As with the swine sector, the same prices are used in both EC projections. The number of females declines in all scenarios but is 28 percent lower in 1990 in the EC projections compared with the baseline scenario. The number of lambs and kids slaughtered increases slightly in the baseline but falls in the EC scenario. The number of mature animals slaughtered declines less in the baseline than the EC projections but all scenarios reflect a continuation of the tendency to slaughter young animals. Slaughter weights increase by the same amounts in all the projections. Total meat production is about 27 percent less after entry than in the baseline projections.

Sheep and goat meat consumption is predicted to be 3 percent to 8 percent greater in the EC. The results suggest that Spain will import small but increasing amounts of lamb, mutton and goat meat. In the baseline projections real lamb and kid prices received continue to increase while these prices fall in the EC scenario. Prices for mature animals also fall more rapidly after entry. The lower prices lead to decreased production and have a small impact on per capita consumption which is estimated to be 4.4 kilograms in 1990 after entry compared with 4.1 kilograms in the baseline scenario.

EC policy toward this sector is difficult to predict. Recent controversies surrounding sheep meat imports have led to a new regime allowing member nations to establish individual guide prices. Historically there have been no policy prices established for lamb or mutton making it difficult to estimate the producer prices that will prevail in Spain. The predicted evolution of this sector may lead Spanish authorities to institute somewhat higher producer prices than were used in the model. Spain has a long tradition of sheep production and technological improvement combined with better returns may result in a reversal of the long-term decline of these sectors.

D. Poultry Meat and Eggs

The relative return measures used in the poultry models evolve differently in the three scenarios. These measures are based on feed costs which are affected by changes in feed ration composition as well as in cereal prices. In the baseline projections, the broiler measure remains positive to 1990 so that the number of broilers slaughtered continues to increase along the trend line. The egg return measure is negative from 1979 to 1982 stopping the growth in the number of layers in those years. Expansion resumes in 1983 and continues to 1990. In both EC scenarios the broiler measure is negative from 1982 to 1986 while the measure for eggs is negative until 1989.

The evolution of these measures results in the prediction that the number of broilers slaughtered in 1990 will be 16 percent less after entry. The number of selected layers depends on feed costs as well as the time trend when the relative return measure is positive. Thus, the projected number of layers in 1990 differs between the two EC scenarios. The projections suggest that the number of layers will be 2 percent to 13 percent lower than in the baseline scenario. On the basis of projected broiler slaughter, total meat production is estimated to be 16 percent to 19 percent less than in the baseline.

Egg production is projected to be 2 percent to 12 percent lower after entry.

The implication of these predictions is that rising feed costs following accession to the EC will reduce profitability in the poultry sectors enough to slow expansion. As noted earlier a more realistic mechanism to slow expansion as profitability falls might lead to more reliable results. However, these results are useful in indicating potential pressures on these sectors.

The poultry meat and egg demand equations both lead to projections of extremely high consumption levels. In all three scenarios per capita consumption has been constrained to be less than or equal to 25 kilograms per year for poultry meat and 18 kilograms per year for eggs. As a result there is no difference in the projected levels of consumption in 1990 among the scenarios. However the differences in production lead to variation in the levels of net trade. In the baseline projections, there are relatively small meat and egg surpluses at the end of the projection period. Deficits are predicted for poultry meat in both the EC scenarios in 1990. Spain achieves self-sufficiency in eggs in the first EC scenario although there is a deficit in the second.

Since the poultry sectors are important in predicting feed disappearance, it is unfortunate that they proved so difficult to model, both on the production and consumption sides. Part of the difficulty in projecting consumption resides in the nature of the data. The fact that per capita poultry meat consumption apparently rose from 0.4 kilograms per year in 1960 to 20.7 kilograms in 1978 is built into the estimated coefficients and probably biases the forecasts in an upward direction. In light of the weaknesses of these components the predictions are best seen as indicative. While output will probably continue to expand after entry, the change in feed costs is likely to reduce the rate of growth compared to recent trends. The most plausible forecast is that Spain will remain self-sufficient in eggs but that small deficits will develop in poultry meat. As in the case of sheep and goat meat, the fact that no common price exists for poultry meat and eggs in the EC may allow market forces or administrative actions to determine somewhat higher producer prices. Since the Spanish poultry sectors are very modern they may be able to cope with the changing cost structure and remain competitive in the EC. Nevertheless, the model predictions suggest that Spain will not become a major poultry meat and egg exporter.

E. Milk and Milk Products

Cow milk production depends on the number of cows milked and the yield in milk per cow. Both of these variables increase over the projection period in all three scenarios leading to substantial growth in milk production. As in the case of beef and veal, the predicted levels of production are similar in the three scenarios. The predicted production levels in 1990 in the EC scenarios are lower than the baseline by 2 percent or less. Sheep and goat milk production is also projected to be slightly lower in the EC scenarios as a result of the decline in the number of females. The total amount of milk available after accession to the EC is predicted to be 1 percent to 2 percent less than in the baseline scenario by 1990.

Milk consumption changes very little in the baseline projections but declines in the two EC scenarios as a result of the higher retail prices. Milk disappearance includes human consumption and milk fed to calves, lambs and kids. The strong negative trend in the feed milk equation led to negative quantities in some of the projections so this variable was left at the 1978 levels in all scenarios. The retail prices used in the projections are higher in the EC scenarios than the baseline although the baseline prices received for cow milk are between the levels used in the two EC scenarios. Total milk disappearance is lowest in the first EC scenario falling 32 percent below the 1990 baseline prediction compared with 25 percent less than the baseline for the second EC scenario.

The combination of production increases and modest consumption growth in the baseline projections leads to the prediction that Spain would become a net exporter of milk. In the EC scenarios, lower consumption estimates lead to the prediction of very large surpluses by 1990. These predictions suggest that milk will continue to constitute a policy issue in the enlarged EC. Some of the present EC governments may hope to dispose of some of the milk surplus in the applicant countries. If Spain does indeed develop milk surpluses, it will not be able to absorb any of the excess production in the EC-9 and will in fact contribute to the surplus milk problem.

The reliability of the preceding comments depends on the accuracy of the consumption forecasts. Even if consumption does not fall after entry as suggested in the model, surpluses are still projected to develop unless per capita consumption rises greatly. If per capita consumption in Spain reaches the levels recorded presently in some of the Northern European countries deficits in milk and milk products could materialize. However, per capita consumption of milk in Spain is already higher than in other Mediterranean countries such as France, Italy, or Greece and the model predictions for the EC scenarios are not inconsistent with the consumption levels recorded in the rest of Europe. Thus, it is unlikely that Spain will be able to import surplus EC milk after accession.

F. Cereal Grains

Despite higher predicted cereal grain prices in the EC scenarios total cereal acreage is projected to be 3 percent to 5 percent lower than the baseline in 1990. The change in relative prices and costs alters the proportion of total wheat acreage which is irrigated. In the baseline projections 5 percent of total wheat acreage is irrigated in 1990 while the proportions for the two EC scenarios are 9 percent and 7 percent. In the case of barley, the same proportion, a little more than 7 percent, is predicted to be irrigated in all scenarios. By 1990, the model predicts that 70 percent to 75 percent of total corn acreage will be irrigated with the baseline projections showing the highest proportion.

Total wheat and rye production is projected to increase in the first EC scenario although it declines in the other scenarios. Production is higher in 1990 in the EC scenarios than in the baseline projections by 6 percent to 19 percent. Total wheat acreage in the EC is estimated to be only 3 percent to 12 percent greater than in the baseline but a higher proportion of wheat production is from irrigated acreage where yields are higher. Production of barley and oats

TABLE 6.10

Comparison of Grain Cereal Projections: Acreage

Variable	Year	Baseline Scenario	First EC Scenario	Second EC Scenario	(B - A)/A	(C - A)/A
		A	B	C		
Dry	1980	2552	2552	2552	0	0
Wheat	1985	2338	2407	2366	.030	.012
	1990	2044	2186	2065	.069	.010
Irrigated	1980	231	231	231	0	0
Wheat	1985	162	218	186	.346	.148
	1990	105	224	150	1.133	.429
Dry	1980	3391	3391	3391	0	0
Barley	1985	3848	3565	3726	- .074	- .032
	1990	4242	3558	3982	- .161	- .061
Irrigated	1980	273	273	273	0	0
Barley	1985	310	278	296	- .103	- .045
	1990	342	272	315	- .205	- .079
Dry Corn	1980	151	151	151	0	0
	1985	109	114	111	.046	.018
	1990	64	75	68	.172	.063
Irrigated	1980	214	186	186	- .131	- .131
Corn	1985	217	203	179	- .065	- .175
	1990	197	204	151	.036	- .234
Rye	1980	160	160	160	0	0
	1985	90	117	103	.300	.144
	1990	25	82	51	2.280	1.040

TABLE 6.10 (continued)

Variable	Year	Baseline Scenario	First EC Scenario	Second EC Scenario	(B - A)/A	(C - A)/A
		A	B	C		
Oats	1980	429	440	440	.026	.026
	1985	456	485	478	.064	.048
	1990	458	516	500	.127	.092
Sorghum	1980	47	42	42	- .106	- .106
	1985	32	25	25	- .219	- .219
	1990	30	15	15	-1.00	-1.00

TABLE 6.11

Comparison of Cereal Grain Production, Disappearance and Net Trade

(thousand metric tons)

Variable	Year	Baseline Scenario	First EC Scenario	Second EC Scenario	(B - A)/A	(C - A)/A
		A	B	C		
		a. Production				
Bread	1980	4991	4991	4991	0	0
Cereals	1985	4847	5203	4997	.073	.031
	1990	4463	5289	4717	.185	.057
Barley and	1980	8415	8428	8428	.002	.002
Oats	1985	10463	9745	10164	-.069	-.029
	1990	12519	10636	11831	-.150	-.055
Corn and	1980	1886	1691	1691	-.103	-.103
Sorghum	1985	1949	1816	1645	-.068	-.156
	1990	1872	1850	1436	-.012	-.233
		b. Disappearance				
Bread	1980	3828	4217	4217	.102	.102
Cereals	1985	3909	3933	3921	.006	.003
	1990	4012	4059	4027	.012	.004
Barley and	1980	7770	5442	5443	-.300	-.300
Oats	1985	8971	6177	6187	-.311	-.310
	1990	10266	7057	6959	-.313	-.322
Corn and	1980	7503	5283	5284	-.296	-.296
Sorghum	1985	8755	5959	6085	-.319	-.305
	1990	10147	6827	6924	-.327	-.318

TABLE 6.11 (continued)

Variable	Year	Baseline Scenario	First EC Scenario	Second EC Scenario	(B - A)/A	(C - A)/A
		A	B	C		
		c. Net Trade				
Bread	1980	336	- 53	- 52	--	--
Cereals	1985	110	443	249	--	--
	1990	- 376	403	- 138	--	--
Barley and	1980	941	2486	2485	--	--
Oats	1985	1684	3579	3666	--	--
	1990	2424	4118	4779	--	--
Corn and	1980	-5617	-3592	-3593	--	--
Sorghum	1985	-6807	-4142	-4440	--	--
	1990	-8275	-4977	-5488	--	--

in 1990 is predicted to be 6 percent to 15 percent lower in the EC than in the baseline scenario while corn and sorghum production in the EC scenarios is 1 percent to 23 percent lower. The same yield projections are used in all scenarios so these differences reflect the acreage changes.

Bread cereal disappearance is about the same in all three scenarios since per capita consumption has been constrained to be greater than or equal to 65 kilograms per year. The amount of wheat and rye used as animal feed also remains at about the same level in the three projections. Deficits in bread cereals are projected in the baseline and second EC scenarios. The higher wheat prices used in the first EC scenario lead to predictions of higher wheat production and a surplus in 1990. In the EC scenarios, the surplus and deficit are fairly small suggesting that Spain will remain self-sufficient in bread cereals following accession to the EC.

The change to EC feed conversion ratios results in the prediction that demand for feedgrains will be lower in the EC than the baseline. The amount of barley and oats fed increases in all scenarios but is projected to be 33 percent to 36 percent less in the EC compared with the baseline scenario. The lower disappearance in the EC scenarios leads to large surpluses despite the reduced production levels. In the second EC scenario production is only slightly lower than the baseline while disappearance is 32 percent lower. As a result, net exports are predicted to be 97 percent greater. In the first EC scenario net exports are about 70 percent above the baseline projections.

Corn and sorghum disappearance follows a pattern similar to that for barley and oats. Feed use increases over the projection period for the EC scenarios, but at a lower rate than in the baseline. The deficit in corn and sorghum is predicted to be 34 percent to 40 percent lower after entry which implies that corn imports will expand less than would be the case if Spain remained outside the EC. Nevertheless, the predicted net imports of 5.0 to 5.5 million metric tons in 1990 in the EC scenarios are still larger than present levels.

Total feedgrain production is projected to be 8 percent to 13 percent less in 1990 in the EC scenarios compared with the baseline. Forage acreage is projected to be about 3 percent greater in the EC scenarios. This is consistent with the small reduction in total cereal acreage implying that there will be a small shift from feedgrains to forage in livestock rations. The prediction that barley acreage will be less in the EC scenarios than the baseline results from the relatively more favorable price for wheat. The decline in corn acreage in the three scenarios reflects the impact of energy costs and sugarbeet prices. That competition from non-cereal crops for both irrigated and dryland corn acreage will lead to reduced corn planting is consistent with the views of several informants in Spain.

It should be noted that the bread cereal and corn/sorghum stock equations performed poorly in the projections and were not used. Changes in corn and sorghum stocks were set at zero since the large deficits in these commodities make it unlikely that stocks will be built up and releases from existing stocks in the long run cannot be very large. Since there appeared to be a tendency for wheat surpluses to develop in the predictions, the change in stocks was left at the 1978 level of 827 thousand metric tons added to stocks. This means that the forecasts include a fairly substantial stock build-up over the projection period. Replacing this assumption with the supposition that stock changes are zero increases total availability so that Spain would become a substantial net exporter in all three scenarios in 1990.

The projections indicate that imports of corn and sorghum will continue to grow following entry but will be 34 percent to 40 percent below the projected baseline imports by the end of the projection period. The model also predicts substantial barley surpluses in all three scenarios although the surpluses in the EC scenarios are almost twice as large as in the baseline projections. Finally, the projection results suggest that Spain will be self-sufficient in bread cereals and may export relatively small amounts. Exports are predicted to be larger with entry than in the baseline.

G. Land Use

Total cereal acreage declines slightly over the projection period in the EC scenarios, increasing moderately in the baseline projections. Total forage acreage is projected to increase in all three scenarios with the smallest growth registered in the baseline. Total acreage planted to other crops rises in all three projections but expands more in the EC scenarios than the baseline due to the decline in cereal acreage.

Total irrigated acreage is increased exogenously by 30 thousand hectares per year in all the scenarios. Irrigated forage acreage is also set exogenously as indicated in Table 6.12. Irrigated cereal acreage is projected to increase in the first EC scenario and decline in the other two. Irrigated acreage planted to other crops is a residual in the land accounting component and is projected to increase in all three scenarios.

It should be recalled that the land use component of the model is an accounting system. It provides an easy method for checking the aggregate acreage predictions for cereal grains. The results presented in Table 6.12 indicate that the predicted acreage for dryland and irrigated cereal cultivation does not lead to unreasonable developments in the use of land for non-cereal crops. If irrigated acreage increases at a faster pace than the 30 thousand hectares per year used in these projections, the model would allocate the difference to the cultivation of other crops.

H. Feed Consumption

It has already been noted that the change to EC feed conversion ratios and the evolution of livestock numbers in the EC scenarios result in lowered feedgrain disappearance. The total amount of feedgrains fed is about 34 percent lower in the EC projections compared with the baseline scenario in 1990. The shares of the specific feedgrains in total feedgrain use do not vary greatly across the scenarios. Corn and sorghum make up about 52 percent of all cereal grains fed in the three projections.

Soybean meal used for feed is predicted to be 3 percent to 5 percent lower in 1990 in the EC scenarios as compared with the baseline projections. Although the average EC rations rely more heavily

TABLE 6.12

Comparison of Land Use Projections

(thousand hectares)

Variable	Year	Baseline Scenario	First EC Scenario	Second EC Scenario	(B - A)/A	(C - A)/A
		A	B	C		
Total	1980	840	812	812	-.023	-.033
Irrigated	1985	811	820	782	.011	-.036
Cereals	1990	765	822	738	.075	-.035
Total	1980	7548	7525	7525	-.003	-.003
Cereal	1985	7662	7510	7566	-.020	-.013
Acreage	1990	7605	7232	7396	-.049	-.027
Total	1980	1260	1275	1275	.012	.012
Forage	1985	1461	1485	1485	.016	.016
Acreage	1990	1625	1670	1670	.028	.028
Irrigated	1980	430	430	430	--	--
Forage	1985	481	481	481	--	--
Acreage	1990	533	533	533	--	--
Total Other	1980	6815	6822	6822	.001	.001
Crop	1985	7039	7166	7110	.018	.010
Acreage	1990	7472	7800	7637	.044	.022
Irrigated	1980	1630	1658	1658	.011	.011
Other Crop	1985	1758	1748	1786	-.006	.016
Acreage	1990	1902	1845	1929	-.030	.014

on soybean meal than the Spanish estimates, the slow growth in broiler and egg production reduce the use of soybean meal. Still, soybean meal consumption is predicted to be 28 percent to 31 percent greater than the 1978 level in 1990 in the EC scenarios. Total feedgrain use is about 5 percent lower than the 1978 level in the EC projections to 1990. These results reflect the change in feed conversion ratios and are consistent with projected increases in forage acreage.

The EC feed conversion ratios were imposed in 1980 so there is a rather abrupt decline in feedgrain use in that year. It would be more realistic to impose the EC ratios gradually over the projection period to reflect a slower transition. However, this procedure would not alter the 1990 forecasts and the conclusions that feedgrain use will decline while soybean meal and forage used for feed increase.

I. Human Consumption

Long-term projections of per capita consumption based on the coefficients in the demand model appear to be reasonable for beef and veal, pigmeat, sheep and goat meat, other food and non-food items but are questionable for the other categories. By constraining consumption of poultry meat, eggs, and bread cereals the results become more plausible but are not based on economic relationships.

Based on the constrained projections, consumption of all meat in 1990 is predicted to be 77.1 kilograms per capita in the baseline compared with 64.5 kilograms and 70.3 kilograms in the first and second EC scenarios respectively. These figures do not include secondary meats of which about 7 kilograms per capita were consumed in 1978 in Spain. Adding the 1978 consumption of these other meats results in estimates for the EC projections of about 70 to 77 kilograms in 1990 compared with the 1978 per capita consumption of all meat of 67.2 kilograms in Spain and 87.3 kilograms in the EC (66).

The shares of consumer budgets allocated to the different demand categories are of some interest. Table 6.13 contains the projected value shares in the three scenarios based on the constrained predictions. The value shares of all the meat categories, milk and bread cereals are higher in the EC scenarios than the baseline. The value shares for other food and non-food items are lower in the two EC scenarios compared with the baseline projections. These results reflect the higher relative prices for meat, milk and bread cereals in the EC scenarios.

The projections suggest that the lower levels of meat and milk consumption in the EC scenarios will actually take a greater share of the consumer budget as a result of the higher prices. The proportion of the consumer budget devoted to food items is predicted to be 4 percent to 7 percent higher in 1990 in the EC scenarios compared with the baseline projections. The quantity index for non-food items is slightly higher in the EC scenarios than the baseline reflecting a moderate shift away from food items in response to the higher relative prices for food.

Concluding Comments

The projections of production, consumption and trade presented in this chapter highlight the strengths and weaknesses of the Spanish feedgrain-livestock model. In some cases, the predictions have been

TABLE 6.13

Comparison of Consumption Value Shares*

Variable	Year	Baseline Scenario	First EC Scenario	Second EC Scenario
		A	B	C
Beef and	1980	.024	.026	.026
Veal	1985	.023	.028	.027
	1990	.022	.030	.027
Milk	1980	.028	.032	.032
	1985	.021	.025	.023
	1990	.018	.021	.018
Pigmeat	1980	.035	.038	.038
	1985	.029	.035	.039
	1990	.026	.033	.041
Poultry	1980	.014	.012	.012
Meat	1985	.012	.013	.013
	1990	.010	.012	.012
Sheep and	1980	.009	.010	.010
Goat Meat	1985	.007	.008	.008
	1990	.006	.008	.007
Eggs	1980	.007	.006	.006
	1985	.007	.006	.006
	1990	.006	.006	.006

TABLE 6.13 (continued)

Variable	Year	Baseline Scenario	First EC Scenario	Second EC Scenario
		A	B	C
Bread	1980	.010	.012	.012
Cereals	1985	.008	.011	.010
	1990	.007	.013	.010
Other	1980	.182	.176	.176
Food	1985	.172	.160	.163
	1990	.166	.149	.157
Non-Food	1980	.691	.689	.689
Items	1985	.721	.713	.710
	1990	.739	.729	.722

*Proportion of Consumer budget allocated to each category; defined as $p_i q_i/m$ as described in Chapter III.

adjusted or modified by alternative assumptions in an effort to explore the most likely paths of adjustment. Details on the assumptions concerning the exogenous variables and their projection have been included in the discussions. Alternative scenarios could be designed to reflect different assumptions or beliefs about the evolution of these variables. In general, the model aids in the investigation of the future development of the cereal grain and livestock sectors in Spain. The results of the analysis, however, are more useful in indicating potential policy issues and the direction of adjustment than in predicting the exact magnitude of the endogenous variables.

CHAPTER VII

SUMMARY AND CONCLUSION

Spanish accession to the EC will have a significant impact on cereal grain and livestock production and consumption. A simulation model of the Spanish feedgrain-livestock economy has been used to forecast the evolution of these sectors in response to the implementation of the EC price regime. The results described in Chapter VI, based on model projections and judgement, are useful in highlighting potential problems and policy issues 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 react to the evolving situation in these sectors in order to mitigate some of the predicted developments. The principal conclusions drawn from the analysis are summarized in the following paragraphs.

The imposition of EC prices for beef, veal and cow milk in Spain is not likely to cause radical changes in the production of these commodities. Meat production is projected to increase moderately in all three scenarios. Beef and veal consumption will increase less rapidly after accession to the EC but the increases appear to be enough to give rise to large meat deficits. Milk consumption, on the other hand, falls with entry so that large milk surpluses are predicted. The beef and veal deficits are smaller in 1990 for Spain as a member of the EC as compared with the baseline projections while the milk surpluses are larger.

The modern poultry and swine sectors in Spain will not be affected in the same way by entry. While hog production will continue to expand, the rising feed costs faced by broiler and egg producers will slow the expansion of these sectors. The EC basic price for pigmeat is higher than Spanish prices acting to encourage production while restraining consumption. The lowered pigmeat consumption predicted by the model reflects a shift by consumers to beef, veal and poultry meat. The result is the development of surpluses in the hog sector. Poultry meat consumption, on the other hand, will continue to increase. The slower expansion of production may lead to deficits although it is likely that the model overstates the magnitude of these changes. The author's judgement is that Spain will remain largely self-sufficient in poultry meat and eggs but it is unlikely that there will be substantial exports of these commodities.

The decline in the sheep and goat sectors will be exacerbated by entry. Consumption of sheep and goat meat has been almost constant for many years and will not change significantly with accession to the EC. Deficits may develop although they are not likely to be very large. Technological change in this sector could improve the outlook for producers since the EC is not presently self-sufficient in sheep meat. The major problem faced by the sector appears to be the labor shortage which might be circumvented by intensive feeding if costs and returns make this option feasible. Much will depend on the final form of the EC sheep meat regime.

Production of cereal grains will be slightly lower following accession to the EC. Wheat production in 1990 is predicted to be somewhat greater in the EC scenarios than the baseline while barley production is lower. The predictions are based on projected yield increases which do not reach the levels presently recorded in other parts of Europe. Although the average EC wheat price used in the projections is higher than the Spanish price, prices for soft wheat in the EC have generally been lower. Spanish farmers have not traditionally grown much hard or durum wheat for which EC prices are more favorable. It is difficult to assess the potential for Spanish farmers to shift from soft to hard or durum wheats.

Consumption of bread cereals is likely to continue declining in the future. The demand equation for bread cereals overstates this decline so per capita consumption has been constrained at 65 kilograms per year, a level similar to those in other Mediterranean countries. Increased production and lower consumption lead to the prediction of wheat and rye surpluses following accession.

Barley acreage is projected to be slightly lower with entry than in the baseline. Some of the acreage shifted from barley cultivation will be used for wheat while the rest will be planted to other crops and forage. Total corn acreage is projected to be lower than the baseline in the second EC scenario based on lower target prices for cereals. The model results suggest that corn production will not expand in the future and that most production will be carried out with irrigation.

Feedgrain disappearance will rise more slowly after accession than has been the case historically as a result of the shift in feed rations, the change in prices and the evolution of livestock numbers. Soybean meal disappearance increases at similar rates in all three scenarios. The average EC feed conversion ratios used in the projections show heavier use of soybean meal in poultry rations than in Spain but lower proportions for hog rations. Since the number of broilers slaughtered and the number of laying hens expand slowly in the projections, the shift to EC rations does not lead to substantial increases in soybean meal use compared with the baseline scenario.

As a result of the lower levels of feedgrain use in the EC scenarios the barley surpluses are projected to be larger following entry while imports of corn and sorghum are smaller than in the baseline scenario. Corn and sorghum imports will continue to rise but less rapidly than has been the case in recent historical periods. The Spanish barley surplus will add to the level of excess production in the EC.

Food consumption in Spain after accession to the EC will be somewhat lower although the share of food in the consumer's budget will increase. Meat consumption is likely to shift away from pigmeat in favor of beef, veal and poultry meat while sheep meat demand will be affected very little. Per capita meat consumption in 1990 is predicted to reach 70 to 77 kilograms per year following entry, somewhat lower than in the baseline scenario. Entry is likely to lead to an increase in the proportion of total calories obtained from bread, eggs and other foods with a slight decrease in the proportion made up by meat and milk products.

These conclusions concerning the probable evolution of the cereal grain and livestock sectors in Spain following entry serve to indicate potential policy issues with which Spain and the EC will be concerned in the future. The projected evolution of the beef sector would affect a large number of Spanish farmers and substantially increase Spain's dependence on foreign meat supplies. The Spanish government will probably react to these pressures by instituting policies to encourage beef production. From the point of view of the present EC it is unlikely that Spain will be able to absorb a large part of the milk surplus since production is likely to expand greatly while consumption falls. If milk prices in an enlarged EC continue to increase as they have in the past Spain may add to the EC surplus. If milk price rises are restrained many small farmers in Spain could be adversely affected. Spanish accession may make the problem of milk surpluses in the EC more difficult to resolve.

In the case of cereal grains, Spain can be expected to add to the EC barley surplus while continuing to import large amounts of corn. This situation will probably result in efforts in Spain to promote the use of barley as feed at the expense of corn. There does not appear to be much potential for Spain to increase corn production and dependence on imported corn is likely to remain high. Barley surpluses in the EC are presently fairly small. If substantial surpluses do develop in Spain the enlarged EC may discover a new commodity mountain in a landscape already dotted with milk and butter mountains and wine lakes. The surplus disposal and budgetary problems of the EC related to commodity surpluses could thereby be increased.

Spain will continue to import large amounts of soybeans in order to extract the meal for use in feed rations. However, policies toward oilseeds, including import policies on soybeans, will be an area of great controversy in an enlarged Community. Spanish olive oil production will add to the EC surplus and, while soybean meal will be needed for feed rations, the oil from soybean crushings could become a greater burden. Elimination of restrictions on soybean oil consumption in Spain would give rise to a dilemma for policy-makers. On the one hand, the large Spanish crushing capacity and need for soybean meal in feed rations should make it easy for the government to adopt the more liberal soybean trade policy of the EC. On the other hand, much of the Spanish countryside is not well suited for anything but the cultivation of olives or grape vines and olives are an important crop in Spain's agricultural economy. These factors may create pressures for the Spanish to join other groups in the EC in demanding import restrictions on soybeans to reduce dependence on foreign suppliers and lessen competition with olive oil.

Production of sunflower seeds in Spain has increased in recent years and maintaining or increasing the present Spanish barriers to soybean imports would be helpful in encouraging feed compounders to substitute the domestically produced sunflower meal for meal from imported soybeans. However, the possibilities of substituting alternative protein sources for soybean meal may be limited and it is unlikely that Spain would wish to leave a large part of its extensive crushing capacity idle.

A key element in the evolution of the vegetable oil situation in the enlarged EC is the elimination of the restrictions on soybean oil consumption in Spain. The Spanish government is likely to request an exemption to the EC rules on consumption quotas. Elimination of the restrictions would lead to some displacement of olive oil consumption in Spain, increasing the EC surplus in this commodity. At present, there are no restrictions on the entry of soybean oil into the EC, yet most of the Spanish soybean oil exports go to North Africa and the Middle East. Allowing Spain to retain the consumption restrictions on soybean oil would probably not lead to any increase in exports to Europe. Thus, it may be in the interest of both Spain and the present EC to maintain the present situation since elimination of the Spanish consumption quotas would only result in larger olive oil surpluses in the EC.

As a member of the EC, Spain may develop surpluses of pigmeat. Since this meat can only be exported to the other EC countries if they are satisfied that Spain has eliminated African Swine Fever, these surpluses could become a problem in Spain. Considering the potential beef deficits and the leveling off of poultry meat output, the Spanish authorities may wish to adjust relative meat prices. Higher producer prices for beef would stimulate production and act as a restraint on consumption, reducing the beef deficit. The poultry sectors are highly concentrated and linked to the important feed compounding industry. These groups may be able to muster enough political pressure to force the policy-makers to take actions which would raise poultry meat prices. In addition, the lower consumption and expanded production of poultry meat might allow Spain to become an important exporter which would improve the balance of payments. Finally, adjusting these prices would have the added benefit of slowing expansion of pigmeat production while increasing consumption, thus alleviating some of the surplus disposal problem. These factors suggest that the Spanish administration may wish to see a different evolution of relative meat prices than was used in the two EC scenarios.

In addition to the adjustments induced by the imposition of a new regime of relative prices, changes in Spanish institutions will force further modifications on the Spanish feedgrain-livestock economy. Individual producers and users of bread cereals will have to establish new marketing channels as the role of SENPA is altered. The present system of state trading for all livestock products will be modified with entry. These factors suggest that a greater number of private traders and distributors will be required to assure the orderly commercialization of livestock products and cereal grains. These and other institutional adjustments have not been addressed specifically in this study but could prove to be as important to the future of the feedgrain and livestock sectors in Spain as the relative price shifts.

Trade with third countries will also be influenced by the projected evolution of Spain's feedgrain and livestock sectors. While imports of corn and sorghum are projected to be lower in the EC scenarios than if present trends were to persist, they will continue to increase. From the point of view of U.S. corn exporters Spanish membership in the EC will not lead to reductions in imports but rather to somewhat slower growth. Trade patterns can be expected to shift following entry since Spain will no longer apply the variable levy to French corn. The lower transportation costs from France suggest that some of the projected corn imports will be supplied by France rather than the U.S. However, since the EC as a whole is far from self-sufficient in corn, sales of French corn in Spain imply increased needs for imported U.S. corn in other parts of the Community. Thus, while U.S. exports to Spain may fall slightly, the European market will continue to be a major outlet for U.S. corn.

The need for imported soybeans in Spain will not be significantly affected by enlargement. If Spain is able to implement effective policies to encourage beef, poultry meat and egg production, the need for soybean imports may actually be greater than predicted by the model. In any case, Spanish soybean production is not likely to increase so that the need for imported soybeans will continue to grow unless the EC establishes trade barriers or policies to discourage the use of imported feeds in favor of internally produced feed stuffs. The elimination of Spanish import duties on soybeans may actually result in increased purchases.

The future of U.S. soybean exports to Europe depends primarily on the ability of U.S. negotiators to head off efforts by European officials to abrogate the agreements which prevent the imposition of trade barriers to soybean imports. The entry of three major olive oil producers will certainly affect the overall policies in the EC toward vegetable oils and fats and the evolution of the situation in these sectors may have some impact on European attitudes toward soybean imports. However, it is likely that the principal element in conditioning European attitudes will remain the problem of dairy surpluses and the extensive use of low-cost, imported soybeans in feed rations.

In general, enlargement in and of itself will not cause major changes in U.S. exports of corn and soybeans to Europe. The significant issue from the perspective of U.S. policy-makers is not enlargement per se, but rather the European desire to achieve self-sufficiency in food production. Several informants in France suggested that the problem of dairy surpluses in Europe would best be solved by taxing soybean imports. They argued that the price of soybean meal was so low relative to other feed stuffs that some producers are using soybean meal as a source of energy rather than as a source of protein. Rather than lowering prices received for milk products, these informants felt that raising costs would be the best way to eliminate surpluses.

These arguments reflect a common European attitude that food self-sufficiency should be achieved with European resources despite the nature of comparative advantage in food production. Spanish authorities share this conviction and may support efforts by other EC members to make greater use of indigenous resources by increasing barriers to imported feed stuffs and by adjusting relative prices. Since the enlarged EC may have a surplus in barley, these attitudes may affect policies with respect to corn as well as soybean imports. While U.S. corn and soybean producers have little to fear from the enlargement of the EC, further development of European attitudes toward dependency on U.S. feed imports may have a significant impact on the evolution of trade.

The conclusions and implied policy issues discussed in the preceding paragraphs are based on projections made with the Spanish feedgrain-livestock model. The projections are highly sensitive to the assumptions made and, in general, the researcher's judgement is very important in using the model. In its present form, the model represents an initial effort to describe the Spanish feedgrain-livestock economy and isolate the variables which will influence its development. Modifications in the model could improve its forecasting accuracy. Nevertheless, it constitutes a useful tool in estimating the direction of change and indicating potential issues related to the accession of Spain to the EC.

The comments in Chapters III to V concerning the validation of the model are reinforced in evaluating the projection results. The demand equations for bread cereals, poultry meat and eggs all led to unreasonable forecasts and had to be constrained. The use of time trends in several equations resulted in exaggerated projections and several of these equations were constrained or replaced by reasonable assumptions.

It should be emphasized that some of these defects may be unavoidable given the quality of the data and the development of these sectors over the base period. In estimating the equations a wide variety of specifications were used. The equations retained in the model were chosen over alternative specifications because they have the best statistical properties and the coefficients have the expected signs. Thus, although the use of these equations for historical simulation and projections sometimes leads to questionable results, they appear to reflect the information contained in the available data series. The real problem with many of these equations is the problem of missing variables since statistical series reflecting costs and technological change are unavailable.

Some improvement in forecasting reliability might be achieved with alternative specifications. Wheat and barley acreage might be better handled with an acreage share approach so that a decline in the acreage of one would be reflected in the acreage of the other. As noted elsewhere, the poultry sectors would probably experience a gradual slowing of expansion as relative profitability falls rather than the abrupt leveling off in the model. The improvements in model performance which could be obtained with these changes would probably contribute to the consistency of the forecasts but would not substantially alter the conclusions drawn from them.

The derived feed demand component of the model is adequate for the purposes of this study. By incorporating assumed ration shifts and feed price changes, it is possible to derive plausible predictions of feedgrain and soybean meal disappearance. However, these projections are more sensitive to the assumptions about feed-conversion ratios than to the predicted evolution of livestock numbers. In addition, alternative sources of nutrients are not included in the model. The addition of an optimum feed ration component might result in slightly more reliable feedgrain and soybean meal projections. The main advantage of such a component, however, resides in the increase in the range of issues which could be studied.

A more elaborate derived feed demand model could also lead to a better understanding of land use. For example, rather than using an estimated equation to predict forage acreage, this variable could be determined by assuming that forage demand calculated in an optimum ration component has to be satisfied by allocating sufficient acreage to forage crops. A similar procedure could be applied to sunflower seeds and other sources of feed which are produced in Spain. Introducing more intricate derived demand and land use components would increase the size and complexity of the model immensely and extend its capacity beyond the scope of this study.

The human demand model frequently leads to unreasonable long-term forecasts since it compounds errors over the projection period. This component would probably be best used for short-term forecasts based on actual values for lagged per capita consumption. The problem with the analysis of human demand in Spain is the inadequacy of consumption and retail price data. The difficulties of analyzing demand are compounded by structural and technological changes that have reduced costs and increased product availability. In addition to the sets of demand equations reported in Chapter III, a variety of single equation demand estimates were made. Some of these equations included alternative dependent variables such as per capita expenditure estimated as functions of different sets of retail prices selected on an ad hoc basis. These estimates frequently resulted in positive own-price elasticities and negative income elasticities. While it is possible that a different specification would improve the demand model somewhat, the author's experience suggests that the primary problem is the reliability of the available data series.

Researchers in Spain obtained better results in analyzing demand for some meats with single equation estimates using data from the period 1958 to 1973 (30). These researchers indicated that their efforts to estimate equations on the basis of statistical series extending to 1978 were unsuccessful. Other researchers using wholesale and farm prices as explanatory variables encountered difficulties in single equation estimation for the period 1954 to 1968 (50). If disaggregated price series were available for the provinces the

cross-sectional approach based on survey data used by Lluch would be a fruitful avenue for further research (51).

In using the model to project the evolution of the Spanish feedgrain-livestock economy, several estimated equations were replaced by plausible assumptions. With the exception of the three demand relationships, these equations are of minor importance. The change in stocks and feed milk equations, for example, were introduced primarily to complete the balance sheets and involve relatively small quantities. The faulty demand equations are a greater problem and it is clear that further research is needed to develop a reliable forecasting model. The present demand component must be complemented by judgement for long-term forecasts but is probably fairly reliable for short-term predictions.

Despite the weaknesses in the model noted above, it serves as a useful tool in analyzing potential adjustments and the consequent policy issues. In evaluating the model, it should be borne in mind that each component could reasonably form the object of a separate research project. Throughout the development of the model it has been necessary to make compromises between the need for detailed and accurate analysis of developments in a large number of sectors and the feasibility of building a complete model on the basis of the available data series and within the time available. The results of this exercise point to the need for further research in several areas.

As noted earlier, the analysis of consumer demand for food in Spain is an area where more research is needed. A related subject on which much fruitful research could be done is the impact of changes in marketing arrangements following entry. A Spanish research institute

(IRESCO) has carried out studies of marketing and distribution costs for 1976 (36). These studies do not isolate the factors which will be affected by accession to the EC and do not provide insights into the potential changes in marketing margins or distribution costs. Market structure and the likely changes in commercial organization constitute fertile fields for further investigation.

Commercial arrangements between producers and first handlers will also be profoundly affected by accession. The impact of altering SENPA's role in wheat commercialization as well as changes in the state trading system for livestock products are subjects upon which little formal research has been carried out. These questions are related to broader issues concerning the changes in Spanish institutions which will occur as Spain implements the CAP. The activities of FORPPA, SENPA, and CAT will have to be modified to conform to EC regulations. Institutional changes will have an impact on agricultural credit, farm organizations, the role of cooperatives, commercial and transportation enterprises and many other aspects of the Spanish agricultural economy. Much further research is needed to understand the basic institutional structure in Spain as well as the consequences of changes in these institutions.

While there is a great deal of information on the evolution of Spanish agricultural policy scattered among many sources, there does not appear to be a single, comprehensive study tracing the recent history of these policies. There is a need for such a study to provide background for analysis of future developments. A definitive work on Spanish agricultural policy would have to reconcile conflicting accounts in the diverse sources and fill in the many gaps in the story. This would involve collecting data on government prices as well as tracing the policy decisions made and the rationale for these decisions. It would also be useful to understand more fully the implementation of policy decisions and how they actually affect producers and consumers.

Further research on each of the specific sectors dealt with in this study would be useful. One approach to the analysis of these sectors would be to develop regional models. There is great regional variation in Spain which is obscured in aggregate models. One of the most interesting areas for research on the livestock sectors is the nature of livestock cycles in Spain. Not only would detailed descriptions of Spanish livestock cycles contribute to more accurate forecasts, but they would also open research possibilities on the nature of these cycles in general. It would be particularly interesting to examine the timing and duration of livestock cycles in different European countries to discover whether they have been in phase historically or whether the creation of the EC has operated to harmonize historically different cycles. With respect to the cropping enterprises, further research on the competition among cereal grains and other crops for irrigated land and the potential for enterprise shifts in response to price and policy changes would be useful.

Concluding Remarks

It is clear that enlargement of the EC to include Spain will have a significant impact on the Spanish feedgrain-livestock economy. The likely paths of adjustment noted in the previous paragraphs will result in several difficult policy issues for future Spanish administrations. Spanish membership will also influence the nature of EC policy toward these sectors and may lead to a worsening of existing problems or the development of new ones. In particular, it is unlikely that Spanish accession will contribute much to the solution of the problem of cereal grain and livestock product surpluses in the EC.

The effect of Spanish entry on third countries will probably be minor. In terms of U.S. exports of corn and soybeans enlargement may slow the rate of growth slightly and lead to changes in the direction of trade. However, the overall impact of enlargement will not seriously diminish the size of the European market. Spanish entry will also affect relations with other countries. For example, there may be some change in the traditional links between Spain and Latin America as the preferential arrangements between the EC and the African, Caribbean and Pacific (ACP) countries are implemented. These issues are beyond the scope of this study but may be of significance to the countries involved.

The implications of enlargement discussed in this study concern the cereal grain and livestock sectors. The effect of Spanish accession on other sectors is of greater concern in many instances than the issues raised in this study. The most controversial problem areas are in the fruit and vegetable, wine and olive oil sectors rather than in feedgrains and livestock products. Nevertheless, cereal grains and livestock are of great importance to Spain and the EC and the issues suggested by the results of this study are likely to become the object of extensive negotiation and debate as Spain implements the EC policies.

APPENDICES

APPENDIX A

APPENDIX A

RETAIL PRICES

The purpose of this appendix is to present detailed information on the way in which the variables involved in the demand component of the model were developed. The OECD Milk and Meat Balances provided the bulk of the information used in developing per capita consumption data. There are no published statistics on average, annual retail prices in Spain so these data had to be estimated on the basis of information contained in several sources.

Retail Prices

The Anuario Estadistico de España (39) includes wholesale price indices and base prices for a great many food commodities. Retail prices were estimated on the basis of these wholesale prices, assumptions about wholesale-retail margins and whatever data on retail prices were available. Originally, an effort was made to estimate demand relationships for thirteen food categories. These categories had to be aggregated due to lack of degrees of freedom in the demand model employed. Retail prices were estimated for all thirteen categories and then aggregated into the eight food categories appearing in the model. Detailed descriptions of the methods employed in estimating these prices will be presented in the following sections.

1. <u>Milk</u>

The retail price for milk used in the analysis is an average annual price for all milk products from cow, sheep and goat milk. Per capita disappearance and wholesale price data apply to all liquid milk and various milk products. Estimates of retail prices for liquid milk were available for 1964-1967 and 1970-1972 (11 and 28). On the basis of these retail prices, margins between wholesale and retail prices were estimated to generate a series of retail prices for liquid milk.

The wholesale and retail prices used in developing this series were in terms of pesetas per liter while the data on consumption are in kilograms. A conversion factor, one liter of milk equal to 1.03 kilograms, was used to translate these prices into the correct units. Table A.1 contains the retail prices used for liquid milk.

Derivation of prices for milk products were much more complicated. The first step involved developing a weighted wholesale price for cheeses, butter, powdered milk and condensed milk. This average wholesale price was developed by using per capita consumption of the various products to weight the wholesale price series, which was in terms of pesetas per kilogram of product. The consumption data were in terms of kilograms of liquid milk disappearing into milk products. In 1977 about 3.5 kilograms of liquid milk were used for a kilogram of cheese, butter, and other milk products. This figure was used to convert the composite wholesale price for milk products into kilograms of liquid equivalent.

Since no other information was available, the wholesale price for milk products was compared with the wholesale price for liquid

TABLE A.1

Milk Prices and Per Capita Consumption

Year	Liquid Wholesale Price (pts/liter)	Margin	Liquid Retail Price (pts/liter)	Liquid Retail Price (pts/kg)	Liquid Milk Consumption (kg)	Processed Milk Retail Price (pts/kg)	Processed Milk Consumption (kg)	All Milk Retail Price (pts/kg)
1960	4.93	1.150	5.80	5.63	64.8	10.17	16.2	6.54
1961	4.88	1.150	5.74	5.57	67.6	8.71	17.3	6.21
1962	5.01	1.150	5.89	5.72	68.1	10.41	16.8	6.65
1963	5.28	1.160	6.29	6.11	70.2	10.92	17.9	7.09
1964	5.80	1.173*	7.01	6.81	69.7	13.03	17.7	8.07
1965	6.52	1.159*	7.75	7.52	66.4	15.70	21.2	9.50
1966	6.79	1.181*	8.29	8.05	70.0	16.62	28.2	10.51
1967	7.02	1.223*	9.03	8.77	73.7	19.62	32.4	12.08
1968	7.02	1.300	10.03	9.74	80.1	21.00	35.2	13.18
1969	7.03	1.361	11.00	10.68	86.7	23.45	36.2	14.44
1970	7.39	1.346*	11.30	10.97	85.3	26.45	38.1	15.75
1971	8.24	1.360*	12.88	12.50	88.7	27.77	37.5	17.04
1972	9.36	1.374*	14.95	14.51	86.4	33.99	42.1	20.89
1973	9.53	1.375	15.25	14.81	92.5	35.67	45.0	21.64
1974	10.89	1.380	17.56	17.05	102.6	48.14	45.8	26.65
1975	13.27	1.390	21.75	21.12	102.4	53.32	42.5	30.57
1976	15.07	1.400	25.12	24.39	105.5	57.50	44.1	34.15
1977	16.76	1.400	27.93	27.12	103.8	59.11	46.0	36.94
1978	18.42	1.400	30.70	29.81	106.3	67.89	47.1	41.50

Source: 11, 28, 67 and author's calculations.

*Based on actual data; the other margins are estimates.

milk. Generation of the milk product retail price series was accomplished with the following formula:

> milk product retail price = ((milk product wholesale price in liquid equivalent - liquid milk wholesale price)/liquid milk wholesale price)*liquid milk retail price.

The actual price for milk used in the demand model was the average of the liquid milk retail price and the milk products retail price weighted by consumption. Table A.1 shows the milk consumption and price data used in the model.

2. Eggs

Retail prices for eggs were derived using the same procedure as for liquid milk. Actual data for 1964-1967 and 1969, 1970 and 1972 were used to estimate wholesale to retail price margins. After 1970 there was a maximum legal wholesale to retail margin of 14 percent in Spain. This was used as a control on margins for 1970-1978. Actual data indicated that the margins were less than 14 percent from 1975 to 1978. Using this information estimates of the margins were applied to the wholesale price series to obtain estimated retail prices which are shown in Table A.2. Prices and consumption data are in terms of kilograms although the production data are expressed in millions of dozens.

3. Beef and Veal

Beef and veal prices were derived largely on the basis of an estimated series of retail beef prices used in a study by Gutierrez, Salas and Zuñiga (30) covering the period 1960 to 1973. This study

TABLE A.2

Egg Prices and Per Capita Consumption

Year	Wholesale Price (pts/kg)	x Margin =	Retail Price (pts/kg)	Per Capita Consumption (kg)
1960	38.62	1.300	50.21	6.2
1961	37.88	1.300	49.24	7.5
1962	37.41	1.300	48.63	8.3
1963	40.84	1.300	53.09	11.2
1964	39.17	1.314	51.47	10.1
1965	48.49	1.301	63.09	10.2
1966	42.93	1.216	52.20	11.8
1967	44.80	1.236	55.37	11.2
1968	43.82	1.240	54.34	11.9
1969	40.19	1.264	50.80	12.8
1970	44.04	1.095	48.22	13.9
1971	48.09	1.140	54.82	14.8
1972	40.66	1.144	46.52	16.4
1973	49.12	1.140	56.00	12.6
1974	59.84	1.140	68.22	13.8
1975	61.84	1.130	69.88	16.1
1976	64.10	1.130	72.43	17.0
1977	67.95	1.124	76.38	16.5
1978	83.64	1.129	94.43	15.4

Source: 39, 67 and author's calculations.

had prices for bovino menor and bovino mayor. Using the proportion of total production from menor and mayor cattle a weighted average retail beef price was derived. From 1974 to 1978 (not covered in the study) retail prices were derived by applying estimates of the wholesale to retail price margins to the wholesale price series for beef.

Retail veal prices were estimated by using actual data for 1964-1967 and 1969-1971 to estimate wholesale retail margins. The estimated margins were compared with those for beef and appeared to be reasonable. The consumption category in the demand model was for beef and veal so the retail price series for these two commodities were weighted by consumption to obtain a composite retail price. This information is summarized in Table A.3.

When the total expenditures for all meats were totaled, the amount was less than the proportion of personal expenditures devoted to all meats as shown in the Spanish national accounts (2). A factor was derived to correct all the meat prices so that personal expenditures on meat would be consistent with the national accounts. The retail price for beef and veal in Table A.3 has been multiplied by this factor and, therefore, cannot be derived directly from the data in the other parts of the table. The meat factor will be further described in discussing the national accounts data used in the demand model.

4. Pigmeat

The basic procedure for estimating retail pigmeat prices was the same as for beef. Using data on the proportions of meat production used for processing (sausages, ham, etc.) and sold as fresh meat

TABLE A.3

Beef and Veal Prices and Per Capita Consumption

	BEEF				VEAL				BEEF AND VEAL	
Year	WSP	Margin	RP	Cons.	WSP	Margin	RP	Cons.	Cons.	RP
1960	36.91	1.486	54.86	3.6	44.43	1.700	75.53	2.0	5.6	90.87
1961	38.83	1.526	59.24	3.8	47.18	1.700	80.21	2.1	5.9	88.72
1962	46.02	1.513	69.61	4.7	55.34	1.700	94.08	2.0	6.7	95.37
1963	44.72	1.581	70.68	6.1	57.52	1.700	97.78	2.1	8.2	90.82
1964	49.76	1.520	75.66	5.1	60.74	1.696	103.02	2.6	7.7	105.27
1965	66.17	1.508	99.81	5.5	81.39	1.663	135.37	2.3	7.8	127.94
1966	62.90	1.555	97.81	6.1	82.22	1.698	139.57	2.8	8.9	133.14
1967	65.50	1.523	99.76	6.9	88.98	1.678	149.30	3.1	10.0	143.90
1968	64.96	1.514	98.36	7.6	88.43	1.675	148.12	3.2	10.8	149.30
1969	69.08	1.537	106.15	7.9	92.63	1.670	154.69	3.3	11.2	150.57
1970	72.21	1.516	109.46	9.7	93.28	1.670	155.78	2.4	12.1	154.24
1971	82.58	1.458	120.39	9.4	103.46	1.668	172.53	2.4	11.8	155.88
1972	97.98	1.611	157.80	9.5	122.65	1.611	197.59	1.8	11.3	177.27
1973	97.88	1.608	157.38	9.8	128.32	1.608	206.34	2.2	12.0	187.98
1974	109.46	1.600	175.14	9.5	138.33	1.600	221.33	2.5	12.0	218.02
1975	111.76	1.600	178.82	11.4	149.83	1.600	239.73	2.6	14.0	235.76
1976	141.64	1.600	226.62	11.3	185.56	1.600	296.90	2.5	13.8	296.80
1977	149.59	1.600	239.34	10.5	203.70	1.600	325.92	2.5	13.0	350.71
1978	188.18	1.600	301.09	10.2	214.21	1.600	342.74	2.5	12.7	423.73

Source: 11, 28, 30, 66 and author's calculations.

WSP = wholesale price (pts/kg)
RP = retail price (pts/kg)
CONS = per capita consumption (kg per year)

(58), per capita consumption of these two types of pigmeat were derived. A wholesale price series exists for fresh pork but the wholesale prices for processed meat had to be estimated as weighted averages of prices for ham, sausage and bacon.

The article by Gutierrez,et al. included retail prices for fresh pork from 1960-1973 (30). Comparing these prices with the wholesale price series, margins were estimated and projected to 1978. The processed pork price was estimated by using the following formula:

(1 + (processed wholesale price - fresh wholesale price)/fresh wholesale price)*fresh retail price.

As with the other meat categories the fresh and processed retail price series were increased by a factor derived from the national accounts data so that total meat expenditure would equal the proportion of personal expenditure for meat as shown in the national account data. In the demand model, the price used is for all pigmeat and was derived as a weighted average of the fresh and processed retail prices. These calculations are summed up in Table A.4. As with the table on beef and veal prices, the weighted average price has been increased by the meat expenditure factor so these prices cannot be derived directly from the other columns in the table.

5. Poultry Meat, Sheep and Goat Meat

Retail prices for poultry were also based on the 1960-1973 retail price series in Gutierrez, et al. Margins between wholesale and retail prices were calculated for 1960-1973 and projected to 1978. The final retail price was increased by the meat expenditure factor derived from the national account data. The procedure was identical

TABLE A.4

Pigmeat Prices and Per Capita Consumption

Year	FRESH PORK				PROCESSED PORK				ALL PIGMEAT	
	WSP	Margin	RP	Cons.	WSP	Margin*	RP	Cons.	Cons.	RP
1960	31.66	1.451	45.95	1.1	45.10	1.425	65.46	7.4	8.5	91.89
1961	37.30	1.480	55.21	1.2	50.09	1.343	74.14	6.8	8.0	94.83
1962	42.50	1.491	63.35	1.5	57.66	1.357	85.95	6.9	8.4	101.57
1963	39.10	1.530	59.81	1.9	59.38	1.519	90.83	8.4	10.3	99.58
1964	38.89	1.454	56.53	1.9	59.20	1.522	86.05	8.2	10.1	99.82
1965	54.36	1.511	82.14	2.0	75.65	1.392	114.31	7.2	9.2	124.49
1966	47.51	1.449	68.86	4.0	84.20	1.772	122.04	8.1	12.1	125.35
1967	45.93	1.450	66.58	4.3	73.79	1.607	106.97	8.5	12.8	116.75
1968	48.84	1.453	70.98	4.7	73.51	1.511	107.27	8.1	12.8	124.01
1969	52.51	1.409	73.98	5.0	73.03	1.391	102.89	8.1	13.1	114.82
1970	49.59	1.347	66.81	5.5	76.78	1.548	103.44	8.3	13.8	115.49
1971	56.46	1.318	74.41	6.0	85.85	1.521	113.14	8.9	14.9	116.08
1972	69.24	1.489	103.11	6.3	109.21	1.577	162.63	9.4	15.7	149.85
1973	67.48	1.440	97.16	8.0	125.82	1.865	181.16	9.8	17.8	162.05
1974	70.46	1.450	102.17	8.9	134.22	1.905	194.62	10.9	19.8	180.62
1975	87.84	1.450	127.37	8.7	147.22	1.676	213.47	10.1	18.8	215.30
1976	98.47	1.450	142.78	9.1	175.82	1.786	254.94	10.5	19.6	251.55
1977	101.15	1.450	146.67	9.2	214.46	2.120	310.97	11.2	20.4	324.52
1978	117.49	1.450	170.36	11.1	235.15	2.001	340.97	11.6	22.7	352.84

Source: 11, 28, 30, 66 and author's calculations.

*Processed pork margin is equal to: $1 + \left(\frac{\text{WSP (processed)} - \text{WSP (fresh)}}{\text{WSP (fresh)}}\right)$

WSP = wholesale price (pts/kg)
RP = retail price (pts/kg)
CONS. = per capita consumption (kg/year)

for sheep and goat meat. The calculations are summed up in Table A.5.

6. Bread Cereals

Developing average retail prices for bread cereals presented particular problems since no wholesale price series exist for bread cereals (wheat and rye). However, there was some policy information which could be used. SENPA, the government cereals agency, buys the entire wheat crop in Spain, adds a 5 percent margin, and sells it to first handlers. Using a weighted average farm gate price for wheat and rye the government margin allowed a first approximation of wholesale prices. The first handlers transform the cereals into flour which is either sold directly to retailers or sold to processors who make bread, pastas, and other wheat products sold to consumers by retailers. The global "extraction rate" (i.e., the proportion of a kilogram of cereal which is left after processing) is .75 for wheat and .6 for rye. The weighted average extraction rate is .74 reflecting the predominance of wheat in this category. Dividing the farm gate price by .74 gives the approximate value in usable cereal of a kilogram of wheat/rye. Based on an assessment of retail prices for various cereal products it was assumed that a further margin for processors and retailers would approximately double this price. The actual figure used (based on 1970 information and assumed constant throughout the period) was 1.984. To render the calculations simpler all of these transformations were combined in a single factor: 1.984 times a number is the same as that number divided by .504. The wholesale price for wheat and rye (= 1.05 x weighted average farm price for

TABLE A.5

Poultry, Sheep and Goat Meat Prices and Per Capita Consumption

Year	POULTRY MEAT					SHEEP/GOAT MEAT				
	WSP	Margin	RP	RPI	Cons.	WSP	Margin	RP	RPI	Cons.
1960	40.46	1.420	57.45	83.88	0.4	33.71	1.684	56.78	82.90	4.0
1961	37.25	1.554	57.88	76.98	2.6	38.52	1.692	65.17	86.68	3.7
1962	38.28	1.640	62.79	77.86	3.6	44.78	1.654	74.08	91.86	3.7
1963	34.96	1.566	54.75	64.06	6.0	48.34	1.736	83.92	98.19	3.7
1964	35.84	1.535	55.02	69.69	6.8	49.62	1.665	82.61	102.44	4.1
1965	38.02	1.640	62.34	71.27	7.5	66.00	1.587	104.73	121.49	4.2
1966	35.83	1.594	57.12	67.42	9.6	66.99	1.644	110.11	132.13	4.2
1967	35.12	1.591	57.21	66.95	10.9	73.07	1.644	120.16	150.20	4.1
1968	36.17	1.761	57.54	75.95	10.8	76.18	1.649	125.60	165.79	4.0
1969	30.69	1.697	54.04	70.03	11.7	78.61	1.675	131.64	164.55	3.9
1970	29.48	1.771	50.02	65.86	14.8	80.52	1.546	124.52	161.88	4.1
1971	34.10	1.843	60.38	71.85	14.1	93.43	1.435	134.09	159.57	4.0
1972	32.19	1.782	59.34	59.67	16.4	113.83	1.597	181.84	196.39	4.0
1973	37.75	1.782	67.26	76.00	17.3	127.53	1.545	197.02	222.63	4.2
1974	44.15	1.700	75.06	88.57	17.1	146.14	1.531	223.74	264.01	4.5
1975	47.70	1.650	78.71	97.60	17.9	169.65	1.531	259.73	322.07	4.2
1976	48.41	1.650	79.88	99.05	19.6	194.27	1.531	297.43	368.81	4.2
1977	57.49	1.650	94.74	129.79	20.4	229.18	1.531	350.87	480.69	4.0
1978	65.19	1.563	101.90	139.60	20.7	280.97	1.531	430.17	589.33	3.8

Source: 11, 28, 30, 66 and author's calculations.

WSP = wholesale price (pts/kg)
RP = retail price (pts/kg)
RPI = retail price corrected by meat expenditure factor (pts/kg)
CONS. = per capita consumption (kg/year)

wheat and rye) was divided by .373 (= .74 x .504) to estimate the retail price for bread cereals. The final retail price series is included in Table A.6.

7. <u>Other Food Prices</u>

The other food category used in the demand model includes beer and fish, two commodities which were treated separately in the original thirteen commodity formulations of the demand component. It is unfortunate that a larger time-series could not be established since it would have been interesting to consider fish, beer, veal, processed pork and processed milk products as separate demand equations. Part of each year's barley crop is used to make beer, the consumption of which has risen significantly over the past twenty years. Per capita fish consumption in Spain is higher than for any meat product and, clearly, competes with pork, beef, chicken, and sheep/goat meat as a source of protein. Since there were only nineteen observations, thirteen categories of consumer goods would have made the standard errors even larger than those reported in the demand analysis.

The "other food" price used in the model, thus, is a weighted average of beer, fish and other food prices. Retail beer prices were derived by multiplying the wholesale price series by 1.69. In 1970, the retail price for Spanish beer was 14.43 pts/liter while the wholesale price was 8.54 pts/liter (45). This information was used to derive the wholesale-retail margin which was assumed constant. Since all the consumption data are in terms of kilograms per capita, use of this price implies the assumption that one liter of beer weighs one kilogram.

TABLE A.6

Bread Cereal Prices and Consumption

Year	Average Farm Gate Price	A : .373 = Retail Price	Per Capita Disappearance
	A	B	C
1960	5.09	13.65	107.7
1961	5.45	14.61	103.5
1962	5.51	14.77	111.4
1963	5.98	16.03	95.9
1964	6.34	17.00	92.5
1965	6.59	17.66	92.4
1966	6.61	17.72	92.5
1967	6.64	17.80	88.1
1968	6.63	17.77	88.9
1969	6.62	17.74	76.4
1970	6.64	17.80	77.0
1971	6.67	17.38	75.3
1972	6.96	18.67	76.0
1973	7.11	19.06	77.5
1974	8.03	21.53	77.6
1975	9.50	25.48	79.7
1976	10.34	27.72	77.1
1977	11.85	31.77	76.9
1978	13.79	36.98	75.7

Source: 58, 65 and author's calculations.

An implied fish price was derived from the national accounts data. From 1964 to 1971, data were available on the per capita expenditure for fish. Using per capita fish consumption statistics an implied fish price was estimated (2). This price turned out to average about 150 percent of the wholesale price for fresh fish (39). Retail prices were thus estimated as 150 percent of the wholesale price series for fresh fish.

An average price for all other food commodities was derived as a residual. National account data provided annual expenditures on all food items. Using the estimated retail prices and consumption data for beef, veal, liquid milk, milk products, fresh pork, processed pigmeat, sheep/goat meat, poultry meat, eggs, bread cereals, beer, and fish total expenditure on these items could be calculated. Subtracting this figure from total food expenditure gave expenditure for other food items. Consumption of other food items was estimated by adding up the figures for all other commodities. Division of total expenditure by total consumption gave an implicit price for this category.

This price was then combined in a weighted average with beer and fish prices in the demand model. This rather indirect process resulted from the initial desire to treat beer and fish as separate demand categories. In future work with the model, the appropriate approach will be to calculate other food prices as estimated total expenditure on all items not included in the other demand equations divided by consumption of these items. It should be noted that this category also includes rabbit meat, horse meat and edible offals in addition to fish, beer, fruits and vegetables, wine, oils and fats, legumes and sugar. The relevant data are shown in Table A.7.

TABLE A.7

Other Food Consumption and Prices

Year	FISH		BEER		OTHER FOOD		Weighted Average
	RP	Cons.	RP	Cons.	RP	Cons.	Retail Price: Other Food
1960	24.18	27.3	10.68	11.3	8.95	442.0	9.86
1961	22.52	28.6	9.72	13.4	9.02	467.2	9.80
1962	26.54	29.7	9.65	14.9	10.14	451.6	11.11
1963	31.50	27.8	9.90	11.1	11.70	484.7	12.71
1964	29.43	29.5	12.47	21.5	12.22	483.9	15.10
1965	35.10	30.6	12.62	23.2	15.18	452.8	16.27
1966	37.28	29.7	12.69	25.9	15.72	471.2	16.79
1967	37.94	19.8	12.95	30.8	19.09	449.7	19.46
1968	40.23	22.3	13.33	31.6	20.14	439.1	20.61
1969	47.45	26.3	14.15	32.9	20.48	423.6	21.5
1970	45.86	24.9	14.43	36.8	19.48	435.4	20.4
1971	58.01	32.2	16.21	37.2	20.08	459.7	22.1
1972	69.69	32.1	17.02	35.9	20.38	492.8	23.0
1973	85.61	31.9	17.20	35.7	26.34	495.1	29.1
1974	106.71	33.2	18.83	43.5	29.03	518.0	32.6
1975	122.82	29.3	20.57	43.8	34.98	517.7	38.3
1976	122.99	27.8	23.76	44.0	42.82	522.2	45.2
1977	156.50	25.4	28.56	44.5	60.52	477.3	62.4
1978	191.82	24.9	34.39	45.0	69.24	491.4	71.9

Source: 58, 65 and author's calculations.

RP = retail price (pts/kg)
CONS. = per capita consumption (kg/year)

8. Non-food Prices

To complete the system of demand equations it was necessary to include non-food items. Per capita non-food expenditures were available from the national accounts data published by the OECD. In order to obtain an average price for non-food items the consumer price index was divided into a price index for food items and an index for non-food items on the basis of the historical weighting used in published CPI statistics. The weight attached to food was 49.39 percent from 1963-1976 (2). Using this figure, a non-food price index can be derived by the following formula: (CPI (all items) - .4939 CPI (food items))/.5061.

Dividing the per capita expenditure on non-food items by this price index gives an index of non-food consumption. The units for the non-food consumption series are meaningless because the price index is a measure with no units attached to it. Since the non-food equation was dropped from the system of demand equations for reasons explained in the description of that system, these considerations are of no importance. The focus of this study is on a particular set of food products. The other food and non-food categories are included primarily for theoretical purposes and to make the expenditures on individual items sum to the total personal expenditures indicated in the national accounts. Table A.8 shows the relevant data for these calculations. Table A.9 shows the breakdown of the Consumer Price Index in Spain for 1963-1976.

TABLE A.8

Personal Expenditure, Price Indices and Population

Year	PERSONAL EXPENDITURE ON:* (per capita) Food (pts)	Non-food (pts)	Total (pts)	PRICES INDICES*** CPI	CPI (Food)	CPI (Non-food)	Non-food Quantity	Population (millions)
1960	8704	7415	16119	79.4	77.6	81.1	91	30.3
1961	9201	8841	18042	81.4	80.3	82.5	107	30.6
1962	10235	10234	20469	86.0	86.5	85.5	120	30.9
1963	11920	12407	24327	93.5	95.2	91.8	135	31.2
1964	12562	14166	26728	100.0	100.0	100.0	142	31.6
1965	14536	17063	31599	113.2	115.8	110.7	154	31.9
1966	16036	19599	35635	120.2	121.0	119.4	164	32.3
1967	17485	22254	39739	128.0	125.6	130.3	171	32.6
1968	18576	24625	43201	134.3	131.3	137.2	179	39.9
1969	18820	28231	47051	137.2	133.9	140.4	201	33.3
1970	19236	32246	51482	145.0	138.8	151.1	213	33.6
1971	21231	36234	57465	156.9	149.5	164.1	221	34.0
1972	23880	43792	67672	170.0	176.5	163.7	268	34.4
1973	28935	51820	80755	189.5	183.7	195.2	265	34.7
1974	34860	63847	98707	219.2	210.1	228.1	280	35.1
1975	40644	74897	115541	256.4	246.0	266.5	331	35.5
1976	47820	92197	140017	301.5	292.1	310.7	291	35.8
1977	59120	115803	174923	375.4	361.2	389.3	301	36.2
1978	69489**	137941**	207430**	448.8	430.2	467.0	295	37.0

Source: 2, 58, 68 and author's calculations.

* Expenditure in current pesetas (figures rounded).

** Author's estimates.

***(1964=100)

TABLE A.9

Index of Cost of Living: National Averages

(1968=100)

Year	General Index (100%)	Food (49.39%)	Clothing (13.94%)	Housing (7.95%)	Household Expend. (9.89%)	Misc. (18.83%)
1963	69.6	72.5	61.4	68.4	77.1	65.3
1964	74.5	76.2	69.7	72.2	83.1	70.7
1965	84.3	88.2	78.5	79.8	89.0	77.1
1966	89.6	92.2	86.2	86.1	92.7	84.6
1967	95.3	95.7	96.1	93.6	96.8	93.5
1968	100.0	100.0	100.0	100.0	100.0	100.0
1969	102.2	102.0	102.5	101.4	101.0	103.5
1970	108.0	105.7	112.1	110.3	107.3	112.3
1971	116.9	113.9	121.5	112.6	115.5	124.1
1972	126.6	124.3	132.3	118.3	122.3	134.1
1973	141.1	140.2	151.2	130.5	131.5	145.5
1974	163.2	160.1	178.3	147.3	157.6	169.6
1975	190.9	187.4	204.5	167.8	185.7	202.5
1976	224.5	222.5	236.9	186.4	212.6	238.8

Source: (2)

9. Meat Correction Factor

Data were available from 1964 to 1971 on the breakdown of personal expenditures according to categories (2). A partial listing of these expenditure data are shown in Table A.10. When the sum of all expenditures on meat items given by the retail prices originally estimated was compared with these data, it was found that the estimated expenditure on meat was too low. Based on the national accounts data in Table A.10, a factor was derived and used to increase all meat prices so that total expenditure on meat would equal the proportions indicated in Table A.10. This factor varied from year to year and is shown in Table A.10.

10. National Account Data

Since national account data play a significant role in the estimation of these series, some comments on these data are in order. The primary source for these figures was the OECD data on national accounts in member countries. Unfortunately, these data are inconsistent. A series of figures for the period 1960-1969 included a breakdown of private final consumption expenditure according to food and non-food categories. This series was re-estimated by OECD and the figures are generally higher. The revised series does not include the breakdown by consumption categories. To estimate food and non-food consumption for 1960-1969 I applied the proportions in the original series to the revised data. The one year of overlap (1970) showed a significant discrepancy with food representing 42 percent of total expenditures in the original series and 37 percent in the revised series. In the absence of any other information I arbitrarily used a figure of 40 percent for food in 1970. The Spanish national

TABLE A.10

Personal Expenditures for Consumer Goods and Meat Price Correction Factor

(billion current pesetas)

Year	Expenditures			Meat Expend. / Total Food**	Estimated Proportion***	Meat Price Correction Factor****
	Total	Food*	Meat			
	A	B	C	D	E	F
1960	--	--	--	.19	.13	1.46
1961	--	--	--	.20	.15	1.33
1962	--	--	--	.21	.17	1.24
1963	--	--	--	.21	.18	1.17
1964	743.1	373	79	.21	.17	1.24
1965	886.9	436	98	.22	.19	1.16
1966	1012.8	494	118	.24	.20	1.20
1967	1139.9	530	130	.25	.20	1.25
1968	1250.7	572	142	.25	.19	1.32
1969	1378.7	617	156	.25	.20	1.25
1970	1522.1	680	178	.26	.20	1.30
1971	1701.8	748	190	.25	.21	1.19
1972	1968.4	--	--	.26	.24	1.08
1973	--	--	--	.26	.23	1.13
1974	--	--	--	.26	.22	1.18
1975	--	--	--	.26	.21	1.24
1976	--	--	--	.26	.21	1.24
1977	--	--	--	.26	.19	1.37
1978	--	--	--	.26	.19	1.37

Source: 2 and author's calculations.

* Includes alcohol and tobacco.

** 1964-1971 based on 2; other years are estimates. D=C/B.

*** Proportion indicated by original series of retail prices.

****F= ((D-E)/E) + 1

statistics bureau (INE) also published national account data (1972-1977) which differed from the OECD figures (39). Since the INE series included expenditure on food and other items it was used for the 1972-1977 period. Final consumption expenditure for 1978 was not divided into expenditure on food and other goods so the proportion spent on food was estimated on the basis of past trends. In summary, the data reported in Table 9 are based on both OECD and INE figures. From 1960-1969, the revised OECD series was used for total expenditures with food and non-food expenditures estimated on the basis of the proportions indicated in the original series. For 1970-1971 the series are taken directly from the revised OECD data, while from 1972-1978 the INE statistics are used. OECD population figures were used to put the expenditures on a per capita basis.

The data used refer to private consumption expenditure. There was no way to add government expenditures to the total. Since the food categories are based on disappearance and independent price estimates, these expenditures include government purchases. Thus, any discrepancy due to exclusion of government consumption will only affect the two residual items, other food and non-food. The data for 1970-1978 include net foreign purchases in Spain while the earlier series does not include these purchases. I added estimated net foreign purchases to the 1960-1969 data so that the series would be consistent.

Table A.11 shows the expenditure shares of the different commodities over time. These value shares are of interest in reflecting the change in allocation of the consumers' budget. The data used to calculate these shares show that the share of food in the consumer budget has been declining. Within the food category, bread cereals,

TABLE A.11

Expenditure Shares by Commodity

Year	Beef/Veal	Milk	Pork	Poultry Meat	Sheep/Goat	Eggs	Bread Cereals	Other Food	Non-food
1962	.0301	.0284	.0419	.0124	.0172	.0201	.0875	.2729	.495
1964	.0305	.0260	.0399	.0168	.0153	.0219	.0610	.2687	.520
1966	.0324	.0276	.0394	.0175	.0159	.0188	.0488	.2545	.545
1968	.0368	.0337	.0372	.0187	.0154	.0153	.0380	.2401	.565
1970	.0360	.0377	.0315	.0182	.0133	.0134	.0277	.2090	.613
1972	.0308	.0385	.0324	.0160	.0114	.0127	.0222	.1971	.639
1974	.0272	.0384	.0360	.0158	.0118	.0091	.0176	.1997	.644
1976	.0289	.0374	.0351	.0145	.0114	.0093	.0164	.1936	.653
1978	.0260	.0312	.0382	.0145	.0109	.0071	.0137	.1948	.664

Source: Author's calculations.

Figures may not sum to one due to rounding.

eggs, sheep and goat meat and other foods have experienced consistent declines in their shares of the food budget. The share of beef, poultry and milk increased until the early to mid 1970s while the share for pigmeat declined in the 1960s and began to increase in the 1970s.

Summary

In the absence of any official retail prices series, many sources and assumptions were needed to derive the relevant price series for the demand analysis. I do not pretend that the retail price series used in the demand model are completely accurate. They are, it is felt, the best estimates possible given the paucity of data. The details provided in this appendix should provide enough information to evaluate these estimated retail prices.

APPENDIX B

APPENDIX B

COMMODITY BALANCE SHEETS

The balance sheets presented in this appendix contain much of the data used in the model. They have been constructed to reflect the structure of the model with net trade appearing as a residual. Data series from the Anuario de Estadistica Agraria (58), a USDA data tape and other sources were sufficient to fill in most of the columns in the tables. Other data series had to be estimated on the basis of generally stable relationships. The procedures used are described in the following paragraphs. The figures in the tables have been rounded and are all expressed in units of one thousand metric tons.

1. Wheat and Rye

Production and net trade data series were taken from the Spanish statistical yearbook (58). Gross human consumption was developed from OECD food consumption data as described in Appendix A. Feed disappearance was taken from the USDA data tape. Complete balance sheets for Spanish products have been published in the Spanish statistical yearbook for the period 1973-1977. The figures for feed disappearance in these tables are not consistent with the USDA figures for 1973, 1976-1977. This is true for all the cereal crops. The decision was made to use the USDA figures throughout. Based on the Spanish balance sheets the amount of seed used appeared to bear a fairly constant relation to the number of hectares planted. The disappearance of wheat and rye as seed was estimated for all years except 1973-1977 by multiplying total acreage by 0.14. The use of wheat and rye for human consumption, feed and seed makes up domestic disappearance. Domestic availability is made up of production plus the change in stocks. Net trade is equal to the difference between availability and disappearance. In the model, net trade is taken as the residual. In deriving the data, however, net trade was known while there are no published statistics on the change in stocks. Thus, the data series on stock variation was derived using the historical series on availability, trade and production. It was only possible to verify the stock series for 1973-1977.

2. Barley and Oats

The procedures used for barley and oats were identical to those for the bread cereals. The factor used to derive disappearance as seed was 0.15. In addition, it was necessary to account for a small proportion used for industrial purposes, primarily the manufacture of beer. Data were available from the Spanish balance sheets indicating that industrial use constituted about 5 percent of total production for the period 1973-1977. The rest of the series was derived as 0.05 times domestic production. Stock variations were again estimated as a residual after the other columns had been filled in.

3. Corn and Sorghum

Production, trade and feed disappearance were taken from the sources already cited. Seed use was estimated as 0.033 times the total acreage. The USDA tape included a series on non-feed

TABLE B.1

Balance Sheet for Wheat and Rye

Year	Domestic Availability			Domestic Disappearance							Net Trade (X-M)
	Prod.	ΔStock	Dom. Avail.	Feed	Seed	Hum. Cons. (gross)	Rate	Hum. Cons. (net)	Per Capita Cons.	Total	
1960	3905	-1491	5396	426	664	4380	.745	3263	107.7	5470	- 74
1961	3782	- 555	4337	424	611	4251	.745	3167	103.5	5286	-949
1962	5265	414	4851	498	663	4620	.745	3442	111.4	5781	-930
1963	5283	380	4903	431	655	4016	.745	2992	95.9	5102	-199
1964	4323	- 456	4779	307	636	3923	.745	2923	92.5	4860	- 81
1965	5064	208	4856	315	651	3970	.745	2948	92.4	4936	- 82
1966	5202	84	5118	548	640	4011	.745	2988	92.5	5199	- 81
1967	5986	- 186	6172	891	652	3855	.745	2872	88.1	5398	+774
1968	5667	- 428	6095	789	606	3926	.745	2925	88.9	5321	+774
1969	4944	- 533	5477	584	577	3415	.745	2544	76.4	4576	+901
1970	4319	-1076	5395	941	569	3472	.745	2587	77.0	4982	+413
1971	5724	903	4821	1005	544	3436	.745	2560	75.3	4985	-164
1972	4825	- 168	4993	730	541	3509	.745	2614	76.0	4780	-213
1973	4218	- 712	4930	708	413	3609	.745	2689	77.5	4730	+200
1974	4788	- 113	4901	672	481	3694	.737	2724	77.6	4847	+ 54
1975	4543	151	4392	196	408	3791	.746	2829	79.7	4395	- 3
1976	4650	453	4197	113	423	3698	.746	2760	77.1	4234	- 37
1977	4292	140	4152	122	449	3731	.746	2784	76.9	4302	-150
1978	5057	827	4230	125	414	3755	.746	2801	75.7	4294	- 64

Source: 58, 65 and USDA data tapes.

In thousands of metric tons except per capita consumption (kg./year).

TABLE B.2

Balance Sheet for Barley and Oats

Year	Domestic Availability			Domestic Disappearance							Net Trade (X-M)
	Prod.	ΔStock	Dom. Avail.	Feed	Seed	Hum. Cons. (gross)	Rate	Hum. Cons. (net)	Per Capita Cons.	Total	
1960	1993	- 244	2237	2008	214	78	--	--	--	2300	- 63
1961	2239	27	2212	2239	218	87	--	--	--	2544	-332
1962	2675	- 110	2785	2568	217	108	--	--	--	2893	-108
1963	2537	- 347	2884	2926	217	104	--	--	--	3247	-363
1964	2317	259	2058	2529	207	96	--	--	--	2832	-774
1965	2261	- 54	2315	2553	206	95	--	--	--	2854	-539
1966	2448	- 27	2475	2736	201	100	--	--	--	3037	-562
1967	3068	313	2755	2868	225	129	--	--	--	3222	-467
1968	3980	- 252	4232	3782	288	172	--	--	--	4242	- 10
1969	4424	- 178	4602	3838	317	194	--	--	--	4349	+253
1970	3498	- 375	3873	3302	334	155	--	--	--	3791	+ 82
1971	5367	45	5322	4959	345	239	--	--	--	5543	-221
1972	4798	- 33	4831	4243	378	218	--	--	--	4839	- 8
1973	4827	- 179	5006	4259	416	260	--	--	--	4935	+ 71
1974	5963	- 73	6036	5399	488	270	--	--	--	6157	+121
1975	7337	841	6496	5685	488	285	--	--	--	6429	+ 28
1976	6001	-1381	7392	6340	488	300	--	--	--	7128	+254
1977	7184	- 245	7429	6601	490	334	--	--	--	7425	+ 4
1978	8621	870	7751	6818	528	403	--	--	--	7749	+ 2

Source: 58, 65 and USDA data tapes.

In thousands of metric tons.

disappearance. The disappearance of corn and sorghum into seed was subtracted from this series to leave "human" consumption, probably made up primarily of such products as corn starch, breakfast cereals, etc. No relationship could be discovered to account for this use so it was left at the 1978 level in all the projections. Stock variation was derived in the same manner as for the other cereals.

4. Livestock Products

Most livestock products are simpler to treat than the cereal grains. For all the meat categories domestic disappearance is equal to total human consumption which is described in Chapter III and Appendix A. Total production and net trade were taken from the Spanish statistical yearbook. The implied stock variations were generally very small, frequently the result of rounding errors rather than any conscious policy of building or releasing stocks. Since the stock variations were so small throughout most of the historical period they are not specifically treated in the model. Thus, net trade is taken as the difference between production and consumption. In reality it includes changes in stocks.

The production statistics for eggs were presented in terms of millions of dozens. To balance egg production with consumption in metric tons, it was necessary to convert a dozen eggs into kilograms. The conversion rate, derived from OECD statistics, is shown in the "extraction rate" column of the egg balance sheet. As for the meat categories, trade and stock variations are lumped together as the difference between consumption and production.

TABLE B.3

Balance Sheet for Corn and Sorghum

	Domestic Availability			Domestic Disappearance							
Year	Prod.	ΔStock	Dom. Avail.	Feed	Seed	Hum. Cons. (gross)	Rate	Hum. Cons. (net)	Per Capita Cons.	Total	Net Trade (X-M)
1960	1019	- 203	1222	1247	14	29	--	--	--	1290	- 68
1961	1074	22	1052	1256	15	32	--	--	--	1303	- 251
1962	927	- 512	1439	1690	14	41	--	--	--	1745	- 306
1963	1187	- 288	1475	2347	16	75	--	--	--	2438	- 963
1964	1254	174	1080	2175	17	64	--	--	--	2256	-1176
1965	1185	- 821	2006	3479	16	114	--	--	--	3609	-1603
1966	1194	60	1134	3703	16	113	--	--	--	3832	-2698
1967	1239	15	1224	3734	16	120	--	--	--	3870	-2646
1968	1564	83	1481	3680	17	119	--	--	--	3816	-2335
1969	1664	23	1641	3863	16	129	--	--	--	4008	-2367
1970	2012	- 271	2283	4062	13	357	--	--	--	4432	-2169
1971	2231	318	1913	4220	18	351	--	--	--	4589	-2676
1972	2100	- 409	2509	4654	18	347	--	--	--	5019	-2510
1973	2202	-1073	3275	5948	18	220	--	--	--	6186	-2911
1974	2149	119	2030	6239	14	270	--	--	--	6523	-4493
1975	1938	192	1746	6161	15	280	--	--	--	6456	-4710
1976	1704	- 653	2357	5899	16	397	--	--	--	6312	-3955
1977	2084	26	2058	6332	16	398	--	--	--	6746	-4688
1978	2253	727	1526	6275	15	410	--	--	--	6400	-4874

Source: 58, 65 and USDA data tapes.

In thousands of metric tons.

The milk balance sheet includes cow, sheep and goat milk consumed in liquid form and as processed milk products. It is essentially the same as for the other livestock products except that it includes the use of milk to feed livestock. The amounts of milk fed were taken from the OECD Milk Balances and the Spanish statistical yearbook. The trade statistics are for fresh liquid milk only, excluding foreign butter, cheese and other milk products. Consistent statistics on trade in these products were unavailable.

TABLE B.4

Balance Sheet for Beef and Veal

Year	Domestic Availability			Domestic Disappearance							Net Trade (X-M)
	Prod.	ΔStock	Dom. Avail.	Feed	Seed	Hum. Cons. (gross)	Rate	Hum. Cons. (net)	Per Capita Cons.	Total	
1960	160	-10	170	--	--	170	--	--	5.6	170	0
1961	178	1	177	--	--	181	--	--	5.9	181	- 4
1962	163	- 2	165	--	--	207	--	--	6.7	207	- 42
1963	172	- 1	173	--	--	256	--	--	8.2	256	- 83
1964	225	1	224	--	--	243	--	--	7.7	243	- 19
1965	177	- 3	180	--	--	249	--	--	7.8	249	- 69
1966	198	- 1	199	--	--	287	--	--	8.9	287	- 88
1967	215	- 4	219	--	--	326	--	--	10.0	326	-107
1968	241	- 5	246	--	--	355	--	--	10.8	355	-109
1969	256	- 5	261	--	--	373	--	--	11.2	373	-112
1970	308	0	308	--	--	407	--	--	12.1	407	- 99
1971	324	-43	367	--	--	401	--	--	11.8	401	- 34
1972	303	- 8	311	--	--	389	--	--	11.3	389	- 78
1973	371	30	341	--	--	416	--	--	12.0	416	- 75
1974	416	9	407	--	--	421	--	--	12.0	421	- 14
1975	454	-16	470	--	--	497	--	--	14.0	497	- 27
1976	418	-32	450	--	--	494	--	--	13.8	494	- 44
1977	431	10	421	--	--	471	--	--	13.0	471	- 50
1978	391	- 6	397	--	--	470	--	--	12.7	470	- 73

Source: 58, 66.

In thousands of metric tons except per capita consumption (kg./year).

TABLE B.5

Balance Sheet for Milk (Cow, Sheep and Goat)

	Domestic Availability			Domestic Disappearance							Net Trade (X-M)
Year	Prod.	ΔStock	Dom. Avail.	Feed	Seed	Hum. Cons. (gross)	Rate	Hum. Cons. (net)	Per Capita Cons.	Total	
1960	3230	-51	3281	827	--	2454	--	--	81.0	3281	0
1961	3547	- 1	3548	951	--	2598	--	--	84.9	3549	- 1
1962	3574	0	3574	952	--	2623	--	--	84.9	3575	- 1
1963	3844	4	3840	1091	--	2749	--	--	88.1	3840	0
1964	3883	- 2	3885	1123	--	2762	--	--	87.4	3885	0
1965	4045	5	4040	1250	--	2794	--	--	87.6	4044	- 4
1966	4544	2	4542	1380	--	3172	--	--	98.2	4552	- 10
1967	4354	11	4353	897	--	3459	--	--	106.1	4356	- 13
1968	4666	29	4637	873	--	3793	--	--	115.3	4666	- 29
1969	5000	- 3	5003	912	--	4093	--	--	122.9	5005	- 2
1970	5042	3	5039	931	--	4146	--	--	123.4	5077	- 38
1971	4944	- 1	4945	830	--	4291	--	--	126.2	5121	-176
1972	5196	0	5196	838	--	4420	--	--	128.5	5258	- 62
1973	5492	- 1	5493	768	--	4771	--	--	137.5	5539	- 46
1974	5593	- 7	5600	747	--	5209	--	--	148.4	5956	-356
1975	5669	- 4	5673	702	--	5144	--	--	144.9	5846	-173
1976	5899	- 2	5901	596	--	5356	--	--	149.6	5952	- 51
1977	6054	- 6	6060	640	--	5423	--	--	149.8	6063	- 3
1978	6235	- 4	6239	565	--	5676	--	--	153.4	6241	- 2

Source: 58, 67.

In thousands of metric tons except per capita consumption (kg./year).

TABLE B.6

Balance Sheet for Pigmeat

Year	Domestic Availability			Domestic Disappearance							Net Trade (X-M)
	Prod.	ΔStock	Dom. Avail.	Feed	Seed	Hum. Cons. (gross)	Rate	Hum. Cons. (net)	Per Capita Cons.	Total	
1960	258	0	258	--	--	258	--	--	8.5	258	0
1961	239	- 1	240	--	--	245	--	--	8.0	245	- 5
1962	245	- 1	246	--	--	260	--	--	8.4	260	-14
1963	311	- 1	312	--	--	321	--	--	10.3	321	- 9
1964	317	- 2	319	--	--	319	--	--	10.1	319	0
1965	266	- 2	268	--	--	293	--	--	9.2	293	-25
1966	367	0	367	--	--	391	--	--	12.1	391	-24
1967	417	0	417	--	--	417	--	--	12.8	417	0
1968	419	0	419	--	--	421	--	--	12.8	421	- 2
1969	436	1	435	--	--	436	--	--	13.1	436	- 1
1970	492	28	464	--	--	464	--	--	13.8	464	0
1971	475	-31	506	--	--	507	--	--	14.9	507	- 1
1972	461	- 3	464	--	--	540	--	--	15.7	540	-76
1973	589	9	580	--	--	618	--	--	17.8	618	-38
1974	710	22	688	--	--	695	--	--	19.8	695	- 7
1975	602	-21	623	--	--	667	--	--	18.8	667	-44
1976	649	0	649	--	--	702	--	--	19.6	702	-53
1977	735	3	732	--	--	738	--	--	20.4	738	- 6
1978	803	0	803	--	--	840	--	--	22.7	840	-37

Source: 58, 66.

In thousands of metric tons except per capita consumption (kg./year).

TABLE B.7

Balance Sheet for Poultry Meat

Year	Domestic Availability			Domestic Disappearance							Net Trade (X-M)
	Prod.	ΔStock	Dom. Avail.	Feed	Seed	Hum. Cons. (gross)	Rate	Hum. Cons. (net)	Per Capita Cons.	Total	
1960	13	0	13	--	--	12	--	--	0.4	12	+1
1961	82	0	82	--	--	80	--	--	2.6	80	2
1962	110	0	110	--	--	111	--	--	3.6	111	-1
1963	187	0	187	--	--	187	--	--	6.0	187	0
1964	214	0	214	--	--	215	--	--	6.8	215	-1
1965	234	1	235	--	--	239	--	--	7.5	239	-4
1966	306	-1	305	--	--	310	--	--	9.6	310	-5
1967	353	1	352	--	--	355	--	--	10.9	355	-3
1968	351	1	350	--	--	355	--	--	10.8	355	-5
1969	386	-2	388	--	--	390	--	--	11.7	390	-2
1970	499	1	498	--	--	497	--	--	14.8	497	+1
1971	477	2	475	--	--	479	--	--	14.1	479	-4
1972	554	-2	556	--	--	564	--	--	16.4	564	-8
1973	600	0	600	--	--	600	--	--	17.3	600	0
1974	608	1	607	--	--	600	--	--	17.1	600	+7
1975	631	0	631	--	--	636	--	--	17.9	636	-5
1976	696	2	698	--	--	702	--	--	19.6	702	-4
1977	735	1	736	--	--	739	--	--	20.4	739	-3
1978	755	2	757	--	--	766	--	--	20.7	766	-9

Source: 58, 66.

In thousands of metric tons except per capita consumption (kg./year).

TABLE B.8

Balance Sheet for Sheep and Goat Meat

	Domestic Availability			Domestic Disappearance							
Year	Prod.	ΔStock	Dom. Avail.	Feed	Seed	Hum. Cons. (gross)	Rate	Hum. Cons. (net)	Per Capita Cons.	Total	Net Trade (X-M)
1960	122	0	122	--	--	121	--	--	4.0	121	+1
1961	115	0	115	--	--	113	--	--	3.7	113	+2
1962	114	0	114	--	--	114	--	--	3.7	114	0
1963	114	0	115	--	--	115	--	--	3.7	115	-1
1964	128	0	128	--	--	130	--	--	4.1	130	-2
1965	134	- 1	135	--	--	134	--	--	4.2	134	+1
1966	133	- 3	136	--	--	136	--	--	4.2	136	0
1967	134	- 2	136	--	--	134	--	--	4.1	134	+2
1968	131	- 3	134	--	--	132	--	--	4.0	132	+2
1969	130	0	130	--	--	130	--	--	3.9	130	0
1970	140	1	139	--	--	138	--	--	4.1	138	+1
1971	136	- 1	137	--	--	136	--	--	4.0	136	+1
1972	137	- 1	138	--	--	138	--	--	4.0	138	0
1973	144	- 1	145	--	--	146	--	--	4.2	146	-1
1974	155	- 1	156	--	--	158	--	--	4.5	158	-2
1975	148	0	148	--	--	149	--	--	4.2	149	-1
1976	146	0	146	--	--	150	--	--	4.2	150	-4
1977	144	0	144	--	--	145	--	--	4.0	145	-1
1978	130	-12	142	--	--	141	--	--	3.8	141	+1

Source: 58, 66.

In thousands of metric tons except per capita consumption (kg./year).

TABLE B.9

Balance Sheet for Eggs

Year	Domestic Availability			Domestic Disappearance							Net Trade (X-M)
	Prod.	ΔStock	Dom. Avail.	Feed	Seed	Hum. Cons. (gross)	Rate*	Hum. Cons. (net)	Per Capita Cons.	Total	
1960	188	0	188	--	--	188	.6022	--	6.2	--	0
1961	230	0	230	--	--	230	.6013	--	7.5	--	0
1962	256	0	256	--	--	256	.5972	--	8.3	--	0
1963	348	0	348	--	--	349	.6004	--	11.2	--	- 1
1964	319	0	319	--	--	319	.6011	--	10.1	--	0
1965	326	1	325	--	--	325	.6603	--	10.2	--	0
1966	379	-1	380	--	--	381	.6605	--	11.8	--	- 1
1967	365	0	365	--	--	365	.6599	--	11.2	--	0
1968	392	0	392	--	--	392	.6594	--	11.9	--	0
1969	432	0	432	--	--	426	.6908	--	12.8	--	+ 6
1970	471	-1	472	--	--	467	.6893	--	13.9	--	+ 5
1971	501	-1	502	--	--	503	.6894	--	14.8	--	- 1
1972	570	1	569	--	--	564	.6904	--	16.4	--	+ 5
1973	442	2	440	--	--	437	.6898	--	13.8	--	+ 3
1974	490	2	488	--	--	484	.6900	--	13.8	--	+ 4
1975	584	4	580	--	--	572	.6906	--	16.1	--	+ 8
1976	623	-1	624	--	--	609	.6902	--	17.0	--	+15
1977	631	-1	632	--	--	597	.6965	--	16.5	--	+35
1978	587	-2	589	--	--	570	.6964	--	15.4	--	+19

Source: 58, 67.

*Rate used to convert production in millions of dozens to production in thousands of metric tons.

In thousands of metric tons except per capita consumption (kg./year).

APPENDIX C

APPENDIX C

PROJECTIONS OF EXOGENOUS VARIABLES

The tables in this Appendix contain the projections of exogenous variables used in the three scenarios. The symbols used are defined in Table 6.1 and Appendix E. The dairy return (DRET), cull beef return (BRET), calf margin (DG), and hog-corn ratio (HCRAT) are not presented but can be computed from the variables in these tables according to the definitions in Chapter IV.

In addition to the projected variables fifteen exogenous variables are set at constant levels for the forecasts. The values used for these variables are listed below.

1.	cattle replacement rate (BREP)	.115
2.	cattle cull rate (CULL)	.116
3.	calving rate (CR)	.667
4.	rice acreage (RICE)	68.3
5.	rye, oat, sorghum irrigated acreage (ROSIA)	53.1
6.	other irrigated cereal acreage (OICA)	.4
7.	other cereal dry acreage (ODCA)	30.4
8.	hog replacement rate (PREP)	.225
9.	broiler slaughter weight (BRSW)	1.48
10.	eggs per hen (EGY)	227
11.	bread cereal extraction rate (BCEXT)	.746

12.	non-feed corn/sorghum disappearance (CNSDO)	425
13.	eggs per kilogram (EGCON)	.70
14.	cattle premium (CP)	0
15.	non-chicken eggs (OTEG)	6.0
16.	surviving pigs per sow (PPS)	8.51

TABLE C.1

Exogenous Variables Projected Differently in the Three Scenarios

Variable	Year	Baseline Scenario	First EC Scenario	Second EC Scenario	(B - A)/A	(C - A)/A
		A	B	C		
		a. Prices Received by Farmers				
DPRV	1980	33.5	30.1	30.1	-	-
	1982	32.4	30.6	28.5	-	-
	1984	31.3	30.0	26.3	-	-
	1986	30.2	30.1	24.7	-	-
	1988	29.1	30.0	22.9	-	-
	1990	28.0	30.0	21.2	.07	-.24
DPRCB	1980	15.10	17.1	17.1	-	-
	1982	13.50	17.3	16.2	-	-
	1984	11.80	17.0	14.9	-	-
	1986	10.20	17.1	14.0	-	-
	1988	8.55	17.0	13.0	-	-
	1990	6.92	17.0	12.0	1.46	.73
DPRN	1980	28.6	28.4	28.4	-	-
	1982	27.8	28.9	27.0	-	-
	1984	27.0	28.3	24.9	-	-
	1986	26.3	28.5	23.2	-	-
	1988	25.5	28.4	21.7	-	-
	1990	24.7	28.4	20.1	.15	-.19
DHPR	1980	18.90	18.9	18.9	-	-
	1982	16.90	21.4	21.4	-	-
	1984	14.90	22.2	22.2	-	-
	1986	12.90	23.1	23.1	-	-
	1988	11.00	23.6	23.6	-	-
	1990	8.97	24.0	24.0	1.67	1.67

TABLE C.1 (continued)

Variable	Year	Baseline Scenario A	First EC Scenario B	Second EC Scenario C	(B - A)/A	(C - A)/A
		a. Prices Received by Farmers (continued)				
DYOPR	1980	39.3	39.3	39.3	-	-
	1982	40.2	31.5	31.5	-	-
	1984	41.1	26.8	26.8	-	-
	1986	42.0	23.6	23.6	-	-
	1988	42.9	21.2	21.2	-	-
	1990	43.8	19.3	19.3	-1.27	-1.27
DADPR	1980	10.8	10.30	10.30	-	-
	1982	10.2	8.25	8.25	-	-
	1984	9.6	7.01	7.01	-	-
	1986	9.0	6.19	6.19	-	-
	1988	8.4	5.57	5.57	-	-
	1990	7.8	5.05	5.05	-.35	-.35
DMKPR	1980	8.95	8.95	8.95	-	-
	1982	8.98	8.98	8.98	-	-
	1984	9.01	9.01	9.01	-	-
	1986	9.04	9.04	9.04	-	-
	1988	9.07	9.07	9.07	-	-
	1990	9.10	9.10	9.10	-	-
DPOPR	1980	13.90	13.90	13.90	-	-
	1982	12.50	11.10	11.10	-	-
	1984	11.30	9.45	9.45	-	-
	1986	10.20	8.34	8.34	-	-
	1988	9.22	7.51	7.51	-	-
	1990	8.32	6.81	6.81	-.18	-.18

TABLE C.1 (continued)

Variable	Year	Baseline Scenario	First EC Scenario	Second EC Scenario	(B - A)/A	(C - A)/A
		A	B	C		
	a.	Prices Received by Farmers (continued)				
DEGPR	1980	10.00	10.00	10.00	-	-
	1982	9.17	8.00	8.00	-	-
	1984	8.38	6.80	6.80	-	-
	1986	7.66	6.00	6.00	-	-
	1988	7.00	5.40	5.40	-	-
	1990	6.40	4.90	4.90	-.23	-.23
DPRD	1980	4.22	4.22	4.22	-	-
	1982	4.05	4.01	3.76	-	-
	1984	3.88	3.79	3.35	-	-
	1986	3.71	3.73	3.07	-	-
	1988	3.54	3.67	2.81	-	-
	1990	3.37	3.65	2.58	.08	-.23
DWPR	1980	2.82	2.82	2.82	-	-
	1982	2.55	2.95	2.73	-	-
	1984	2.30	2.96	2.57	-	-
	1986	2.07	3.05	2.47	-	-
	1988	1.87	3.11	2.36	-	-
	1990	1.69	3.18	2.25	.88	.33
DBPR	1980	2.11	2.11	2.11	-	-
	1982	1.95	2.30	2.11	-	-
	1984	1.79	2.39	2.05	-	-
	1986	1.65	2.55	2.04	-	-
	1988	1.52	2.68	2.02	-	-
	1990	1.40	2.82	2.00	1.01	.43

TABLE C.1 (continued)

Variable	Year	Baseline Scenario	First EC Scenario	Second EC Scenario	(B - A)/A	(C - A)/A
		A	B	C		
	a.	Prices Received by Farmers (continued)				
DCPR	1980	2.93	2.93	2.93	-	-
	1982	2.68	3.05	2.83	-	-
	1984	2.43	3.06	2.66	-	-
	1986	2.18	3.14	2.55	-	-
	1988	1.93	3.20	2.43	-	-
	1990	1.68	3.27	2.31	.95	.38
DRPR	1980	2.28	2.28	2.28	-	-
	1982	2.06	2.45	2.25	-	-
	1984	1.86	2.51	2.16	-	-
	1986	1.68	2.65	2.13	-	-
	1988	1.51	2.76	2.08	-	-
	1990	1.37	2.88	2.04	1.10	.49
DOPR	1980	2.21	2.21	2.21	-	-
	1982	2.03	2.38	2.19	-	-
	1984	1.88	2.45	2.11	-	-
	1986	1.73	2.59	2.08	-	-
	1988	1.59	2.70	2.04	-	-
	1990	1.47	2.82	2.00	.92	.36
DSPR	1980	2.76	2.76	2.76	-	-
	1982	2.59	2.91	2.69	-	-
	1984	2.42	2.94	2.55	-	-
	1986	2.25	3.06	2.47	-	-
	1988	2.08	3.14	2.38	-	-
	1990	1.92	3.24	2.29	.69	.19

TABLE C.1 (continued)

Variable	Year	Baseline Scenario	First EC Scenario	Second EC Scenario	(B - A)/A	(C - A)/A
		A	B	C		
	a. Prices Received by Farmers (continued)					
DSBPR	1980	0.760	1.00	1.00	-	-
	1982	0.708	0.80	0.80	-	-
	1984	0.655	0.68	0.68	-	-
	1986	0.603	0.60	0.60	-	-
	1988	0.551	0.54	0.54	-	-
	1990	0.499	0.49	0.49	-.02	-.02
	b. Prices Paid (costs)					
DPCAM	1980	4.75	4.84	4.84	-	-
	1982	4.45	4.19	4.02	-	-
	1984	4.15	3.88	3.58	-	-
	1986	3.84	3.75	3.31	-	-
	1988	3.54	3.71	3.13	-	-
	1990	3.24	3.62	2.90	.12	-.10
DPCAL	1980	4.01	4.38	4.38	-	-
	1982	3.73	3.99	3.79	-	-
	1984	3.44	3.79	3.43	-	-
	1986	3.16	3.74	3.21	-	-
	1988	2.88	3.75	3.05	-	-
	1990	2.60	3.72	2.86	.43	.10
DCOWPR	1980	3.97	3.54	3.54	-	-
	1982	3.66	3.38	3.17	-	-
	1984	3.36	3.28	2.93	-	-
	1986	3.05	3.32	2.79	-	-
	1988	2.74	3.37	2.69	-	-
	1990	2.43	3.41	2.56	.40	.05

TABLE C.1 (continued)

Variable	Year	Baseline Scenario	First EC Scenario	Second EC Scenario	(B - A)/A	(C - A)/A
		A	B	C		
		b. Prices Paid (costs) (continued)				
FD	1980	3.40	3.03	3.03	-	-
	1982	3.13	3.27	3.00	-	-
	1984	2.89	3.37	2.90	-	-
	1986	2.66	3.57	2.86	-	-
	1988	2.45	3.74	2.82	-	-
	1990	2.26	3.91	2.77	.73	.23
DGOPR	1980	2.00	2.30	2.30	-	-
	1982	2.40	2.90	2.90	-	-
	1984	2.80	3.37	3.37	-	-
	1986	3.10	3.68	3.68	-	-
	1988	3.25	3.90	3.90	-	-
	1990	3.27	4.14	4.14	.27	.27
		c. Retail Prices				
NBRP	1980	442	467	467	-	-
	1982	460	539	523	-	-
	1984	478	613	575	-	-
	1986	496	699	628	-	-
	1988	514	801	683	-	-
	1990	532	928	744	.74	.40
NMKRP	1980	44.1	50.2	50.2	-	-
	1982	46.7	58.9	56.8	-	-
	1984	49.3	67.8	62.8	-	-
	1986	51.9	78.3	68.9	-	-
	1988	54.5	91.1	75.6	-	-
	1990	57.1	107.0	83.2	.87	.46

TABLE C.1 (continued)

Variable	Year	Baseline Scenario	First EC Scenario	Second EC Scenario	(B - A)/A	(C - A)/A
		A	B	C		
		c. Retail Prices (continued)				
NPKRP	1980	363	381	381	-	-
	1982	373	451	451	-	-
	1984	383	522	522	-	-
	1986	393	605	605	-	-
	1988	403	702	702	-	-
	1990	413	823	823	.99	.99
NCRP	1980	148	161	161	-	-
	1982	156	172	172	-	-
	1984	164	185	185	-	-
	1986	172	198	198	-	-
	1988	180	214	214	-	-
	1990	188	233	233	.24	.24
NSGRP	1980	606	651	651	-	-
	1982	618	679	679	-	-
	1984	630	712	712	-	-
	1986	642	750	750	-	-
	1988	654	797	797	-	-
	1990	666	854	854	.28	.28
EGRP	1980	104	102	102	-	-
	1982	114	110	110	-	-
	1984	124	119	119	-	-
	1986	134	128	128	-	-
	1988	144	140	140	-	-
	1990	154	154	154	-	-

TABLE C.1 (continued)

Variable	Year	Baseline Scenario	First EC Scenario	Second EC Scenario	(B - A)/A	(C - A)/A
		A	B	C		
		c. Retail Prices (continued)				
BCRP	1980	39.2	41.2	41.2	-	-
	1982	41.4	50.5	48.6	-	-
	1984	43.6	59.2	54.7	-	-
	1986	45.8	69.7	61.3	-	-
	1988	48.0	82.5	68.6	-	-
	1990	50.2	98.8	77.2	.97	.54
OFP	1980	79	79	79	-	-
	1982	93	93	93	-	-
	1984	107	107	107	-	-
	1986	121	121	121	-	-
	1988	135	135	135	-	-
	1990	149	149	149	-	-
NFP	1980	550	550	550	-	-
	1982	650	650	650	-	-
	1984	750	750	750	-	-
	1986	850	850	850	-	-
	1988	950	950	950	-	-
	1990	1050	1050	1050	-	-

APPENDIX D

TABLE C.2

Exogenous Variables Projected the Same in all Scenarios

Year	TCLB	TIA	FAL	FORIR	DSI	DSSAL	DCOST	POP	PCE
1980	15622	2900	4720	430	211	238	59.3	37.4	2270
1981	15730	2930	4610	440	219	248	57.3	37.8	2470
1982	15838	2960	4500	450	227	257	55.2	38.1	2670
1983	15946	2990	4400	461	235	266	53.2	38.5	2870
1984	16054	3020	4290	471	243	275	51.2	38.9	3070
1985	16162	3050	4180	481	251	284	49.1	39.2	3270
1986	16270	3080	4070	492	259	294	47.1	39.6	3470
1987	16378	3110	3970	502	267	303	45.0	40.0	3670
1988	16486	3140	3860	512	274	312	43.0	40.4	3870
1989	16594	3170	3750	523	282	321	41.0	40.7	4070
1990	16702	3200	3640	533	290	330	38.9	41.1	4270

APPENDIX D

OPERATIONALIZATION OF THE DEMAND MODEL

The Rotterdam demand equations can be used to forecast the value of the dependent variables by introducing predicted values for the exogenous prices. The predicted dependent variables must be manipulated in order to obtain forecasts of meaningful variables. This appendix serves to explain how the equations were used to obtain estimates of per capita consumption under alternative price regimes.

The dependent variables in the demand equations are of the form $w^*_{it} \log (q_{it}/q_{it-1})$, where q_{it} is per capita consumption of one of the goods. The first step in obtaining the fitted or predicted values of q_{it} is to divide the dependent variable by w^*_{it}. Let $X_i = w^*_{it} \log (q_t/q_{t-1})$. Then, $X_i/w^*_{it} = \log (q_t/q_{t-1})$. Taking the antilog of both sides leads to the relation:

$$\exp (X_i/w^*_{it}) = q_t/q_{t-1}$$

and solving for q_t gives:

$$q_t = q_{t-1} (\exp (X_i/w^*_{it})).$$

Since $w^*_{it} = (w_{it} + w_{it-1}/2)$, the exponential term can be reformulated as $\exp (2X_i/(w_{it} + w_{it-1}))$. This is the expression used to obtain per capita consumption.

However, $w_{it} = p_{it}q_{it}/m_t$. Thus, the value shares depend on current consumption and it is necessary to calculate them simultaneously with per capita consumption.

In addition, the X_i depend on the real income term which is the sum of the current dependent variables in the demand equations. It is, thus, necessary to solve a system of simultaneous equations of the following form:

$$X_{it} = f(Q_t, Dp_{ijt})$$
$$w_{it} = q_{it}p_{it}/m_t$$
$$q_{it} = q_{it-1} (\exp (2X_{it}/(w_{it} + w_{it-1})))$$
$$Q_t = \sum_i X_{it}$$

It is also necessary that the w_{it} in any year sum to one. To insure that this is the case, constraints were introduced so that the sum of the value shares would always equal one. Three equations (bread cereals, poultry meat, and eggs) were constrained when it became apparent that they yielded unreasonable forecasts. The constraints are placed on the per capita consumption estimates (q_{it}).

The system of simultaneous equations has one unfortunate characteristic. The income term, Q_t, has a positive coefficient in most of the equations which leads to a positive feedback in several of the X_{it} equations. These equations do not converge in the Gauss-Seidel algorithm. To overcome this problem, an estimate of Q_t was obtained by fixing its value after one iteration. In subsequent iterations Q_t was not allowed to change interrupting the positive feedback on the X_{it} equations which then converged after about forty iterations.

An alternative approach would have been to use the estimated elasticities to predict per capita consumption. Using the elasticities calculated at the average weights would have led to inaccuracies since the weights have changed over time. Calculating the point estimate of the elasticity for each year would have required the simultaneous computation of the value shares. Since the model involves eight equations and nine explanatory variables, seventy-two elasticities would have been required for each year. Using the system of simultaneous equations is considerably more efficient than using varying elasticities. The estimates of per capita consumption are multiplied by population to obtain the total consumption of the various food items.

APPENDIX E

APPENDIX E

LIST OF MODEL VARIABLES AND SYMBOLS

I. ENDOGENOUS VARIABLES

	Symbol	Units	Description
			Cattle Model
1.	BH	1000 head	cows and bulls (breeding herd) on farms
2.	COWS	1000 head	number of cows on farms
3.	COWM	1000 head	number of cows milked
4.	CA	1000 head	number of calves available for slaughter
5.	VSCA	--	proportion of calves available slaughtered as calves (VS/CA)
6.	VS	1000 head	number of calves slaughtered
7.	SHS	1000 head	steers and heifers slaughtered
8.	CBS	1000 head	cow and bull slaughter
9.	BFS	1000 head	total beef cattle slaughter (SHS + CBS)
10.	VSW	kilograms	dressed slaughter weight, calves
11.	BFSW	kilograms	dressed slaughter weight, beef cattle
12.	DY	liters	milk per cow per year
13.	VPROD	metric tons	veal production
14.	BPROD	metric tons	beef production

I. ENDOGENOUS VARIABLES (continued)

Symbol		Units	Description
			Cattle Model (continued)
15.	DPROD	million liters	cow milk production
			Hog Model
1.	SOW	1000 head	number of sows on farms
2.	PIGS	1000 head	pig crop
3.	THSL	1000 head	total hog slaughter
4.	LESL	1000 head	slaughter of suckling pigs
5.	HSL	1000 head	mature hog slaughter
6.	LSW	kilograms	live hog slaughter weight
7.	HSLW	kilograms	dressed hog slaughter weight
8.	HPROD	metric tons	pigmeat production
9.	LPROD	metric tons	suckling pig production
			Sheep and Goat Model
1.	FEM	1000 head	number of female sheep and goats
2.	YM	1000 head	lamb and kid slaughter
3.	ADULT	1000 head	sheep and goat slaughter
4.	MKPROD	million liters	sheep and goat milk production
5.	YMPROD	metric tons	lamb and kid meat production
6.	ADPROD	metric tons	mutton and goat meat production
7.	YMSW	kilograms	lamb/kid dressed slaughter weight
8.	ADSW	kilograms	sheep/goat dressed slaughter weight
			Poultry Meat and Egg Models
1.	NBS	1000 head	number of broilers slaughtered
2.	TPPROD	metric tons	total poultry meat production

I. ENDOGENOUS VARIABLES (continued)

Symbol		Units	Description
		Poultry Meat and Egg Models (continued)	
3.	BRPROD	metric tons	broiler meat production
4.	SLAY	1000 head	number of selected laying hens
5.	TPEGPR	million dozen	total poultry egg production
6.	SEPROD	million dozen	selected layer egg production
7.	AEPROD	million dozen	production of all eggs
		Crop Model and Land Use	
1.	WDA	1000 has.	dryland wheat acreage
2.	WIA	1000 has.	irrigated wheat acreage
3.	BDA	1000 has.	dryland barley acreage
4.	BIA	1000 has.	irrigated barley acreage
5.	CDA	1000 has.	dryland corn acreage
6.	CIA	1000 has.	irrigated corn acreage
7.	RA	1000 has.	total rye acreage
8.	OA	1000 has.	total oat acreage
9.	SA	1000 has.	total sorghum acreage
10.	ROSA	1000 has.	RA + OA + SA
11.	ROSDA	1000 has.	dryland rye, oat, sorghum acreage
12.	WBCIA	1000 has.	WIA + BIA + CIA
13.	WBCDA	1000 has.	WDA + BDA + CDA
14.	TICA	1000 has.	total irrigated cereal acreage
15.	TDCA	1000 has.	total dryland cereal acreage
16.	TCA	1000 has.	total cereal acreage
17.	TFOR	1000 has.	total forage acreage

I. ENDOGENOUS VARIABLES (continued)

Symbol		Units	Description
		Crop Model and Land Use (continued)	
18.	DFOR	1000 has.	dryland forage acreage
19.	TOCA	1000 has.	total other crop acreage
20.	TOCIA	1000 has.	irrigated acreage in other crops
21.	TOCDA	1000 has.	dryland acreage in other crops
22.	TDA	1000 has.	total dryland acreage
23.	WDY	kg/ha	dryland wheat yield
24.	WIY	kg/ha	irrigated wheat yield
25.	BDY	kg/ha	dryland barley yield
26.	BIY	kg/ha	irrigated barley yield
27.	CDY	kg/ha	dryland corn yield
28.	CIY	kg/ha	irrigated corn yield
29.	RY	kg/ha	average rye yield
30.	OY	kg/ha	average oat yield
31.	SY	kg/ha	average sorghum yield
32.	WPROD	1000 metric tons	total wheat production
33.	BAPROD	1000 metric tons	total barley production
34.	CPROD	1000 metric tons	total corn production
35.	RPROD	1000 metric tons	rye production
36.	OPROD	1000 metric tons	oat production
37.	SPROD	1000 metric tons	sorghum production

I. ENDOGENOUS VARIABLES (continued)

Symbol		Units	Description
			Demand Model
1.	XB	log kg.	beef and veal — Weighted log change dependent variables in Rotterdam demand system. See Chapter III for complete definition.
2.	XM	log kg.	milk — Weighted log change dependent variables in Rotterdam demand system. See Chapter III for complete definition.
3.	XP	log kg.	pigmeat — Weighted log change dependent variables in Rotterdam demand system. See Chapter III for complete definition.
4.	XC	log kg.	poultry meat — Weighted log change dependent variables in Rotterdam demand system. See Chapter III for complete definition.
5.	XSG	log kg.	sheep/goat meat — Weighted log change dependent variables in Rotterdam demand system. See Chapter III for complete definition.
6.	XEG	log kg.	eggs — Weighted log change dependent variables in Rotterdam demand system. See Chapter III for complete definition.
7.	XBC	log kg.	bread cereals — Weighted log change dependent variables in Rotterdam demand system. See Chapter III for complete definition.
8.	XOF	log kg.	other food — Weighted log change dependent variables in Rotterdam demand system. See Chapter III for complete definition.
9.	XNF	log kg.	non-food items — Weighted log change dependent variables in Rotterdam demand system. See Chapter III for complete definition.
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	--	non-food value share
19.	QT	log kg.	real income term
20.	BFC	kilograms/yr.	per capita consumption of beef/veal
21.	MKC	kilograms/yr.	per capita milk consumption
22.	PKC	kilograms/yr.	per capita pigmeat consumption
23.	CHC	kilograms/yr.	per capita poultry meat consumption

I. ENDOGENOUS VARIABLES (continued)

Symbol		Units	Description
			Demand Model (continued)
24.	SGC	kilograms/yr.	per capita sheep/goat meat consumption
25.	EGC	kilograms/yr.	per capita egg consumption
26.	BRC	kilograms/yr.	per capita bread cereal consumption
27.	OFC	kilograms/yr.	per capita other food consumption
28.	NFQ	--	per capita non-food consumption
29.	TBF	metric tons	total beef consumption
30.	TMK	metric tons	total milk consumption
31.	TPK	metric tons	total pigmeat consumption
32.	TCH	metric tons	total poultry meat consumption
33.	TSG	metric tons	total sheep/goat meat consumption
34.	TEG	metric tons	total egg consumption
35.	TOF	metric tons	total other food consumption
			Other Endogenous Variables
1.	FDEM	1000 metric tons	total feedgrain disappearance
2.	BCFDC	1000 metric tons	bread cereals fed
3.	BOFDC	1000 metric tons	barley and oats fed
4.	SCFDC	1000 metric tons	corn and sorghum fed
5.	SOYCON	1000 metric tons	soybean meal fed
6.	MKFD	1000 metric tons	milk fed to animals
7.	BCDIS	1000 metric tons	total bread cereal disappearance
8.	BODIS	1000 metric tons	total barley/oat disappearance
9.	SCDIS	1000 metric tons	total corn/sorghum disappearance

I. ENDOGENOUS VARIABLES (continued)

Symbol		Units	Description
		Other Endogenous Variables (continued)	
10.	MKDIS	1000 metric tons	total milk disappearance
11.	BCSTK	1000 metric tons	change in bread cereal stocks
12.	BOSTK	1000 metric tons	change in barley/oat stocks
13.	SCSTK	1000 metric tons	change in corn/sorghum stocks
14.	BCAV	1000 metric tons	domestic bread cereal availability
15.	BOAV	1000 metric tons	domestic barley/oat availability
16.	SCAV	1000 metric tons	domestic corn/sorghum availability
17.	MKAV	1000 metric tons	cow, sheep and goat milk availability
18.	BCTR	1000 metric tons	net trade in bread cereals
19.	BOTR	1000 metric tons	net trade in barley and oats
20.	SCTR	1000 metric tons	net trade in corn and sorghum
21.	BFTR	metric tons	net trade in beef and veal
22.	PKTR	metric tons	net trade in pigmeat
23.	CHTR	metric tons	net trade in poultry meat
24.	MKTR	metric tons	net trade in milk
25.	SGTR	metric tons	net trade in sheep/goat meat
27.	EGTR	metric tons	net trade in eggs

II. EXOGENOUS VARIABLES

Symbol	Units	Description
DRET	pts.	milk yield times milk price
BRET	pts.	cull beef price times slaughter weight
BREP	--	cattle replacement rate

II. EXOGENOUS VARIABLES (continued)

Symbol	Units	Description
CULL	--	cattle cull rate
CR	--	calving rate
FD	pts/kg	cost of calf feed (deflated)
CP	pts.	cattle ("añojo") premium
DPRV	pts/kg	real price received for calves
DPRC	pts/kg	real price received for cows/bulls
DPRD	pts/liter	real price received for cow milk
DPRN	pts/kg	real price received for steers/ heifers
L2BHC	1000 head	change in breeding herd at t + 2
BH2	1000 head	breeding herd at t + 2
DG	pts/kg	real calf price less real feed costs
DWPR	pts/kg	real price received for wheat
DBPR	pts/kg	real price received for barley
DCPR	pts/kg	real price received for corn
DRPR	pts/kg	real price received for rye
DOPR	pts/kg	real price received for oats
DSBPR	pts/kg	real price received for sugarbeets
DSPR	pts/kg	real price received for sorghum
DGOPR	pts/liter	real price of diesel fuel
DSI	--	real agricultural wage index
DPIC	--	real cereal price index
FORIR	1000 has.	irrigated forage acreage
TCLB	1000 has.	total cropland base

II. EXOGENOUS VARIABLES (continued)

Symbol	Units	Description
TIA	1000 has.	total irrigated acreage
RICE	1000 has.	total rice acreage
ROSIA	1000 has.	irrigated rye, oat, sorghum acreage
OICA	1000 has.	other cereal irrigated acreage
ODCA	1000 has.	other cereal dryland acreage
FAL	1000 has.	total acreage in fallow
DHPR	pts/kg	real price received for hogs
PPS	--	surviving pigs per sow
PREP	--	hog replacement rate
HCRAT	--	hog-corn ratio
DYOPR	pts/kg	real price received for lambs/kids
DADPR	pts/kg	real price received for sheep/goats
DMKPR	pts/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	pts.	relative returns measure, broilers
EGPI	pts.	relative returns measure for eggs
DPOPR	pts/kg	real price received for poultry meat
DEGPR	pts/doz.	real price received for eggs
DPCAM	pts/kg	real price of broiler feed
DPCAL	pts/kg	real price of layer feed
DCONPR	pts/kg	real price of hog concentrate

II. EXOGENOUS VARIABLES (continued)

Symbol	Units	Description
OTEG	mil. doz.	goose, duck and other eggs
POP	millions	population
NBRP	pts/kg	nominal retail beef price
NMKRP	pts/kg	nominal retail milk price
NPKRP	pts/kg	nominal retail pigmeat price
NCRP	pts/kg	nominal retail poultry meat price
NSGRP	pts/kg	nominal retail sheep/goat meat price
EGRP	pts/kg	nominal retail egg price
BCRP	pts/kg	nominal retail bread cereal price
OFP	pts/kg	nominal retail other food price
NFP	pts/kg	non-food retail price index
PCE	pts.	per capita consumer expenditure
P1	--	beef, veal
P2	--	milk
P3	--	pigmeat
P4	--	poultry meat
P5	--	sheep/goat meat
P6	--	eggs
P7	--	bread cereals
P8	--	other food
BCEXT	--	bread cereal extraction rate
CNSDO	1000 metric tons	non-feed corn/sorghum disappearance
SOYRES	1000 metric tons	soybean meal residual correction

P1–P8: Deflated log change price variables. Full description in Chapter III.

II. EXOGENOUS VARIABLES (continued)

Symbol	Units	Description
DBCPR	pts/kg	real average price received wheat/rye
DBOPR	pts/kg	real average barley/oat price received
DSCPR	pts/kg	real average corn/sorghum price received
DGBOP	pts/kg	real average government price for barley and oats
DGSCP	pts/kg	real average government price for corn and sorghum
EGCON	doz/kg	conversion rate for eggs, dozens to kg.
CPI	--	projected Spanish Consumer Price Index
ER	pts/ECU	projected exchange rate/green rate
CER	pts/kg	projected EC price for cereal grains
SYM	pts/kg	projected soybean meal price in Spain
FTPI	--	projected fertilizer price index
BV	pts/kg	projected EC guide price for beef
MKG	pts/kg	projected EC price for milk
PGM	pts/kg	projected EC price for pigmeat

APPENDIX F

APPENDIX F

PROJECTIONS OF ENDOGENOUS VARIABLES TO 1990

Page

(For definitions of the symbols and the units associated with each variable, see Appendix E.)

F.1: Baseline Simulation

SIMULATION RESULTS

		1980 1990	1981	1982	1983	1984	1985	1986	1987	1988	1989
1	DH	.263E+04 .292E+04	.265E+04	.268E+04	.271E+04	.274E+04	.277E+04	.280E+04	.283E+04	.286E+04	.289E+04
2	CDMS	.253E+04 .286E+04	.261E+04	.264E+04	.266E+04	.269E+04	.272E+04	.275E+04	.278E+04	.281E+04	.283E+04
3	COMM	.199E+04 .219E+04	.200E+04	.202E+04	.204E+04	.206E+04	.208E+04	.210E+04	.213E+04	.215E+04	.217E+04
4	CA	.139E+04 .153E+04	.140E+04	.141E+04	.143E+04	.144E+04	.146E+04	.147E+04	.149E+04	.150E+04	.152E+04
5	VSCA	.409 .337	.399	.390	.383	.375	.367	.361	.354	.348	.342
6	VS	567. 517.	559.	551.	546.	540.	535.	531.	526.	523.	520.
7	AFM	736. 995.	821.	840.	860.	880.	900.	921.	940.	960.	979.
8	CDS	333. 335.	305.	309.	311.	315.	318.	321.	325.	328.	332.
9	BFS	.106E+04 .133E+04	.113E+04	.115E+04	.117E+04	.119E+04	.122E+04	.124E+04	.127E+04	.129E+04	.131E+04
12	DY	.295E+04 .349E+04	.300E+04	.305E+04	.311E+04	.316E+04	.322E+04	.327E+04	.333E+04	.338E+04	.343E+04
13	VPROD	.895E+05 .817E+05	.882E+05	.870E+05	.862E+05	.853E+05	.845E+05	.838E+05	.831E+05	.826E+05	.821E+05
14	BPROD	.334E+06 .420E+06	.355E+06	.362E+06	.369E+06	.376E+06	.384E+06	.391E+06	.399E+06	.406E+06	.413E+06
15	DPROD	.595E+04 .765E+04	.600E+04	.617E+04	.634E+04	.652E+04	.670E+04	.688E+04	.707E+04	.726E+04	.745E+04
16	CDSA	245. 245.	245.	245.	245.	245.	245.	245.	245.	245.	245.
17	CLPROD	.728E+05 .728E+05	.728E+05	.728E+05	.728E+05	.728E+05	.728E+05	.728E+05	.728E+05	.728E+05	.728E+05
20	WDA	.255E+04 .204E+04	.253E+04	.250E+04	.245E+04	.239E+04	.234E+04	.228E+04	.222E+04	.216E+04	.210E+04
21	WIA	231. 105.	218.	203.	189.	175.	162.	149.	137.	125.	115.
22	BDA	.333E+04 .424E+04	.348E+04	.357E+04	.367E+04	.376E+04	.385E+04	.394E+04	.402E+04	.410E+04	.417E+04
23	BIA	273. 342.	280.	287.	295.	302.	310.	317.	324.	330.	336.
24	CCA	151. 63.7	145.	136.	127.	118.	109.	99.7	90.7	81.7	72.7
25	CIA	214. 197.	269.	271.	253.	235.	217.	209.	200.	197.	196.
26	RA	150. 24.7	145.	131.	117.	103.	89.7	76.1	63.2	49.9	37.1
27	GA	425. 459.	434.	440.	445.	450.	456.	458.	460.	460.	460.
28	SA	47.1 30.0	44.2	41.3	38.3	35.4	33.5	31.2	29.9	29.5	29.6
29	HCSA	635. 513.	624.	612.	601.	589.	578.	565.	553.	540.	526.
30	RCSDA	543. 460.	571.	559.	547.	536.	525.	512.	500.	487.	473.

F.1: Baseline Simulation (continued)

31	WBCIA	719. 644.	786.	761.	737.	712.	689.	675.	661.	652.	647.
32	WBCDA	.603E+04 .635E+04	.615E+04	.621E+04	.624E+04	.627E+04	.630E+04	.631E+04	.633E+04	.634E+04	.634E+04
33	TACA	[illegible] 795.	908.	883.	855.	834.	811.	796.	783.	774.	769.
34	TOCA	.571E+04 .694E+04	.675E+04	.680E+04	.682E+04	.684E+04	.685E+04	.686E+04	.686E+04	.685E+04	.685E+04
35	TCA	.755E+04 .760E+04	.766E+04	.768E+04	.768E+04	.767E+04	.766E+04	.765E+04	.764E+04	.763E+04	.762E+04
36	TFOR	.125E+04 .152E+04	.130E+04	.134E+04	.138E+04	.142E+04	.146E+04	.150E+04	.153E+04	.156E+04	.159E+04
37	UFOR	830. .109E+04	860.	890.	920.	950.	980.	.100E+04	.103E+04	.105E+04	.107E+04
38	TCCA	.641E+04 .747E+04	.677E+04	.682E+04	.689E+04	.696E+04	.704E+04	.712E+04	.721E+04	.730E+04	.738E+04
39	TCCIA	.153E+04 .190E+04	.158E+04	.163E+04	.167E+04	.171E+04	.176E+04	.179E+04	.183E+04	.185E+04	.188E+04
40	TCCDA	.511E+04 .557E+04	.518E+04	.519E+04	.522E+04	.525E+04	.528E+04	.533E+04	.538E+04	.544E+04	.551E+04
41	TUA	.127E+05 .135E+05	.128E+05	.129E+05	.130E+05	.130E+05	.131E+05	.132E+05	.133E+05	.133E+05	.134E+05
42	WDY	.159E+04 .196E+04	.162E+04	.166E+04	.170E+04	.174E+04	.178E+04	.181E+04	.185E+04	.189E+04	.193E+04
43	WIY	.333E+04 .398E+04	.340E+04	.346E+04	.353E+04	.359E+04	.366E+04	.372E+04	.379E+04	.385E+04	.391E+04
44	BDY	.204E+04 .246E+04	.208E+04	.213E+04	.217E+04	.221E+04	.225E+04	.229E+04	.233E+04	.238E+04	.242E+04
45	BIY	.347E+04 .410E+04	.353E+04	.360E+04	.366E+04	.372E+04	.379E+04	.385E+04	.391E+04	.398E+04	.404E+04
46	CDY	.243E+04 .291E+04	.248E+04	.252E+04	.257E+04	.262E+04	.267E+04	.272E+04	.277E+04	.282E+04	.286E+04
47	CIY	.590E+04 .741E+04	.605E+04	.620E+04	.635E+04	.650E+04	.665E+04	.680E+04	.696E+04	.711E+04	.726E+04
48	RY	.107E+04 .123E+04	.109E+04	.110E+04	.112E+04	.113E+04	.115E+04	.116E+04	.118E+04	.120E+04	.121E+04
49	OY	.126E+04 .150E+04	.128E+04	.131E+04	.133E+04	.135E+04	.138E+04	.140E+04	.143E+04	.145E+04	.147E+04
50	SY	.547E+04 .760E+04	.569E+04	.590E+04	.611E+04	.632E+04	.654E+04	.675E+04	.696E+04	.718E+04	.739E+04
51	WPROD	.542E+04 * .443E+04	.485E+04	.495E+04	.493E+04	.479E+04	.474E+04	.468E+04	.462E+04	.456E+04	.449E+04
52	BAPROD	.795E+04 * .119E+05	.824E+04	.863E+04	.903E+04	.943E+04	.983E+04	.102E+05	.106E+05	.110E+05	.114E+05
53	CPROD	.163E+04 .154E+04	.213E+04	.202E+04	.193E+04	.184E+04	.174E+04	.169E+04	.165E+04	.163E+04	.163E+04
54	RPROD	260. * 31.2	158.	145.	131.	117.	103.	88.6	74.6	59.7	44.9
55	OPROD	613. * 585.	558.	575.	592.	610.	629.	642.	656.	667.	677.
56	SPROD	259. 229.	251.	243.	234.	224.	212.	211.	208.	212.	216.
57	RCSFF	.109E+04 .109E+04	.109E+04	.108E+04	.108E+04	.108E+04	.108E+04	.108E+04	.108E+04	.108E+04	.108E+04

F.1: Baseline Simulation (continued)

58	CERPR	.158E+05 .158E+05	.158E+05	.158E+05	.158E+05	.158E+05	.158E+05	.158E+05	.158E+05	.158E+05	.158E+05
59	RCRIA	122. 122.	122.	122.	122.	122.	122.	122.	122.	122.	122.
60	TCLBF	.203E+05 .203E+05	.203E+05	.203E+05	.203E+05	.203E+05	.203E+05	.203E+05	.203E+05	.203E+05	.203E+05
61	SOW	.132E+04 .180E+04	.138E+04	.143E+04	.148E+04	.152E+04	.157E+04	.162E+04	.166E+04	.171E+04	.175E+04
62	PIGS	.119E+05 .162E+05	.125E+05	.129E+05	.133E+05	.137E+05	.141E+05	.145E+05	.149E+05	.154E+05	.158E+05
63	THSL	.116E+05 .158E+05	.122E+05	.126E+05	.130E+05	.134E+05	.138E+05	.142E+05	.146E+05	.150E+05	.154E+05
64	LESL	232. 316.	243.	251.	259.	267.	275.	283.	291.	300.	308.
65	HSL	.115E+05 .155E+05	.119E+05	.123E+05	.127E+05	.131E+05	.135E+05	.139E+05	.143E+05	.147E+05	.151E+05
66	LSW	89.9 85.0	88.4	87.0	85.5	85.0	85.0	85.0	85.0	85.0	85.0
67	HSLW	71.9 68.0	70.8	69.6	68.4	68.0	68.0	68.0	68.0	68.0	68.0
68	HPROD	.815E+06 .105E+07	.843E+06	.856E+06	.869E+06	.890E+06	.917E+06	.944E+06	.971E+06	.998E+06	.102E+07
69	LPROD	.232E+04 .316E+04	.243E+04	.251E+04	.259E+04	.267E+04	.275E+04	.283E+04	.291E+04	.300E+04	.308E+04
70	FEM	.992E+04 .692E+04	.961E+04	.932E+04	.902E+04	.872E+04	.842E+04	.813E+04	.782E+04	.752E+04	.722E+04
71	YM	.119E+05 .127E+05	.118E+05	.119E+05	.120E+05	.121E+05	.122E+05	.123E+05	.124E+05	.125E+05	.126E+05
72	ADULT	.128E+04 728.	.125E+04	.119E+04	.113E+04	.107E+04	.101E+04	954.	897.	837.	778.
73	MKPROD	502. 455.	498.	493.	483.	484.	479.	474.	469.	464.	459.
74	YMPROD	.130E+06 .153E+06	.130E+06	.132E+06	.134E+06	.136E+06	.138E+06	.141E+06	.143E+06	.145E+06	.149E+06
75	ADPROD	.231E+05 .140E+05	.226E+05	.217E+05	.208E+05	.199E+05	.190E+05	.180E+05	.171E+05	.160E+05	.150E+05
76	YMSW	10.9 11.8	11.0	11.1	11.2	11.3	11.4	11.5	11.6	11.7	11.7
77	ADSW	18.0 19.5	18.1	18.3	18.4	18.6	18.7	18.9	19.0	19.2	19.3
78	NBS	.510E+06 .754E+06	.535E+06	.559E+06	.583E+06	.608E+06	.632E+06	.656E+06	.681E+06	.705E+06	.729E+06
79	TPPROD	.780E+06 .117E+07	.822E+06	.863E+06	.902E+06	.940E+06	.978E+06	.102E+07	.105E+07	.109E+07	.113E+07
80	BKPROD	.757E+06 .112E+07	.793E+06	.829E+06	.865E+06	.901E+06	.937E+06	.973E+06	.101E+07	.105E+07	.108E+07
81	SLAY	.383E+05 .514E+05	.383E+05	.389E+05	.405E+05	.420E+05	.436E+05	.452E+05	.467E+05	.483E+05	.499E+05
82	TPEGPR	837. .107E+04	837.	836.	865.	896.	925.	955.	985.	.101E+04	.104E+04
83	SEPROD	736. 973.	736.	736.	765.	795.	825.	854.	884.	914.	943.
84	AEPROD	843. .108E+04	843.	842.	872.	902.	931.	961.	991.	.102E+04	.105E+04

F.1: Baseline Simulation (continued)

85	XB	.117E-02 .560E-03	.107E-02	.974E-03	.899E-03	.832E-03	.773E-03	.721E-03	.687E-03	.632E-03	.594E-03
86	XM	-.203E-03 -.571E-04	-.176E-03	-.154E-03	-.135E-03	-.118E-03	-.105E-03	-.926E-04	-.887E-04	-.728E-04	-.649E-04
87	XP	.777E-03 .442E-03	.730E-03	.686E-03	.648E-03	.611E-03	.577E-03	.546E-03	.512E-03	.490E-03	.464E-03
88	XC	.775E-03 .455E-03	.726E-03	.684E-03	.648E-03	.616E-03	.588E-03	.563E-03	.548E-03	.522E-03	.504E-03
89	XSG	.337E-04 .370E-04	.362E-04	.379E-04	.388E-04	.392E-04	.393E-04	.391E-04	.371E-04	.383E-04	.377E-04
90	XEG	.771E-03 .411E-03	.710E-03	.656E-03	.611E-03	.572E-03	.537E-03	.506E-03	.487E-03	.454E-03	.431E-03
91	XBC	-.144E-02 -.720E-03	-.132E-02	-.121E-02	-.112E-02	-.104E-02	-.971E-03	-.909E-03	-.871E-03	-.805E-03	-.760E-03
92	XOF	-.344E-02 -.737E-03	-.292E-02	-.249E-02	-.214E-02	-.185E-02	-.160E-02	-.139E-02	-.134E-02	-.105E-02	-.916E-03
93	XNF	.496E-02 .301E-02	.454E-02	.421E-02	.394E-02	.372E-02	.354E-02	.340E-02	.340E-02	.317E-02	.308E-02
94	WB	.241E-01 .217E-01	.237E-01	.233E-01	.230E-01	.228E-01	.225E-01	.223E-01	.222E-01	.220E-01	.219E-01
95	WM	.275E-01 .181E-01	.259E-01	.245E-01	.234E-01	.223E-01	.214E-01	.206E-01	.199E-01	.192E-01	.187E-01
96	WP	.353E-01 .259E-01	.336E-01	.322E-01	.311E-01	.300E-01	.291E-01	.283E-01	.276E-01	.270E-01	.264E-01
97	WC	.135E-01 .101E-01	.134E-01	.134E-01	.129E-01	.123E-01	.119E-01	.114E-01	.111E-01	.107E-01	.104E-01
98	WSG	.946E-02 .594E-02	.883E-02	.829E-02	.784E-02	.744E-02	.709E-02	.678E-02	.651E-02	.626E-02	.604E-02
99	WEG	.734E-02 .598E-02	.731E-02	.708E-02	.689E-02	.671E-02	.656E-02	.642E-02	.630E-02	.618E-02	.608E-02
100	WBC	.104E-01 .704E-02	.976E-02	.929E-02	.888E-02	.853E-02	.821E-02	.793E-02	.767E-02	.744E-02	.723E-02
101	WOF	.192 .166	.173	.177	.175	.173	.172	.171	.169	.168	.167
102	WNF	.631 .739	.698	.705	.711	.716	.721	.726	.730	.733	.736
103	QT	.343E-02 .338E-02	.342E-02	.342E-02	.341E-02	.341E-02	.340E-02	.340E-02	.339E-02	.339E-02	.339E-02
104	BFC	13.5 18.9	14.1	14.7	15.3	15.8	16.4	16.9	17.5	18.0	18.5
105	MKC	154. 147.	153.	152.	151.	151.	150.	149.	149.	148.	148.
106	PKC	24.0 29.1	24.5	25.0	25.6	26.1	26.6	27.1	27.6	28.1	28.6
107	CHC	22.5 25.0	23.7	24.9	25.0	25.0	25.0	25.0	25.0	25.0	25.0
108	SGC	3.85 4.07	3.87	3.89	3.91	3.93	3.95	3.97	3.99	4.02	4.04
109	EGC	17.4 18.0	18.0	18.0	18.0	18.0	18.0	18.0	18.0	18.0	18.0
110	BRC	65.6 65.0	65.0	65.0	65.0	65.0	65.0	65.0	65.0	65.0	65.0
111	OFC	568. 517.	559.	551.	544.	539.	534.	529.	525.	522.	519.

F.1: Baseline Simulation (continued)

112	TBF	.504E+05 .776E+05	.532E+05	.560E+05	.588E+05	.616E+05	.643E+05	.670E+05	.698E+05	.725E+05	.752E+05
113	TMK	.577E+04 .603E+04	.579E+04	.581E+04	.583E+04	.586E+04	.588E+04	.591E+04	.594E+04	.598E+04	.601E+04
114	TPK	.898E+05 .119E+06	.926E+05	.955E+05	.934E+05	.101E+06	.104E+06	.107E+06	.110E+06	.113E+06	.116E+06
115	TCM	.861E+05 .103E+06	.895E+05	.951E+05	.963E+05	.972E+05	.981E+(5	.990E+05	.100E+06	.101E+06	.102E+06
116	TSG	.144E+05 .167E+05	.146E+05	.148E+05	.150E+05	.153E+05	.155E+(5	.157E+05	.160E+05	.162E+05	.165E+05
117	TEG	652. 740.	680.	686.	693.	700.	706.	713.	720.	726.	733.
118	TBC	.245E+04 .267E+04	.245E+04	.248E+04	.250E+04	.253E+04	.255E+04	.258E+04	.260E+04	.262E+04	.265E+04
119	TOF	.212E+07 .212E+07	.211E+07	.210E+07	.210E+07	.209E+07	.209E+C7	.210E+07	.210E+07	.211E+07	.211E+07
120	BVPROD	.424E+06 .502E+06	.443E+06	.449E+06	.455E+06	.462E+06	.468E+06	.475E+06	.482E+06	.489E+06	.495E+06
121	FDEM	.140E+05 .189E+05	.145E+05	.149E+05	.153E+05	.158E+05	.163E+05	.168E+05	.173E+05	.178E+05	.183E+05
122	DBCPR	2.80 1.69	2.66	2.54	2.41	2.29	2.17	2.06	1.96	1.87	1.78
123	DBOPR	2.12 1.40	2.04	1.96	1.37	1.80	1.72	1.65	1.59	1.52	1.46
124	DSCPR	2.90 1.71	2.79	2.67	2.55	2.43	2.31	2.19	2.07	1.95	1.83
126	BCFD	.668E+04 .887E+04	.690E+04	.707E+04	.727E+04	.749E+04	.772E+04	.795E+04	.818E+04	.841E+04	.864E+04
127	SCFD	.693E+04 .959E+04	.719E+04	.740E+04	.765E+04	.791E+04	.819E+04	.847E+04	.875E+04	.903E+04	.931E+04
128	SOYCON	.227E+04 .303E+04	.234E+04	.240E+04	.247E+04	.254E+04	.262E+04	.271E+04	.279E+04	.287E+04	.295E+04
130	BCDIS	.383E+04 .401E+04	.382E+04	.385E+04	.387E+04	.389E+04	.391E+04	.393E+04	.395E+04	.397E+04	.399E+04
131	BODIS	.777E+04 .103E+05	.802E+04	.822E+04	.846E+04	.871E+04	.897E+C4	.923E+04	.949E+04	.975E+04	.100E+05
132	SCDIS	.750E+04 .101E+05	.776E+04	.797E+04	.822E+04	.848E+04	.876E+04	.903E+04	.931E+04	.959E+04	.987E+04
133	MKDIS	.633E+04 .661E+04	.635E+04	.637E+04	.640E+04	.642E+04	.645E+04	.648E+04	.651E+04	.654E+04	.658E+04
134	DGBOP	2.22 .839	2.09	1.95	1.81	1.67	1.53	1.39	1.26	1.12	.979
135	DGSCP	2.91 1.71	2.79	2.67	2.55	2.43	2.30	2.19	2.06	1.95	1.82
137	BOSTK	-296. -171.	-267.	-232.	-214.	-200.	-193.	-186.	-185.	-182.	-176.
139	BCAV	.416E+04 .364E+04	.418E+04	.417E+04	.413E+04	.408E+04	.402E+C4	.395E+04	.387E+04	.379E+04	.371E+04
140	BOAV	.871E+04 .127E+05	.907E+04	.944E+04	.983E+04	.102E+05	.107E+05	.111E+05	.115E+05	.119E+05	.123E+05
141	SCAV	.193E+04 .197E+04	.236E+04	.226E+04	.217E+04	.206E+04	.195E+04	.190E+04	.185E+04	.184E+04	.185E+04
142	MKAV	.654E+04 .835E+04	.670E+04	.686E+04	.704E+04	.721E+04	.739E+04	.758E+04	.777E+04	.796E+04	.815E+04

F.1: Baseline Simulation (continued)

143	BCTR	-336. 376.	-356.	-323.	-264.	-191.	-111.	-16.6	88.8	182.	280.
144	BOTR	-941. -.242E+04	-.105E+04	-.122E+04	-.138E+04	-.153E+04	-.168E+04	-.184E+04	-.200E+04	-.214E+04	-.229E+04
145	SCTR	.562E+04 .827E+04	.541E+04	.571E+04	.605E+04	.642E+04	.681E+04	.713E+04	.746E+04	.775E+04	.802E+04
146	BFTR	.403E+05 .276E+06	.895E+05	.111E+06	.133E+06	.154E+06	.175E+06	.195E+06	.216E+06	.236E+06	.257E+06
147	PKTR	.773E+05 .140E+06	.803E+05	.363E+05	.112E+06	.121E+06	.123E+06	.126E+06	.129E+06	.133E+06	.137E+06
148	CHTR	.593E+05 -.133E+06	.728E+05	.886E+05	.611E+05	.320E+05	.321E+04	-.254E+05	-.530E+05	-.822E+05	-.111E+06
149	SGTR	-.347E+04 .322E+04	-.629E+04	-.540E+04	-.447E+04	-.361E+04	-.255E+04	-.157E+04	-441.	811.	.192E+04
150	MKTR	-210. -.173E+04	-347.	-491.	-633.	-791.	-945.	-.110E+04	-.126E+04	-.142E+04	-.157E+04
151	EGTR	.622E+05 -.161E+05	.899E+05	.967E+05	.826E+05	.685E+05	.544E+05	.403E+05	.262E+05	.121E+05	-.200E+04
152	BCPROD	.493E+04 .446E+04	.501E+04	.500E+04	.496E+04	.491E+04	.485E+04	.477E+04	.470E+04	.462E+04	.454E+04
153	BOPROD	.841E+04 .125E+05	.880E+04	.921E+04	.962E+04	.100E+05	.105E+05	.109E+05	.113E+05	.117E+05	.121E+05
154	SCPROD	.163E+04 .187E+04	.236E+04	.226E+04	.217E+04	.206E+04	.195E+04	.190E+04	.185E+04	.184E+04	.185E+04
155	AFDEM	239. 250.	294.	291.	286.	280.	275.	270.	265.	259.	255.
156	BCFDC	128. 127.	128.	127.	127.	127.	127.	127.	127.	127.	127.
157	BGFDC	.683E+04 .893E+04	.705E+04	.721E+04	.741E+04	.763E+04	.786E+04	.808E+04	.831E+04	.854E+04	.876E+04
158	SCFDC	.703E+04 .972E+04	.734E+04	.755E+04	.779E+04	.805E+04	.833E+04	.861E+04	.889E+04	.916E+04	.944E+04
159	NFQ	310. 326.	312.	314.	316.	318.	319.	321.	322.	324.	325.

ZTAB 1970 1979 0 0 0 0 0 0 0 0 0 0 0

F.2: First EC Scenario

SIMULATION RESULTS

		1980 1990	1981	1982	1983	1984	1985	1986	1987	1988	1989
1	EM	.263E+04 .292E+04	.266E+04	.269E+04	.271E+04	.274E+04	.277E+04	.280E+04	.283E+04	.286E+04	.290E+04
2	CONS	.259E+04 .287E+04	.262E+04	.265E+04	.268E+04	.270E+04	.273E+04	.276E+04	.278E+04	.281E+04	.284E+04
3	CONV	.199E+04 .220E+04	.201E+04	.203E+04	.205E+04	.207E+04	.209E+04	.211E+04	.213E+04	.215E+04	.218E+04
4	CA	.139E+04 .154E+04	.140E+04	.142E+04	.143E+04	.145E+04	.146E+04	.148E+04	.149E+04	.151E+04	.152E+04
5	VSCA	.345 .426	.353	.361	.370	.377	.385	.393	.401	.410	.419
6	VS	478. 656.	495.	512.	530.	546.	563.	591.	599.	618.	636.
7	AFM	758. 867.	909.	909.	906.	904.	903.	899.	896.	893.	890.
8	CRS	303. 335.	306.	309.	312.	316.	319.	322.	325.	328.	332.
9	BFS	.106E+04 .122E+04	.121E+04	.122E+04	.122E+04	.122E+04	.122E+04	.122E+04	.122E+04	.122E+04	.122E+04
12	DY	.295E+04 .349E+04	.300E+04	.305E+04	.311E+04	.316E+04	.322E+04	.327E+04	.333E+04	.338E+04	.343E+04
13	VPROD	.755E+05 .104E+06	.782E+05	.809E+05	.837E+05	.863E+05	.890E+05	.918E+05	.946E+05	.976E+05	.101E+06
14	BPROD	.334E+06 .385E+06	.383E+06	.384E+06	.384E+06	.384E+06	.385E+06	.384E+06	.384E+06	.385E+06	.385E+06
15	DPROD	.585E+04 .767E+04	.602E+04	.620E+04	.637E+04	.655E+04	.672E+04	.690E+04	.709E+04	.728E+04	.749E+04
16	CRAW	245. 245.	245.	245.	245.	245.	245.	245.	245.	245.	245.
17	CPPROD	.728E+05 .728E+05	.728E+05	.728E+05	.728E+05	.728E+05	.728E+05	.728E+05	.729E+05	.728E+05	.728E+05
20	SDA	.255E+04 .219E+04	.253E+04	.251E+04	.248E+04	.245E+04	.241E+04	.236E+04	.232E+04	.228E+04	.223E+04
21	WIA	231. 224.	218.	215.	217.	222.	218.	219.	219.	221.	222.
22	EDA	.339E+04 .356E+04	.348E+04	.353E+04	.355E+04	.354E+04	.357E+04	.357E+04	.357E+04	.357E+04	.356E+04
23	EIA	273. 272.	280.	281.	280.	276.	278.	277.	276.	275.	273.
24	CDA	151. 75.1	145.	137.	130.	122.	114.	106.	98.4	90.7	92.9
25	CIA	186. 204.	171.	182.	162.	201.	203.	199.	205.	206.	207.
26	FA	150. 62.5	145.	139.	133.	129.	117.	110.	104.	96.7	89.5
27	GA	440. 516.	449.	461.	476.	482.	495.	494.	499.	505.	510.
28	SA	42.1 15.5	37.5	32.9	27.2	25.9	24.6	21.5	20.1	18.7	17.1
29	ROSA	642. 614.	532.	633.	637.	637.	627.	626.	623.	620.	617.
30	ROSDA	589. 561.	579.	580.	584.	594.	574.	573.	570.	567.	564.

F.2: <u>First EC Scenario (continued)</u>

31	WBCIA	690. 700.	568.	678.	678.	699.	699.	694.	700.	702.	[illegible]
32	WBCDA	.609E+04 .582E+04	.615E+04	.617E+04	.616E+04	.611E+04	.609E+04	.604E+04	.599E+04	.594E+04	[illegible]
33	TICA	812. 822.	790.	830.	800.	821.	820.	816.	822.	824.	824.
34	TDCA	.671E+04 .641E+04	.676E+04	.678E+04	.677E+04	.673E+04	.669E+04	.565E+04	.659E+04	.653E+04	.647E+04
35	TCA	.753E+04 .723E+04	.755E+04	.758E+04	.757E+04	.755E+04	.751E+04	.746E+04	.741E+04	.736E+04	.730E+04
36	TFOR	.128E+04 .167E+04	.132E+04	.137E+04	.142E+04	.145E+04	.149E+04	.153E+04	.156E+04	.160E+04	.163E+04
37	DFOR	845. .114E+04	881.	916.	954.	979.	.100E+04	.103E+04	.106E+04	.109E+04	.111E+04
38	TOCA	.682E+04 .780E+04	.686E+04	.689E+04	.696E+04	.705E+04	.717E+04	.728E+04	.740E+04	.753E+04	.766E+04
39	TOCIA	.166E+04 .185E+04	.170E+04	.171E+04	.173E+04	.173E+04	.175E+04	.177E+04	.179E+04	.180E+04	.182E+04
40	TOCDA	.516E+04 .596E+04	.516E+04	.518E+04	.523E+04	.533E+04	.542E+04	.551E+04	.561E+04	.573E+04	.584E+04
41	TDA	.127E+05 .135E+05	.128E+05	.129E+05	.130E+05	.130E+05	.131E+05	.132E+05	.133E+05	.133E+05	.134E+05
42	WDY	.159E+04 .196E+04	.162E+04	.166E+04	.170E+04	.174E+04	.178E+04	.181E+04	.185E+04	.189E+04	.193E+04
43	WIY	.333E+04 .398E+04	.340E+04	.346E+04	.353E+04	.359E+04	.366E+04	.372E+04	.379E+04	.385E+04	.391E+04
44	BDY	.204E+04 .246E+04	.208E+04	.213E+04	.217E+04	.221E+04	.225E+04	.229E+04	.233E+04	.238E+04	.242E+04
45	BIY	.347E+04 .410E+04	.353E+04	.360E+04	.366E+04	.372E+04	.379E+04	.385E+04	.391E+04	.398E+04	.404E+04
46	CDY	.243E+04 .291E+04	.248E+04	.252E+04	.257E+04	.262E+04	.267E+04	.272E+04	.277E+04	.282E+04	.286E+04
47	CIY	.590E+04 .741E+04	.605E+04	.620E+04	.635E+04	.650E+04	.665E+04	.680E+04	.696E+04	.711E+04	.726E+04
48	RY	.107E+04 .126E+04	.108E+04	.109E+04	.110E+04	.112E+04	.114E+04	.116E+04	.119E+04	.121E+04	.123E+04
49	OY	.126E+04 .150E+04	.126E+04	.131E+04	.133E+04	.135E+04	.138E+04	.140E+04	.143E+04	.145E+04	.147E+04
50	SY	.547E+04 .760E+04	.568E+04	.590E+04	.611E+04	.632E+04	.654E+04	.675E+04	.696E+04	.715E+04	.739E+04
51	WPROD	.542E+04* .519E+04	.485E+04	.491E+04	.498E+04	.505E+04	.507E+04	.510E+04	.513E+04	.515E+04	.517E+04
52	BAPROD	.795E+04* .986E+04	.824E+04	.851E+04	.871E+04	.886E+04	.908E+04	.926E+04	.942E+04	.957E+04	.972E+04
53	CPROD	.146E+04 .173E+04	.139E+04	.148E+04	.149E+04	.163E+04	.166E+04	.164E+04	.170E+04	.172E+04	.174E+04
54	RPROD	266. * 104.	157.	152.	147.	144.	134.	128.	123.	117.	110.
55	OPROD	613. * 772.	576.	603.	634.	653.	669.	692.	712.	731.	751.
56	SPROD	231. 118.	213.	194.	166.	164.	161.	145.	140.	134.	126.
57	ROSPR	.108E+04 .108E+04	.108E+04	.108E+04	.108E+04	.109E+04	.108E+04	.108E+04	.108E+04	.108E+04	.108E+04

F.2: First EC Scenario (continued)

58	CERPR	.158E+05 .158E+05	.158E+05	.158E+05	.158E+05	.158E+05	.158E+05	.158E+05	.158E+05	.158E+05	.158E+05
59	RCRIA	122. 122.	122.	122.	122.	122.	122.	122.	122.	122.	122.
60	TCLBF	.203E+05 .203E+05	.203E+05	.203E+05	.203E+05	.203E+05	.203E+05	.203E+05	.203E+05	.203E+05	.203E+05
61	SOW	.132E+04 .189E+04	.141E+04	.149E+04	.156E+04	.163E+04	.167E+04	.172E+04	.176E+04	.181E+04	.185E+04
62	PIGS	.119E+05 .170E+05	.127E+05	.134E+05	.141E+05	.146E+05	.150E+05	.155E+05	.159E+05	.163E+05	.166E+05
63	THSL	.116E+05 .166E+05	.123E+05	.131E+05	.137E+05	.143E+05	.146E+05	.151E+05	.155E+05	.159E+05	.162E+05
64	LESL	232. 331.	247.	262.	275.	286.	293.	302.	310.	317.	324.
65	HSL	.114E+05 .162E+05	.121E+05	.128E+05	.135E+05	.140E+05	.143E+05	.148E+05	.152E+05	.155E+05	.159E+05
66	LSW	89.6 85.0	88.6	87.8	86.7	85.4	85.0	85.0	85.0	85.0	85.0
67	HSLW	71.7 68.0	71.0	70.2	69.3	68.3	68.0	68.0	68.0	68.0	68.0
68	HPROD	.815E+06 .110E+07	.859E+06	.901E+06	.933E+06	.956E+06	.975E+06	.101E+07	.103E+07	.106E+07	.108E+07
69	LPROD	.232E+04 .331E+04	.247E+04	.262E+04	.275E+04	.286E+04	.293E+04	.302E+04	.310E+04	.317E+04	.324E+04
70	FEM	.993E+04 .498E+04	.971E+04	.906E+04	.845E+04	.789E+04	.737E+04	.687E+04	.638E+04	.590E+04	.543E+04
71	YM	.119E+05 .939E+04	.118E+05	.112E+05	.107E+05	.103E+05	.101E+05	.991E+04	.972E+04	.959E+04	.946E+04
72	ADULT	.128E+04 483.	.125E+04	.120E+04	.110E+04	997.	904.	816.	732.	647.	565.
73	MKPROC	502. 423.	500.	489.	479.	470.	462.	454.	446.	438.	430.
74	YMPROD	.130E+06 .111E+06	.130E+06	.124E+06	.119E+06	.116E+06	.115E+06	.114E+06	.112E+06	.112E+06	.111E+06
75	ADPROD	.231E+05 .941E+04	.227E+05	.220E+05	.202E+05	.185E+05	.169E+05	.154E+05	.139E+05	.124E+05	.109E+05
76	YMSW	10.9 11.8	11.0	11.1	11.2	11.3	11.4	11.5	11.6	11.7	11.7
77	ADSW	18.0 19.5	18.1	18.3	18.4	18.6	18.7	18.9	19.0	19.2	19.3
78	NBS	.510E+06 .632E+06	.535E+06	.535E+06	.535E+06	.535E+06	.535E+06	.535E+06	.559E+06	.583E+06	.608E+06
79	TPPROD	.780E+06 .941E+06	.815E+06	.815E+06	.813E+06	.817E+06	.816E+06	.815E+06	.846E+06	.878E+06	.909E+06
80	BRPROD	.757E+06 .937E+06	.793E+06	.793E+06	.793E+06	.793E+06	.793E+06	.793E+06	.829E+06	.865E+06	.901E+06
81	SLAY	.400E+05 .505E+05	.400E+05	.400E+05	.400E+05	.400E+05	.400E+05	.400E+05	.400E+05	.400E+05	.450E+05
82	TPEGPR	857. .106E+04	857.	857.	857.	857.	857.	857.	857.	857.	952.
83	SEPROD	757. 954.	757.	757.	757.	757.	757.	757.	757.	757.	851.
84	AEPROD	863. .106E+04	863.	863.	863.	863.	863.	863.	863.	863.	958.

F.2: **First EC Scenario (continued)**

85	XB	.202E-02 -.267E-03	.900E-03	.766E-03	.273E-03	.924E-03	.375E-03	.278E-03	.114E-03	-.371E-04	-.254E-03
86	XM	.444E-03 -.126E-02	-.271E-02	-.235E-03	-.162E-02	-.687E-03	-.112E-02	-.121E-02	-.107E-02	-.111E-02	-.952E-03
87	XP	.161E-02 -.154E-02	-.200E-02	.794E-03	-.110E-02	.574E-03	-.559E-03	-.722E-03	-.516E-03	-.113E-02	-.141E-02
88	XC	-.179E-02 .153E-03	.308E-02	-.496E-03	.472E-03	.842E-03	.535E-03	.473E-03	.376E-03	.269E-03	.153E-03
89	XSG	.343E-03 .982E-04	-.371E-03	.442E-03	.160E-03	.546E-04	.917E-04	.101E-03	.779E-04	.431E-04	.553E-04
90	XEG	-.464E-04 .741E-03	.300E-02	.447E-03	.120E-02	.954E-03	.962E-03	.961E-03	.816E-03	.765E-03	.597E-03
91	XBC	-.150E-03 -.569E-03	-.377E-02	-.264E-03	-.115E-02	-.122E-02	-.130E-02	-.967E-03	-.778E-03	-.666E-03	-.437E-03
92	XOF	-.815E-02 -.127E-02	-.336E-03	-.539E-02	-.246E-02	-.232E-02	-.210E-02	-.200E-02	-.170E-02	-.141E-02	-.961E-03
93	XNF	.871E-02 .679E-02	.518E-02	.743E-02	.759E-02	.375E-02	.571E-02	.593E-02	.597E-02	.611E-02	.621E-02
94	WB	.261E-01 .296E-01	.265E-01	.271E-01	.275E-01	.278E-01	.281E-01	.285E-01	.288E-01	.290E-01	.293E-01
95	WM	.318E-01 .210E-01	.288E-01	.275E-01	.267E-01	.255E-01	.245E-01	.235E-01	.226E-01	.221E-01	.217E-01
96	WP	.375E-01 .328E-01	.354E-01	.363E-01	.358E-01	.358E-01	.354E-01	.351E-01	.346E-01	.341E-01	.334E-01
97	WC	.119E-01 .119E-01	.143E-01	.131E-01	.131E-01	.135E-01	.131E-01	.127E-01	.125E-01	.122E-01	.121E-01
98	WSG	.104E-01 .764E-02	.934E-02	.922E-02	.831E-02	.857E-02	.832E-02	.810E-02	.794E-02	.780E-02	.773E-02
99	WEG	.634E-02 .566E-02	.700E-02	.669E-02	.648E-02	.627E-02	.611E-02	.594E-02	.584E-02	.576E-02	.575E-02
100	WBC	.119E-01 .131E-01	.117E-01	.111E-01	.114E-01	.113E-01	.114E-01	.117E-01	.119E-01	.123E-01	.127E-01
101	WOF	.176 .149	.174	.169	.165	.163	.160	.157	.155	.153	.151
102	WNF	.682 .729	.693	.700	.705	.709	.713	.717	.721	.724	.726
103	QT	.334E-02 .296E-02	.327E-02	.319E-02	.315E-02	.309E-02	.305E-02	.301E-02	.299E-02	.297E-02	.297E-02
104	BFC	13.9 15.6	14.4	14.8	15.0	15.5	15.7	15.8	15.9	15.9	15.7
105	MKC	158. 95.8	144.	140.	132.	128.	123.	117.	111.	106.	102.
106	PKC	24.5 19.5	23.2	23.7	23.0	23.4	23.0	22.6	22.0	21.3	20.4
107	CHC	18.5 25.0	23.4	22.5	23.4	24.9	25.0	25.0	25.0	25.0	25.0
108	SGC	3.97 4.38	3.82	4.01	4.08	4.11	4.15	4.20	4.24	4.29	4.32
109	EGC	15.6 18.0	18.0	18.0	18.0	18.0	18.0	15.0	18.0	18.0	18.0
110	ERC	73.3 65.0	55.0	65.0	65.0	65.0	65.0	65.0	65.0	65.0	65.0
111	CFC	553. 488.	552.	535.	526.	519.	512.	506.	500.	496.	492.

F.2: First EC Scenario (continued)

112	TPF	.520E+05 .641E+05	.544E+05	.565E+05	.576E+05	.601E+05	.615E+05	.627E+05	.636E+05	.641E+05	.641E+05
113	TMK	.589E+04 .394E+04	.544E+04	.533F+04	.507E+04	.499E+04	.482E+04	.462E+04	.446E+04	.428E+04	.414E+04
114	TPK	.917E+05 .800E+05	.876E+05	.905E+05	.886E+05	.909E+05	.904E+05	.894E+05	.879E+05	.854E+05	.831E+05
115	TCH	.691E+05 .103E+06	.682E+05	.659F+05	.839E+05	.968E+05	.981E+05	.990E+05	.100E+06	.101E+06	.102E+06
116	TSC	.149E+05 .180E+05	.144E+05	.153E+05	.157F+05	.160E+05	.163E+05	.167E+05	.170E+05	.173E+05	.176E+05
117	TEG	592. 740.	580.	646.	693.	700.	706.	713.	720.	726.	733.
118	TGC	.274E+04 .267E+04	.245E+04	.248E+04	.250E+04	.253E+04	.255F+04	.258E+04	.260E+04	.262E+04	.265E+04
119	TOF	.207E+07 .201E+07	.209E+07	.204E+07	.203F+07	.202F+07	.201E+07	.200F+07	.200E+07	.200E+07	.201E+07
120	GVPROD	.409E+06 .489E+06	.461E+06	.465E+06	.468E+06	.470F+06	.474E+06	.476F+06	.479E+06	.482E+06	.485E+06
121	FDEM	.949E+04 .125E+05	.987E+04	.101E+05	.104F+05	.106E+05	.108E+05	.110E+05	.113E+05	.116E+05	.121E+05
122	DBCPR	2.99 3.13	2.86	2.93	3.03	2.95	2.99	3.04	3.07	3.11	3.14
123	DBPPR	2.12 2.82	2.21	2.31	2.43	2.39	2.47	2.55	2.62	2.68	2.76
124	DSCPR	2.91 3.27	2.96	3.04	3.13	3.05	3.09	3.13	3.17	3.20	3.23
126	GOFC	.432E+04 .583E+04	.451E+04	.465E+04	.478E+04	.487E+04	.497E+04	.509E+04	.523E+04	.538E+04	.555E+04
127	SCFD	.466E+04 .623E+04	.485E+04	.499E+04	.510E+04	.524E+04	.535E+04	.547E+04	.562E+04	.577E+04	.599E+04
128	SOYCON	.233E+04 .293E+04	.242E+04	.246E+04	.249E+04	.251E+04	.253E+04	.256E+04	.263E+04	.270E+04	.281E+04
130	ECDIS	.422E+04 .406E+04	.383E+04	.385F+04	.388E+04	.391E+04	.393E+04	.396E+04	.398E+04	.401E+04	.403E+04
131	EODIS	.544E+04 .706E+04	.567E+04	.583F+04	.597E+04	.606E+04	.618E+04	.630E+04	.645E+04	.660E+04	.682E+04
132	SCDIS	.528E+04 .683E+04	.547E+04	.561E+04	.572E+04	.586E+04	.596E+04	.608E+04	.623E+04	.638E+04	.660E+04
133	MKDIS	.646E+04 .450E+04	.600E+04	.590E+04	.564E+04	.556E+04	.538E+04	.519E+04	.502E+04	.485F+04	.470E+04
134	DGPOP	2.12 2.82	2.21	2.31	2.43	2.39	2.47	2.55	2.62	2.68	2.76
135	DGSCP	2.91 3.27	2.96	3.04	3.13	3.05	3.09	3.13	3.17	3.20	3.23
137	LOSTK	500. -539.	388.	231.	81.2	40.9	-11.1	-111.	-215.	-307.	-420.
139	GCAV	.416E+04 .446E+04	.418E+04	.424E+04	.430E+04	.437E+04	.438E+04	.440E+04	.442E+04	.444E+04	.445F+04
140	EOAV	.793E+04 .112E+05	.843E+04	.888E+04	.927E+04	.947E+04	.976E+04	.101E+05	.103E+05	.106E+05	.109E+05
141	SCAV	.169E+04 .185E+04	.160E+04	.167E+04	.165E+04	.179E+04	.182E+04	.179E+04	.184E+04	.186E+04	.187E+04
142	MKAV	.654E+04 .834E+04	.672E+04	.689E+04	.705E+04	.723E+04	.740E+04	.758E+04	.776E+04	.795E+04	.814E+04

F.2: First EC Scenario (continued)

143	BCTP	52.5 -403.	-353.	-383.	-416.	-459.	-443.	-441.	-440.	-433.	-420.
144	BOTR	-.249E+04 -.412E+04	-.276E+04	-.305E+04	-.330E+04	-.341E+04	-.358E+04	-.376E+04	-.399E+04	-.401E+04	-.437E+04
145	SCTP	.359E+04 .499E+04	.387E+04	.393E+04	.406E+04	.406E+04	.414E+04	.429E+04	.439E+04	.452E+04	.473E+04
146	EFTP	.111E+06 .152E+06	.827E+05	.130E+06	.139E+05	.131E+06	.142E+06	.151E+06	.157E+06	.159E+06	.156E+06
147	FKTH	.995E+05 -.307E+06	.149E+05	.164E+04	-.492E+05	-.496E+05	-.746E+05	-.114E+06	-.156E+06	-.202E+06	-.251E+06
148	CHTR	-.889E+05 .868E+05	.672E+05	.441E+05	.864E+05	.159E+06	.165E+06	.176E+06	.154E+06	.131E+06	.103E+06
149	SGTR	-.417E+04 .593E+05	-.818E+04	.692E+04	.175E+05	.246E+05	.313E+05	.375E+05	.434E+05	.489E+05	.539E+05
150	MKTR	-85.2 -.384E+04	-715.	-987.	-.142E+04	-.168E+04	-.202E+04	-.239E+04	-.274E+04	-.310E+04	-.344E+04
151	EGTR	-.226E+05 -.331E+04	.754E+05	.821E+05	.889E+05	.956E+05	.102E+06	.109E+06	.116E+06	.123E+06	.625E+05
152	BCPROD	.499E+04 .529E+04	.501E+04	.506E+04	.512E+04	.519E+04	.520E+04	.523E+04	.525E+04	.527E+04	.526E+04
153	BOPROD	.843E+04 .106E+05	.882E+04	.912E+04	.935E+04	.951E+04	.975E+04	.995E+04	.101E+05	.103E+05	.105E+05
154	SCPROD	.169E+04 .195E+04	.160E+04	.167E+04	.165E+04	.179E+04	.182E+04	.179E+04	.184E+04	.186E+04	.197E+04
155	AFDEM	387. 344.	381.	376.	373.	372.	369.	367.	362.	358.	351.
156	ECFDC	130. 129.	130.	130.	130.	130.	129.	129.	129.	129.	129.
157	EOFDC	.450E+04 .599E+04	.469E+04	.483E+04	.496E+04	.505E+04	.515E+04	.526E+04	.541E+04	.555E+04	.576E+04
158	SCFDC	.486E+04 .640E+04	.505E+04	.518E+04	.529E+04	.543E+04	.553E+04	.565E+04	.580E+04	.595E+04	.617E+04
159	NFQ	312. 340.	314.	318.	321.	323.	325.	328.	331.	334.	337.

ZTAE 1970 1979 0 0 0 0 0 0 0 0 0 0 0

F.3: Second EC Scenario

SIMULATION RESULTS

		1980 1990	1981	1982	1983	1984	1985	1986	1987	1988	1989
1	RH	.263E+04 .287E+04	.266E+04	.268E+04	.271E+04	.273E+04	.275E+04	.277E+04	.280E+04	.282E+04	.284E+04
2	COWS	.259E+04 .281E+04	.262E+04	.264E+04	.267E+04	.269E+04	.271E+04	.273E+04	.275E+04	.277E+04	.279E+04
3	COWM	.199E+04 .216E+04	.201E+04	.203E+04	.204E+04	.206E+04	.207E+04	.209E+04	.211E+04	.212E+04	.214E+04
4	CA	.140E+04 .152E+04	.141E+04	.143E+04	.144E+04	.145E+04	.146E+04	.147E+04	.148E+04	.150E+04	.151E+04
5	VSCA	.345 .420	.352	.360	.368	.375	.382	.390	.397	.405	.412
6	VS	[illegible] 638.	498.	513.	529.	544.	558.	574.	590.	605.	622.
7	AFM	763. 896.	916.	916.	914.	910.	908.	903.	899.	895.	890.
8	CBS	303. 330.	306.	309.	311.	314.	317.	319.	322.	324.	327.
9	BFS	.107E+04 .122E+04	.122E+04	.123E+04	.123E+04	.122E+04	.122E+04	.122E+04	.122E+04	.122E+04	.122E+04
12	DY	.295E+04 .349E+04	.300E+04	.305E+04	.311E+04	.316E+04	.322E+04	.327E+04	.333E+04	.338E+04	.343E+04
13	VPROD	.761E+05 .101E+06	.786E+05	.811E+05	.836E+05	.859E+05	.882E+05	.907E+05	.932E+05	.956E+05	.982E+05
14	BPROD	.336E+06 .383E+06	.385E+06	.386E+06	.386E+06	.386E+06	.386E+06	.385E+06	.384E+06	.384E+06	.383E+06
15	DPROD	.585E+04 .752E+04	.602E+04	.619E+04	.635E+04	.651E+04	.667E+04	.684E+04	.700E+04	.717E+04	.734E+04
16	CBSW	245. 245.	245.	245.	245.	245.	245.	245.	245.	245.	245.
17	CBPROD	.728E+05 .728E+05	.728E+05	.728E+05	.728E+05	.728E+05	.728E+05	.728E+05	.728E+05	.728E+05	.728E+05
20	WDA	.255E+04 .207E+04	.253E+04	.250E+04	.246E+04	.242E+04	.237E+04	.231E+04	.225E+04	.219E+04	.213E+04
21	WIA	231. 150.	218.	207.	201.	197.	186.	178.	170.	164.	157.
22	BDA	.339E+04 .398E+04	.348E+04	.356E+04	.362E+04	.366E+04	.373E+04	.378E+04	.384E+04	.388E+04	.393E+04
23	BIA	273. 315.	280.	285.	288.	290.	296.	300.	304.	308.	311.
24	CDA	151. 68.2	145.	136.	129.	120.	111.	102.	53.7	85.2	76.7
25	CIA	186. 151.	171.	174.	168.	181.	179.	169.	169.	165.	159.
26	RA	160. 50.6	145.	134.	125.	116.	103.	92.3	82.0	71.6	61.0
27	OA	440. 500.	449.	459.	472.	476.	478.	485.	489.	492.	496.
28	SA	42.1 15.5	37.5	32.9	27.2	25.9	24.6	21.5	20.1	18.7	17.1
29	ROSA	642. 566.	632.	626.	625.	619.	605.	599.	591.	582.	574.
30	ROSDA	585. 513.	579.	573.	572.	566.	552.	546.	538.	529.	521.

F.3: Second EC Scenario (continued)

31	WRCIA	693. 616.	668.	667.	657.	669.	660.	647.	643.	636.	627.
32	WBCDA	.609E+04 .611E+04	.615E+04	.620E+04	.621E+04	.620E+04	.620E+04	.619E+04	.618E+04	.616E+04	.614E+04
33	TICA	812. 735.	790.	788.	779.	790.	782.	769.	765.	758.	749.
34	TOCA	.671E+04 .656E+04	.676E+04	.680E+04	.681E+04	.680E+04	.678E+04	.677E+04	.675E+04	.672E+04	.669E+04
35	TCA	.753E+04 .740E+04	.755E+04	.759E+04	.759E+04	.759E+04	.757E+04	.754E+04	.751E+04	.748E+04	.744E+04
36	TFOR	.128E+04 .167E+04	.132E+04	.137E+04	.142E+04	.145E+04	.149E+04	.153E+04	.156E+04	.160E+04	.163E+04
37	DFOR	845. .114E+04	881.	916.	954.	979.	.100E+04	.103E+04	.106E+04	.109E+04	.111E+04
38	TOCA	.682E+04 .764E+04	.686E+04	.689E+04	.694E+04	.702E+04	.711E+04	.720E+04	.730E+04	.741E+04	.752E+04
39	TOCIA	.166E+04 .193E+04	.170E+04	.172E+04	.175E+04	.176E+04	.179E+04	.182E+04	.184E+04	.187E+04	.190E+04
40	TOCDA	.516E+04 .571E+04	.516E+04	.516E+04	.519E+04	.526E+04	.532E+04	.539E+04	.546E+04	.554E+04	.562E+04
41	TDA	.127E+05 .135E+05	.128E+05	.129E+05	.130E+05	.130E+05	.131E+05	.132E+05	.133E+05	.133E+05	.134E+05
42	WDY	.159E+04 .196E+04	.162E+04	.166E+04	.170E+04	.174E+04	.176E+04	.181E+04	.185E+04	.189E+04	.193E+04
43	WIY	.333E+04 .398E+04	.340E+04	.346E+04	.353E+04	.359E+04	.366E+04	.372E+04	.379E+04	.385E+04	.391E+04
44	RDY	.204E+04 .246E+04	.208E+04	.213E+04	.217E+04	.221E+04	.225E+04	.229E+04	.233E+04	.238E+04	.242E+04
45	BIY	.347E+04 .410E+04	.353E+04	.360E+04	.366E+04	.372E+04	.379E+04	.385E+04	.391E+04	.398E+04	.404E+04
46	CDY	.243E+04 .291E+04	.248E+04	.252E+04	.257E+04	.262E+04	.267E+04	.272E+04	.277E+04	.282E+04	.286E+04
47	CIY	.590E+04 .741E+04	.605E+04	.620E+04	.635E+04	.650E+04	.665E+04	.680E+04	.696E+04	.711E+04	.726E+04
48	RY	.107E+04 .126E+04	.108E+04	.109E+04	.110E+04	.112E+04	.114E+04	.116E+04	.119E+04	.121E+04	.123E+04
49	OY	.126E+04 .150E+04	.128E+04	.131E+04	.133E+04	.135E+04	.138E+04	.140E+04	.143E+04	.145E+04	.147E+04
50	SY	.547E+04 .760E+04	.568E+04	.590E+04	.611E+04	.632E+04	.654E+04	.675E+04	.696E+04	.718E+04	.739E+04
51	WPROD	.542E+04 • .465E+04	.485E+04	.487E+04	.489E+04	.491E+04	.488E+04	.485E+04	.481E+04	.477E+04	.471E+04
52	BAFROD	.795E+04 • .111E+05	.824E+04	.859E+04	.889E+04	.917E+04	.951E+04	.983E+04	.101E+05	.105E+05	.108E+05
53	CPROD	.146E+04 .132E+04	.139E+04	.142E+04	.139E+04	.149E+04	.148E+04	.143E+04	.143E+04	.141E+04	.138E+04
54	RPROD	266. • 63.5	157.	146.	138.	131.	117.	107.	97.1	86.5	75.2
55	OPROD	613. • 749.	576.	600.	629.	645.	658.	680.	696.	713.	730.
56	SPROD	231. 118.	213.	194.	166.	164.	161.	145.	140.	134.	126.
57	RCSPR	.108E+04 .108E+04	.108E+04	.108E+04	.108E+04	.108E+04	.108E+04	.108E+04	.108E+04	.108E+04	.108E+04

F.3: Second EC Scenario (continued)

58	CERPP	.158E+05 .158E+05	.158E+05	.158E+05	.158E+05	.158E+05	.158E+05	.158E+05	.158E+05	.158E+05	.158E+05
59	RCRIA	122. 122.	122.	122.	122.	122.	122.	122.	122.	122.	122.
60	TCLBF	.203E+05 .203E+05	.203E+05	.203E+05	.203E+05	.203E+05	.203E+05	.203E+05	.203E+05	.203E+05	.283E+05
61	SOW	.132E+04 .189E+04	.141E+04	.145E+04	.156E+04	.163E+04	.167E+04	.172E+04	.176E+04	.181E+04	.185E+04
62	PIGS	.119E+05 .179E+05	.127E+05	.134E+05	.141E+05	.146E+05	.150E+05	.155E+05	.159E+05	.163E+05	.166E+05
63	THSL	.116E+05 .166E+05	.123E+05	.131E+05	.137E+05	.143E+05	.146E+05	.151E+05	.155E+05	.159E+05	.162E+05
64	LESL	232. 331.	247.	262.	275.	286.	293.	302.	310.	317.	324.
65	HSL	.114E+05 .162E+05	.121E+05	.128E+05	.135E+05	.140E+05	.143E+05	.148E+05	.152E+05	.155E+05	.159E+05
66	LSW	89.6 85.0	89.3	88.8	88.2	87.4	86.6	85.9	85.1	85.0	85.0
67	HSLW	71.7 68.0	71.5	71.0	70.5	69.9	69.3	68.7	68.1	68.0	68.0
68	HPRCD	.815E+06 .110E+07	.865E+06	.911E+06	.949E+06	.978E+06	.994E+06	.102E+07	.103E+07	.106E+07	.108E+07
69	LPROD	.232E+04 .331E+04	.247E+04	.262E+04	.275E+04	.286E+04	.293E+04	.302E+04	.310E+04	.317E+04	.324E+04
70	FEM	.993E+04 .498E+04	.971E+04	.906E+04	.845E+04	.789E+04	.737E+04	.687E+04	.638E+04	.590E+04	.543E+04
71	YM	.119E+05 .939E+04	.118E+05	.112E+05	.107E+05	.103E+05	.101E+05	.991E+04	.972E+04	.959E+04	.946E+04
72	ADULT	.128E+04 484.	.125E+04	.120E+04	.110E+04	997.	904.	816.	732.	647.	565.
73	MKPROD	502. 423.	500.	489.	479.	470.	462.	454.	446.	438.	430.
74	YMPROD	.130E+06 .111E+06	.130E+06	.124E+06	.119E+06	.116E+06	.115E+06	.114E+06	.112E+06	.112E+06	.111E+06
75	ADPROD	.231E+05 .941E+04	.227E+05	.220E+05	.202E+05	.185E+05	.169E+05	.154E+05	.139E+05	.124E+05	.109E+05
76	YMSW	10.9 11.8	11.0	11.1	11.2	11.3	11.4	11.5	11.6	11.7	11.7
77	ADSW	18.0 19.5	18.1	18.3	18.4	18.6	18.7	18.9	19.0	19.2	19.3
78	MHS	.510E+06 .632E+06	.535E+06	.535E+06	.535E+06	.535E+06	.535E+06	.535E+06	.559E+06	.583E+06	.608E+06
79	TPPROD	.790E+06 .978E+06	.820E+06	.824E+06	.826E+06	.833E+06	.835E+06	.838E+06	.873E+06	.908E+06	.943E+06
80	BRPROD	.757E+06 .937E+06	.793E+06	.793E+06	.793E+06	.793E+06	.793E+06	.793E+06	.829E+06	.865E+06	.901E+06
81	SLAY	.400E+05 .447E+05	.400E+05	.400E+05	.400E+05	.400E+05	.400E+05	.400E+05	.400E+05	.400E+05	.423E+05
82	TPFGPP	857. 945.	857.	857.	857.	857.	857.	857.	857.	857.	900.
83	SEPROD	757. 845.	757.	757.	757.	757.	757.	757.	757.	757.	800.
84	AEPROD	863. 951.	863.	863.	863.	863.	863.	863.	863.	863.	906.

F.3: Second EC Scenario (continued)

85	XR	.202E-02 .126E-03	.109E-02	.926E-03	.480E-03	.110E-02	.615E-03	.550E-03	.407E-03	.281E-03	.101E-03
86	XM	.444E-03 -.959E-03	-.244E-02	-.637E-03	-.135E-02	-.461E-03	-.824E-03	-.884E-03	-.735E-03	-.746E-03	-.574E-03
87	XP	.161E-02 -.592E-03	-.142E-02	.124E-02	-.500E-03	.108E-02	.111E-03	.188E-04	-.151E-03	-.315E-03	-.519E-03
88	XC	-.179E-02 .249E-03	.305E-02	-.458E-03	.487E-03	.870E-03	.570E-03	.521E-03	.426E-03	.355E-03	.244E-03
89	XSG	.343E-03 .273E-04	-.386E-03	.414E-03	.132E-03	.272E-04	.546E-04	.571E-04	.305E-04	.287E-04	-.645E-05
90	XEG	-.464E-04 .756E-03	.292E-02	.425E-03	.115E-02	.920E-03	.923E-03	.928E-03	.794E-03	.750E-03	.597E-03
91	XPC	-.150E-03 -.272E-03	-.350E-02	-.968E-04	-.916E-03	-.102E-02	-.746E-03	-.694E-03	-.511E-03	-.388E-03	-.151E-03
92	XCF	-.815E-02 -.431E-03	-.457E-04	-.504E-02	-.246E-02	-.195E-02	-.161E-02	-.143E-02	-.109E-02	-.739E-03	-.206E-03
93	XNF	.871E-02 .389E-02	.370E-02	.612E-02	.594E-02	.232E-02	.380E-02	.378E-02	.373E-02	.367E-02	.350E-02
94	WB	.261E-01 .266E-01	.263E-01	.267E-01	.269E-01	.270E-01	.270E-01	.271E-01	.270E-01	.269E-01	.267E-01
95	WM	.318E-01 .184E-01	.285E-01	.274E-01	.259E-01	.245E-01	.232E-01	.220E-01	.210E-01	.201E-01	.194E-01
96	WP	.375E-01 .409E-01	.360E-01	.374E-01	.376E-01	.381E-01	.385E-01	.390E-01	.394E-01	.399E-01	.404E-01
97	WC	.119E-01 .121E-01	.143E-01	.132E-01	.132E-01	.136E-01	.132E-01	.128E-01	.126E-01	.124E-01	.123E-01
98	WSG	.104E-01 .739E-02	.934E-02	.921E-02	.888E-02	.852E-02	.825E-02	.801E-02	.781E-02	.764E-02	.752E-02
99	WEG	.634E-02 .576E-02	.701E-02	.670E-02	.650E-02	.630E-02	.615E-02	.600E-02	.591E-02	.583E-02	.583E-02
100	WRC	.119E-01 .104E-01	.115E-01	.107E-01	.108E-01	.105E-01	.104E-01	.103E-01	.103E-01	.103E-01	.104E-01
101	WOF	.176 .157	.175	.170	.167	.165	.163	.161	.160	.159	.158
102	WNF	.689 .722	.692	.699	.703	.707	.710	.714	.716	.718	.720
103	QT	.334E-02 .296E-02	.327E-02	.319E-02	.315E-02	.309E-02	.305E-02	.301E-02	.299E-02	.297E-02	.297E-02
104	BFC	13.9 17.2	14.5	15.0	15.3	15.9	16.3	16.6	16.9	17.0	17.1
105	MKC	158. 107.	145.	142.	135.	133.	128.	123.	119.	115.	111.
106	PKC	24.5 23.9	23.6	24.4	24.1	24.8	24.8	24.9	24.8	24.6	24.3
107	CHC	18.5 25.0	23.3	22.6	23.4	25.0	25.0	25.0	25.0	25.0	25.0
108	SGC	3.97 4.15	3.82	3.99	4.05	4.06	4.09	4.12	4.13	4.15	4.15
109	EGC	15.6 18.0	18.0	18.0	18.0	18.0	18.0	18.0	18.0	18.0	18.0
110	HRC	73.3 65.0	65.0	65.0	65.0	65.0	65.0	65.0	65.0	65.0	65.0
111	OFC	553. 506.	553.	537.	529.	523.	518.	514.	510.	508.	507.

F.3: Second EC Scenario (continued)

112	TBF	.520E+05 .707E+05	.547E+05	.572E+05	.588E+05	.619E+05	.639E+05	.658E+05	.675E+05	.688E+05	.697E+05
113	TMK	.599E+04 .438E+04	.549E+04	.542E+04	.520E+04	.515E+04	.503E+04	.488E+04	.476E+04	.463E+04	.454E+04
114	TPK	.917E+05 .942E+05	.891E+05	.931E+05	.927E+05	.963E+05	.975E+05	.985E+05	.990E+05	.992E+05	.988E+05
115	TCM	.691E+05 .103E+06	.881E+05	.860E+05	.901E+05	.971E+05	.981E+05	.990E+05	.100E+06	.101E+06	.102E+06
116	TSG	.148E+05 .171E+05	.144E+05	.152E+05	.156E+05	.158E+05	.160E+05	.163E+05	.165E+05	.167E+05	.169E+05
117	TEG	582. 740.	680.	686.	693.	700.	706.	713.	720.	726.	733.
118	TPC	.274E+04 .267E+04	.245E+04	.248E+04	.250E+04	.253E+04	.255E+04	.258E+04	.260E+04	.262E+04	.265E+04
119	TOF	.207E+07 .208E+07	.209E+07	.205E+07	.204E+07	.203E+07	.203E+07	.203E+07	.204E+07	.205E+07	.207E+07
120	RVPROD	.412E+06 .484E+06	.464E+06	.467E+06	.470E+06	.472E+06	.474E+06	.476E+06	.478E+06	.480E+06	.482E+06
121	FDEM	.949E+04 .124E+05	.990E+04	.102E+05	.105E+05	.107E+05	.109E+05	.111E+05	.114E+05	.117E+05	.120E+05
122	DRCPR	2.80 2.25	2.73	2.71	2.71	2.56	2.51	2.46	2.41	2.36	2.30
123	DBCPR	2.12 2.00	2.09	2.11	2.14	2.05	2.05	2.04	2.03	2.02	2.01
124	DSCPR	2.91 2.31	2.83	2.81	2.80	2.65	2.60	2.54	2.49	2.43	2.37
126	POFD	.432E+04 .559E+04	.450E+04	.464E+04	.476E+04	.485E+04	.493E+04	.502E+04	.513E+04	.526E+04	.542E+04
127	SCFD	.466E+04 .631E+04	.489E+04	.505E+04	.519E+04	.535E+04	.546E+04	.559E+04	.574E+04	.591E+04	.610E+04
128	SOYCON	.233E+04 .287E+04	.242E+04	.247E+04	.250E+04	.253E+04	.254E+04	.257E+04	.263E+04	.269E+04	.278E+04
130	RCDIS	.422E+04 .403E+04	.383E+04	.385E+04	.387E+04	.390E+04	.392E+04	.394E+04	.396E+04	.399E+04	.401E+04
131	BODIS	.544E+04 .696E+04	.566E+04	.583E+04	.597E+04	.608E+04	.619E+04	.630E+04	.644E+04	.659E+04	.677E+04
132	SCDIS	.528E+04 .692E+04	.551E+04	.567E+04	.581E+04	.597E+04	.609E+04	.621E+04	.636E+04	.653E+04	.672E+04
133	MKDIS	.646E+04 .494E+04	.605E+04	.598E+04	.576E+04	.572E+04	.559E+04	.544E+04	.532E+04	.520E+04	.511E+04
134	DGBCP	2.12 2.00	2.09	2.11	2.14	2.05	2.05	2.04	2.03	2.02	2.01
135	DGSCP	2.91 2.31	2.83	2.81	2.80	2.65	2.60	2.54	2.49	2.43	2.37
137	ROSTK	500. 92.8	463.	389.	307.	311.	312.	276.	233.	193.	144.
139	RCAV	.416E+04 .389E+04	.418E+04	.419E+04	.420E+04	.422E+04	.417E+04	.413E+04	.408E+04	.403E+04	.396E+04
140	ROAV	.793E+04 .117E+05	.836E+04	.980E+04	.922E+04	.950E+04	.985E+04	.102E+05	.106E+05	.110E+05	.114E+05
141	SCAV	.169E+04 .144E+04	.160E+04	.162E+04	.156E+04	.165E+04	.165E+04	.157E+04	.157E+04	.154E+04	.150E+04
142	MKAV	.654E+04 .818E+04	.672E+04	.688E+04	.703E+04	.719E+04	.735E+04	.751E+04	.767E+04	.784E+04	.801E+04

F.3: Second EC Scenario (continued)

143	RCTP	52.5 139.	-353.	-344.	-330.	-316.	-249.	-187.	-118.	-41.3	44.5
144	ROTR	-.249E+04 -.478E+04	-.269E+04	-.297E+04	-.324E+04	-.342E+04	-.367E+04	-.393E+04	-.417E+04	-.438E+04	-.458E+04
145	SCTR	.359E+04 .545E+04	.391E+04	.405E+04	.425E+04	.431E+04	.444E+04	.464E+04	.479E+04	.499E+04	.522E+04
146	RFTR	.108E+06 .223E+06	.838E+05	.105E+06	.119E+06	.147E+06	.165E+06	.183E+06	.197E+06	.209E+06	.216E+06
147	PKTR	.995E+05 -.125E+06	.237E+05	.169E+05	-.248E+05	-.179E+05	-.219E+05	-.336E+05	-.454E+05	-.690E+05	-.945E+05
148	CHTR	-.889E+05 .495E+05	.603E+05	.362E+05	.754E+05	.138E+06	.146E+06	.153E+06	.127E+06	.101E+06	.753E+05
149	SGTR	-.417E+04 .504E+05	-.849E+04	.623E+04	.163E+05	.229E+05	.288E+05	.341E+05	.390E+05	.433E+05	.460E+05
150	MKTR	-85.2 -.324E+04	-668.	-896.	-.127E+04	-.148E+04	-.176E+04	-.206E+04	-.235E+04	-.264E+04	-.290E+04
151	EGTR	-.226E+05 .740E+05	.754E+05	.821E+05	.889E+05	.956E+05	.102E+06	.109E+06	.116E+06	.123E+06	.993E+05
152	RCPROD	.495E+04 .472E+04	.501E+04	.502E+04	.503E+04	.504E+04	.500E+04	.496E+04	.491E+04	.485E+04	.479E+04
153	ROPROD	.843E+04 .118E+05	.882E+04	.919E+04	.952E+04	.981E+04	.102E+05	.105E+05	.108E+05	.112E+05	.115E+05
154	SCPROD	.169E+04 .144E+04	.160E+04	.162E+04	.156E+04	.165E+04	.165E+04	.157E+04	.157E+04	.154E+04	.150E+04
155	AFDEM	397. 367.	383.	380.	378.	379.	378.	378.	376.	374.	370.
156	RCFCC	130. 129.	130.	130.	130.	130.	129.	129.	129.	129.	129.
157	ROFDC	.459E+04 .576E+04	.469E+04	.482E+04	.494E+04	.503E+04	.511E+04	.519E+04	.531E+04	.544E+04	.559E+04
158	SCFCC	.486E+04 .650E+04	.508E+04	.524E+04	.539E+04	.554E+04	.566E+04	.579E+04	.594E+04	.610E+04	.630E+04
159	NFG	312. 330.	314.	316.	319.	320.	322.	324.	325.	327.	329.

ZTAB 1970 1979 0 0 0 0 0 0 0 0 0 0 0

APPENDIX G

APPENDIX G

HISTORICAL DATA, 1960-1978

(For definitions of the symbols and the units associated with each variable, see Appendix E and Chapters III, IV and V.)

Historical Data, 1960-1978

SIMULATION RESULTS

		1960	1961	1962	1963	1964	1965	1966	1967	1968	1969
1	BH	0.	0.	.199E+04	.200E+04	.207E+04	.204E+04	.213E+04	.222E+04	.226E+04	.238E+04
2	COWS	0.	0.	.197E+04	.198E+04	.205E+04	.202E+04	.211E+04	.219E+04	.223E+04	.238E+04
3	COWM	0.	0.	.149E+04	.150E+04	.153E+04	.151E+04	.158E+04	.165E+04	.170E+04	.179E+04
4	CA	0.	0.	901.	.103E+04	.109E+04	980.	951.	.114E+04	.120E+04	.131E+04
5	VSCA	0.	0.	.638	.599	.727	.704	.758	.699	.669	.538
6	VS	574.	616.	574.	615.	765.	605.	721.	790.	802.	797.
7	AFM	282.	342.	306.	326.	407.	284.	294.	231.	343.	397.
8	CBS	261.	274.	241.	239.	346.	253.	228.	259.	300.	288.
9	BFS	544.	615.	547.	565.	753.	538.	522.	490.	643.	684.
10	VSW	106.	106.	109.	106.	109.	120.	125.	125.	129.	137.
11	BFSW	182.	182.	185.	180.	189.	195.	206.	210.	215.	214.
12	DY	0.	0.	.194E+04	.208E+04	.209E+04	.217E+04	.234E+04	.214E+04	.236E+04	.240E+04
13	VPROD	.605E+05	.654E+05	.623E+05	.664E+05	.831E+05	.726E+05	.902E+05	.996E+05	.103E+06	.109E+06
14	BPROD	.998E+05	.112E+06	.101E+06	.106E+06	.142E+06	.105E+06	.100E+06	.116E+06	.130E+06	.146E+06
15	DPROD	.260E+04	.286E+04	.289E+04	.312E+04	.313E+04	.320E+04	.371E+04	.372E+04	.401E+04	.430E+04
16	CBSW	199.	201.	205.	209.	208.	213.	225.	231.	238.	232.
17	CBPROD	.520E+05	.551E+05	.493E+05	.501E+05	.718E+05	.530E+05	.510E+05	.600E+05	.706E+05	.668E+05
20	WDA	.395E+04	.362E+04	.397E+04	.394E+04	.382E+04	.390E+04	.385E+04	.393E+04	.369E+04	.355E+04
21	WIA	284.	263.	281.	299.	320.	327.	338.	328.	277.	214.
22	BDA	.135E+04	.137E+04	.137E+04	.136E+04	.130E+04	.119E+04	.125E+04	.139E+04	.100E+04	.194E+04
23	BIA	77.2	77.5	78.3	82.6	83.2	83.7	83.8	109.	128.	157.
24	CDA	304.	305.	297.	310.	308.	283.	286.	277.	285.	246.
25	CIA	158.	175.	168.	212.	206.	195.	196.	201.	238.	249.
26	RA	509.	485.	486.	438.	406.	393.	384.	398.	366.	354.
27	OA	556.	583.	549.	527.	509.	502.	469.	486.	508.	493.
28	SA	1.10	.800	.708	1.60	81.6	19.8	20.5	17.5	31.5	40.6

Historical Data, 1960-1978 (continued)

29	ROSA	.107E+04	.107E+04	.104E+04	975.	937.	915.	879.	901.	905.	902.
30	ROSDA	.105E+04	.106E+04	.102E+04	958.	904.	887.	854.	876.	873.	860.
31	WBCIA	518.	516.	527.	593.	610.	630.	618.	638.	643.	620.
32	WBCDA	.560E+04	.529E+04	.564E+04	.561E+04	.542E+04	.538E+04	.539E+04	.560E+04	.577E+04	.574E+04
33	TICA	606.	596.	607.	675.	700.	719.	703.	725.	737.	727.
34	TDCA	.667E+04	.637E+04	.668E+04	.659E+04	.634E+04	.638E+04	.625E+04	.648E+04	.665E+04	.662E+04
35	TCA	.728E+04	.696E+04	.729E+04	.726E+04	.705E+04	.709E+04	.696E+04	.721E+04	.738E+04	.735E+04
36	TFOR	799.	821.	814.	813.	853.	838.	839.	856.	895.	966.
37	DFOR	588.	543.	538.	537.	596.	570.	563.	571.	597.	642.
38	TOCA	.591E+04	.603E+04	.610E+04	.614E+04	.600E+04	.594E+04	.605E+04	.587E+04	.570E+04	.570E+04
39	TOCIA	.101E+04	984.	997.	.104E+04	.104E+04	.107E+04	.111E+04	.114E+04	.117E+04	.118E+04
40	TOCDA	.490E+04	.505E+04	.511E+04	.510E+04	.495E+04	.487E+04	.494E+04	.473E+04	.453E+04	.452E+04
41	TDA	.122E+05	.120E+05	.123E+05	.122E+05	.119E+05	.118E+05	.118E+05	.118E+05	.118E+05	.118E+05
42	WDY	760.	807.	.102E+04	.106E+04	861.	986.	.107E+04	.122E+04	.124E+04	.114E+04
43	WIY	.183E+04	.195E+04	.267E+04	.235E+04	.216E+04	.246E+04	.230E+04	.259E+04	.268E+04	.262E+04
44	BDY	.104E+04	.114E+04	.142E+04	.144E+04	.135E+04	.143E+04	.141E+04	.163E+04	.170E+04	.178E+04
45	BIY	.206E+04	.228E+04	.268E+04	.241E+04	.208E+04	.223E+04	.287E+04	.283E+04	.309E+04	.273E+04
46	CDY	.174E+04	.164E+04	.127E+04	.151E+04	.158E+04	.163E+04	.168E+04	.170E+04	.188E+04	.186E+04
47	CIY	.307E+04	.323E+04	.323E+04	.332E+04	.348E+04	.349E+04	.344E+04	.350E+04	.393E+04	.422E+04
48	RY	756.	724.	932.	968.	852.	888.	849.	844.	970.	984.
49	OY	775.	849.	934.	884.	766.	737.	942.	.101E+04	.106E+04	.111E+04
50	SY	.636E+04	.875E+04	.100E+05	.100E+05	.236E+04	.221E+04	.157E+04	.251E+04	.289E+04	.323E+04
51	WPROD	.352E+04	.343E+04	.481E+04	.486E+04	.398E+04	.472E+04	.488E+04	.565E+04	.531E+04	.462E+04
52	BAPROD	.156E+04	.174E+04	.216E+04	.207E+04	.193E+04	.189E+04	.201E+04	.258E+04	.344E+04	.388E+04
53	CPROD	.101E+04	.107E+04	920.	.117E+04	.120E+04	.114E+04	.115E+04	.120E+04	.147E+04	.151E+04
54	RPROD	385.	351.	453.	424.	346.	349.	326.	336.	355.	320.
55	OPROD	431.	495.	513.	466.	390.	370.	442.	492.	539.	547.

Historical Data, 1960-1978 (continued)

56	SPROD	7.00	7.00	7.00	16.0	51.0	43.0	40.0	44.0	91.0	157.
57	ROSPR	823.	853.	973.	906.	787.	762.	808.	872.	985.	.102E+04
58	CERPR	.692E+04	.710E+04	.887E+04	.901E+04	.789E+04	.851E+04	.884E+04	.103E+05	.112E+05	.110E+05
59	RCRIA	87.8	80.1	80.4	82.4	98.8	88.8	84.9	86.3	93.7	107.
60	TCLBF	.205E+05	.207E+05	.208E+05	.208E+05	.206E+05	.203E+05	.202E+05	.200E+05	.199E+05	.198E+05
61	SOW	815.	830.	867.	835.	712.	940.	908.	767.	713.	880.
62	PIGS	.350E+04	.318E+04	.318E+04	.387E+04	.397E+04	.334E+04	.461E+04	.526E+04	.529E+04	.569E+04
63	THSL	.299E+04	.268E+04	.268E+04	.340E+04	.359E+04	.296E+04	.416E+04	.492E+04	.495E+04	.527E+04
64	LESL	67.0	43.0	28.0	58.0	72.0	35.0	66.0	68.0	47.0	68.0
65	HSL	.292E+04	.264E+04	.265E+04	.335E+04	.351E+04	.292E+04	.409E+04	.485E+04	.491E+04	.520E+04
66	LSW	110.	113.	116.	113.	113.	114.	112.	107.	107.	105.
67	HSLW	88.2	90.7	92.5	90.0	90.0	91.0	89.4	85.9	85.3	83.7
68	HPROD	.257E+06	.239E+06	.245E+06	.311E+06	.316E+06	.266E+06	.366E+06	.416E+06	.419E+06	.435E+06
69	LPROD	424.	352.	252.	260.	524.	353.	609.	750.	455.	911.
70	FEM	0.	0.	.138E+05	.136E+05	.129E+05	.128E+05	.124E+05	.124E+05	.119E+05	.127E+05
71	YM	.964E+04	.934E+04	.915E+04	.902E+04	.955E+04	.962E+04	.102E+05	.107E+05	.105E+05	.105E+05
72	ADULT	.241E+04	.214E+04	.192E+04	.186E+04	.231E+04	.245E+04	.180E+04	.184E+04	.185E+04	.183E+04
73	MKPROD	582.	586.	578.	613.	639.	648.	703.	498.	515.	558.
74	YMPROD	.862E+05	.833E+05	.851E+05	.845E+05	.919E+05	.938E+05	.103E+06	.103E+06	.101E+06	.997E+05
75	ADPROD	.354E+05	.317E+05	.292E+05	.297E+05	.365E+05	.399E+05	.297E+05	.301E+05	.301E+05	.299E+05
76	YMSW	8.94	8.91	9.30	9.36	9.62	9.75	10.1	9.70	9.59	9.52
77	ADSW	14.7	14.8	15.2	16.0	15.8	16.3	16.5	16.3	16.3	16.3
78	NBS	0.	0.	0.	.115E+06	.142E+06	.164E+06	.219E+06	.257E+06	.246E+06	.259E+06
79	TPPROD	.127E+05	.815E+05	.110E+06	.187E+06	.214E+06	.257E+06	.306E+06	.353E+06	.351E+06	.386E+06
80	BRPROD	0.	0.	0.	.127E+06	.158E+06	.182E+06	.243E+06	.286E+06	.281E+06	.316E+06
81	SLAY	0.	0.	0.	0.	.196E+05	.181E+05	.222E+05	.207E+05	.226E+05	.238E+05
82	TPEGPR	381.	371.	417.	569.	522.	490.	568.	547.	589.	620.

Historical Data, 1960-1978 (continued)

83	SEPROD	0.	0.	0.	0.	354.	340.	416.	387.	422.	453.
84	AEPROD	312.	383.	429.	580.	531.	494.	574.	553.	595.	625.
85	XB	.272E-01	.158E-02	.383E-02	.625E-02	-.192E-02	.399E-03	.428E-02	.405E-02	.283E-02	.133E-02
86	XM	.766E-01	.155E-02	0.	.104E-02	-.220E-03	.639E-04	.335E-02	.251E-02	.297E-02	.247E-02
87	XP	.518E-01	-.274E-02	.204E-02	.855E-02	-.783E-03	-.345E-02	.108E-01	.225E-02	0.	.796E-03
88	XC	-.954E-03	.123E-01	.403E-02	.753E-02	.210E-02	.170E-02	.433E-02	.232E-02	-.172E-03	.146E-02
89	XSG	.143E-01	-.149E-02	0.	0.	.157E-02	.384E-03	0.	-.374E-03	-.381E-03	-.367E-03
90	XEG	.176E-01	.379E-02	.204E-02	.662E-02	-.227E-02	.196E-03	.274E-02	-.858E-03	.927E-03	.105E-02
91	XBC	.213	-.348E-02	.604E-02	-.108E-01	-.220E-02	-.597E-04	.528E-04	-.208E-02	.344E-03	-.495E-02
92	XOF	.901	.164E-01	-.701E-02	.145E-01	.570E-02	-.142E-01	.989E-02	-.126E-01	-.350E-02	-.472E-02
93	XNF	1.04	.754E-01	.547E-01	.613E-01	.245E-01	.452E-01	.343E-01	.220E-01	.280E-01	.665E-01
94	WB	.316E-01	.290E-01	.312E-01	.306E-01	.303E-01	.316E-01	.333E-01	.362E-01	.373E-01	.358E-01
95	WM	.154E-01	.310E-01	.284E-01	.266E-01	.260E-01	.264E-01	.276E-01	.306E-01	.337E-01	.364E-01
96	WP	.485E-01	.420E-01	.417E-01	.422E-01	.377E-01	.362E-01	.426E-01	.376E-01	.367E-01	.320E-01
97	WC	.208E-02	.111E-01	.137E-01	.158E-01	.177E-01	.169E-01	.182E-01	.184E-01	.190E-01	.174E-01
98	WSG	.206E-01	.178E-01	.166E-01	.149E-01	.157E-01	.161E-01	.156E-01	.155E-01	.154E-01	.136E-01
99	WEG	.193E-01	.205E-01	.197E-01	.244E-01	.194E-01	.204E-01	.173E-01	.156E-01	.150E-01	.138E-01
100	WBC	.912E-01	.838E-01	.804E-01	.632E-01	.588E-01	.516E-01	.460E-01	.395E-01	.366E-01	.288E-01
101	WOF	.292	.275	.267	.272	.262	.259	.246	.243	.233	.218
102	WNF	.460	.490	.500	.510	.530	.540	.550	.560	.570	.600
104	BFC	5.60	5.90	6.70	8.20	7.70	7.80	8.90	10.0	10.8	11.2
105	MKC	81.0	84.9	84.9	88.1	87.4	87.6	98.2	106.	115.	123.
106	PKC	8.50	8.00	8.40	10.3	10.1	9.20	12.1	12.8	12.8	13.1
107	CHC	.400	2.60	3.60	6.00	6.80	7.50	9.60	10.9	10.8	11.7
108	SGC	4.00	3.70	3.70	3.70	4.10	4.20	4.20	4.10	4.00	3.90
109	EGC	6.20	7.50	8.30	11.2	10.1	10.2	11.8	11.2	11.9	12.8
110	BRC	108.	104.	111.	95.9	92.5	92.4	92.5	88.1	88.9	76.4

Historical Data, 1960-1978 (continued)

111	OFC	481.	509.	496.	524.	535.	507.	527.	500.	493.	483.
112	TBF	.170E+05	.181E+05	.207E+05	.256E+05	.243E+05	.249E+05	.287E+05	.326E+05	.355E+05	.373E+05
113	TMK	.245E+04	.260E+04	.262E+04	.275E+04	.276E+04	.279E+04	.317E+04	.346E+04	.379E+04	.409E+04
114	TPK	.258E+05	.245E+05	.260E+05	.321E+05	.319E+05	.293E+05	.391E+05	.417E+05	.421E+05	.436E+05
115	TCH	.121E+04	.796E+04	.111E+05	.187E+05	.215E+05	.239E+05	.318E+05	.355E+05	.355E+05	.390E+05
116	TSG	.121E+05	.113E+05	.114E+05	.115E+05	.130E+05	.134E+05	.136E+05	.134E+05	.132E+05	.130E+05
117	TEG	188.	230.	256.	349.	319.	325.	381.	365.	392.	426.
118	TBC	.326E+04	.317E+04	.344E+04	.299E+04	.292E+04	.295E+04	.299E+04	.287E+04	.292E+04	.254E+04
119	TOF	.146E+07	.156E+07	.153E+07	.163E+07	.169E+07	.162E+07	.170E+07	.163E+07	.162E+07	.161E+07
120	BVPROD	.160E+06	.178E+06	.163E+06	.172E+06	.225E+06	.177E+06	.198E+06	.215E+06	.241E+06	.256E+06
121	FDEM	.368E+04	.395E+04	.476E+04	.570E+04	.501E+04	.635E+04	.699E+04	.749E+04	.825E+04	.829E+04
122	DBCPR	6.36	6.70	6.40	6.39	6.34	5.82	5.50	5.19	4.93	4.82
123	DBOPR	5.32	5.34	4.52	4.91	4.74	4.20	4.17	4.02	3.82	3.74
124	DSCPR	6.40	6.18	5.86	5.96	5.01	4.64	4.47	4.40	4.31	4.40
125	BCFD	426.	424.	498.	431.	307.	315.	548.	891.	789.	584.
126	BOFD	.201E+04	.227E+04	.257E+04	.293E+04	.253E+04	.255E+04	.274E+04	.287E+04	.378E+04	.384E+04
127	SCFD	.125E+04	.126E+04	.169E+04	.235E+04	.218E+04	.348E+04	.370E+04	.373E+04	.368E+04	.386E+04
128	SOYCON	0.	0.	0.	12.5	45.1	272.	511.	651.	739.	821.
129	MKFD	827.	951.	952.	.109E+04	.112E+04	.125E+04	.138E+04	897.	873.	912.
130	BCDIS	.547E+04	.529E+04	.578E+04	.510E+04	.486E+04	.494E+04	.520E+04	.540E+04	.532E+04	.458E+04
131	BODIS	.230E+04	.257E+04	.289E+04	.325E+04	.283E+04	.285E+04	.304E+04	.322E+04	.424E+04	.435E+04
132	SCDIS	.129E+04	.130E+04	.175E+04	.244E+04	.226E+04	.361E+04	.383E+04	.387E+04	.382E+04	.401E+04
133	MKDIS	.328E+04	.355E+04	.358E+04	.384E+04	.389E+04	.404E+04	.455E+04	.436E+04	.467E+04	.501E+04
134	DGBOP	0.	0.	3.98	4.22	3.96	3.50	3.91	3.81	3.93	3.85
135	DGSCP	0.	0.	4.15	4.65	4.34	3.84	4.03	3.90	4.01	4.02
136	BCSTK	-.149E+04	-555.	414.	380.	-456.	208.	84.0	-186.	-428.	-533.
137	BOSTK	-244.	27.0	-110.	-347.	259.	-54.0	-27.0	313.	-252.	-178.

Historical Data, 1960-1978 (continued)

138	SCSTK	-203.	22.0	-512.	-280.	174.	-821.	60.0	15.0	83.0	23.0
139	BCAV	.548E+04	.434E+04	.485E+04	.490E+04	.478E+04	.486E+04	.512E+04	.617E+04	.610E+04	.548E+04
140	BOAV	.224E+04	.221E+04	.279E+04	.288E+04	.206E+04	.232E+04	.248E+04	.276E+04	.423E+04	.460E+04
141	SCAV	.122E+04	.105E+04	.144E+04	.148E+04	.108E+04	.201E+04	.113E+04	.122E+04	.148E+04	.164E+04
142	MKAV	.328E+04	.355E+04	.357E+04	.384E+04	.388E+04	.404E+04	.454E+04	.435E+04	.467E+04	.500E+04
143	BCTR	74.0	949.	930.	199.	81.0	82.0	81.0	-774.	-774.	-901.
144	BOTR	63.0	362.	108.	363.	774.	539.	562.	467.	10.0	-253.
145	SCTR	68.0	251.	306.	963.	.118E+04	.160E+04	.270E+04	.265E+04	.234E+04	.237E+04
146	BFTR	.100E+05	.300E+04	.440E+05	.840E+05	.180E+05	.720E+05	.898E+05	.111E+06	.114E+06	.117E+06
147	PKTR	0.	.600E+04	.150E+05	.100E+05	.200E+04	.270E+05	.240E+05	0.	.200E+04	0.
148	CHTR	-.100E+04	.200E+04	.100E+04	0.	.100E+04	.500E+04	.400E+04	.200E+04	.400E+04	.400E+04
149	SGTR	-.100E+04	-.200E+04	0.	.100E+04	.200E+04	0.	.300E+04	0.	.100E+04	0.
150	MKTR	51.0	2.00	1.00	-4.00	2.00	-1.00	8.00	2.00	0.	5.00
151	EGTR	0.	0.	0.	.100E+04	0.	-.100E+04	.200E+04	0.	0.	-.600E+04
152	BCPROD	.391E+04	.378E+04	.527E+04	.528E+04	.432E+04	.506E+04	.520E+04	.599E+04	.567E+04	.494E+04
153	BOPROD	.199E+04	.224E+04	.268E+04	.254E+04	.232E+04	.226E+04	.245E+04	.307E+04	.398E+04	.442E+04
154	SCPROD	.102E+04	.107E+04	927.	.119E+04	.125E+04	.119E+04	.119E+04	.124E+04	.156E+04	.166E+04
155	AFDEM	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
156	BCFDC	426.	424.	498.	431.	387.	315.	548.	891.	789.	584.
157	BOFDC	.201E+04	.227E+04	.257E+04	.293E+04	.253E+04	.255E+04	.274E+04	.287E+04	.378E+04	.384E+04
158	SCFDC	.125E+04	.126E+04	.169E+04	.235E+04	.218E+04	.348E+04	.370E+04	.373E+04	.368E+04	.386E+04
159	NFQ	91.4	107.	120.	136.	142.	154.	164.	171.	179.	201.

YTAB 1970 1978 0 0 0 0 0 0 0 0 0 0 0

Historical Data, 1960-1978 (continued)

SIMULATION RESULTS

		1970	1971	1972	1973	1974	1975	1976	1977	1978
1	BH	.242E+04	.240E+04	.242E+04	.252E+04	.245E+04	.241E+04	.241E+04	.255E+04	.259E+04
2	COWS	.239E+04	.238E+04	.239E+04	.249E+04	.242E+04	.238E+04	.238E+04	.252E+04	.255E+04
3	COWM	.183E+04	.186E+04	.187E+04	.194E+04	.185E+04	.181E+04	.182E+04	.195E+04	.195E+04
4	CA	.142E+04	.145E+04	.140E+04	.155E+04	.169E+04	.161E+04	.159E+04	.147E+04	.145E+04
5	VSCA	.457	.451	.337	.344	.351	.396	.379	.415	.423
6	VS	648.	655.	472.	532.	593.	637.	602.	611.	614.
7	AFM	709.	771.	796.	927.	.101E+04	.110E+04	971.	987.	863.
8	CBS	310.	306.	221.	253.	310.	303.	282.	284.	298.
9	BFS	.102E+04	.108E+04	.102E+04	.118E+04	.132E+04	.140E+04	.125E+04	.127E+04	.116E+04
10	VSW	127.	123.	131.	141.	145.	145.	149.	151.	153.
11	BFSW	222.	226.	237.	251.	250.	258.	262.	266.	256.
12	DY	.237E+04	.229E+04	.241E+04	.248E+04	.266E+04	.275E+04	.286E+04	.275E+04	.285E+04
13	VPROD	.820E+05	.886E+05	.619E+05	.749E+05	.859E+05	.924E+05	.895E+05	.924E+05	.937E+05
14	BPROD	.226E+06	.243E+06	.241E+06	.296E+06	.330E+06	.361E+06	.329E+06	.330E+06	.297E+06
15	DPROD	.432E+04	.426E+04	.451E+04	.479E+04	.493E+04	.498E+04	.521E+04	.535E+04	.556E+04
16	CBSW	229.	229.	236.	238.	241.	240.	241.	243.	245.
17	CBPROD	.710E+05	.782E+05	.520E+05	.603E+05	.747E+05	.727E+05	.679E+05	.691E+05	.728E+05
20	WDA	.353E+04	.345E+04	.339E+04	.295E+04	.298E+04	.250E+04	.258E+04	.249E+04	.252E+04
21	WIA	230.	207.	196.	198.	184.	165.	191.	222.	235.
22	BDA	.209E+04	.222E+04	.234E+04	.258E+04	.280E+04	.302E+04	.300E+04	.311E+04	.324E+04
23	BIA	131.	147.	183.	192.	229.	238.	236.	233.	274.
24	CDA	235.	223.	220.	207.	206.	202.	193.	180.	176.
25	CIA	305.	321.	314.	315.	295.	283.	239.	262.	267.
26	RA	313.	285.	278.	268.	249.	228.	224.	236.	230.
27	OA	467.	455.	467.	470.	475.	457.	455.	485.	420.
28	SA	47.0	41.5	44.3	43.3	36.6	34.7	37.5	41.3	53.5
29	ROSA	827.	780.	789.	781.	761.	720.	716.	682.	701.
30	ROSDA	784.	737.	744.	736.	723.	682.	676.	640.	648.
31	WBCIA	666.	675.	693.	705.	707.	686.	665.	717.	777.
32	WBCDA	.585E+04	.589E+04	.595E+04	.574E+04	.598E+04	.572E+04	.578E+04	.579E+04	.594E+04
33	TICA	774.	780.	808.	812.	807.	787.	770.	827.	898.
34	TDCA	.666E+04	.666E+04	.669E+04	.649E+04	.671E+04	.641E+04	.646E+04	.644E+04	.662E+04
35	TCA	.743E+04	.744E+04	.750E+04	.730E+04	.752E+04	.720E+04	.723E+04	.727E+04	.751E+04
36	TFOR	990.	.105E+04	.106E+04	.109E+04	.111E+04	.113E+04	.114E+04	.113E+04	.119E+04
37	DFOR	641.	684.	715.	748.	743.	742.	759.	744.	790.
38	TOCA	.624E+04	.691E+04	.699E+04	.714E+04	.712E+04	.746E+04	.720E+04	.692E+04	.681E+04
39	TOCIA	.108E+04	.128E+04	.135E+04	.138E+04	.141E+04	.144E+04	.150E+04	.148E+04	.144E+04
40	TOCDA	.516E+04	.563E+04	.564E+04	.576E+04	.572E+04	.602E+04	.570E+04	.544E+04	.537E+04
41	TDA	.125E+05	.130E+05	.130E+05	.130E+05	.132E+05	.132E+05	.129E+05	.126E+05	.128E+05

Historical Data, 1960-1978 (continued)

42	WDY	.101E+04	.142E+04	.119E+04	.117E+04	.135E+04	.151E+04	.149E+04	.135E+04	.160E+04*
43	WIY	.249E+04	.275E+04	.277E+04	.259E+04	.272E+04	.323E+04	.316E+04	.318E+04	.335E+04*
44	BDY	.131E+04	.196E+04	.165E+04	.150E+04	.168E+04	.197E+04	.160E+04	.192E+04	.217E+04*
45	BIY	.283E+04	.297E+04	.279E+04	.271E+04	.310E+04	.320E+04	.287E+04	.333E+04	.370E+04*
46	CDY	.195E+04	.219E+04	.208E+04	.222E+04	.241E+04	.189E+04	.175E+04	.230E+04	.264E+04*
47	CIY	.457E+04	.489E+04	.466E+04	.500E+04	.508E+04	.499E+04	.506E+04	.564E+04	.562E+04*
48	RY	827.	944.	946.	940.	.102E+04	.106E+04	995.	966.	.113E+04*
49	OY	846.	.120E+04	942.	984.	.118E+04	.133E+04	.116E+04	.103E+04	.129E+04*
50	SY	.402E+04	.417E+04	.408E+04	.379E+04	.429E+04	.415E+04	.424E+04	.465E+04	.520E+04*
51	WPROD	.406E+04	.546E+04	.456E+04	.397E+04	.453E+04	.430E+04	.444E+04	.406E+04	.481E+04
52	BAPROD	.310E+04	.479E+04	.436E+04	.440E+04	.548E+04	.673E+04	.547E+04	.677E+04	.807E+04
53	CPROD	.182E+04	.206E+04	.192E+04	.204E+04	.199E+04	.179E+04	.155E+04	.189E+04	.197E+04
54	RPROD	259.	269.	263.	252.	254.	241.	214.	228.	251.
55	OPROD	395.	582.	440.	425.	559.	609.	528.	418.	553.
56	SPROD	189.	173.	177.	164.	157.	144.	159.	192.	204.
57	ROSPR	843.	.102E+04	880.	841.	970.	994.	901.	838.	.108E+04*
58	CERPR	.983E+04	.133E+05	.117E+05	.112E+05	.129E+05	.138E+05	.124E+05	.136E+05	.158E+05*
59	RCRIA	108.	105.	107.	107.	99.9	101.	105.	110.	122. *
60	TCLBF	.205E+05	.212E+05	.212E+05	.210E+05	.209E+05	.208E+05	.207E+05	.206E+05	.206E+05*
61	SOW	813.	879.	.103E+04	.114E+04	983.	.105E+04	.113E+04	.120E+04	.133E+04*
62	PIGS	.637E+04	.627E+04	.607E+04	.779E+04	.978E+04	.834E+04	.885E+04	.101E+05	.113E+05*
63	THSL	.602E+04	.591E+04	.567E+04	.740E+04	.946E+04	.803E+04	.851E+04	.982E+04	.110E+05*
64	LESL	107.	77.0	58.0	117.	205.	171.	180.	204.	278.
65	HSL	.592E+04	.583E+04	.561E+04	.728E+04	.926E+04	.786E+04	.833E+04	.953E+04	.107E+05
66	LSW	104.	102.	103.	101.	95.6	95.4	97.0	96.0	93.9 *
67	HSLW	82.9	81.3	82.1	80.7	76.5	76.3	77.6	76.8	75.1
68	HPROD	.491E+06	.474E+06	.461E+06	.588E+06	.708E+06	.600E+06	.647E+06	.732E+06	.801E+06
69	LPROD	957.	728.	550.	972.	.166E+04	.211E+04	.171E+04	.223E+04	.182E+04
70	FEM	.131E+05	.128E+05	.122E+05	.122E+05	.107E+05	.105E+05	.103E+05	.102E+05	.104E+05*
71	YM	.111E+05	.107E+05	.108E+05	.113E+05	.120E+05	.115E+05	.113E+05	.114E+05	.112E+05
72	ADULT	.186E+04	.196E+04	.179E+04	.155E+04	.171E+04	.150E+04	.147E+04	.138E+04	.126E+04
73	MKPROD	573.	537.	533.	540.	498.	520.	514.	524.	493. *
74	YMPROD	.109E+06	.104E+06	.107E+06	.117E+06	.129E+06	.122E+06	.120E+06	.119E+06	.120E+06
75	ADPROD	.308E+05	.323E+05	.299E+05	.266E+05	.262E+05	.261E+05	.262E+05	.251E+05	.222E+05
76	YMSW	9.83	9.74	9.96	10.4	10.8	10.6	10.6	10.5	10.7
77	ADSW	16.6	16.5	16.7	17.2	15.3	17.4	17.8	18.2	17.7
78	NBS	.300E+06	.285E+06	.336E+06	.396E+06	.402E+06	.419E+06	.467E+06	.496E+06	.462E+06*
79	TPPROD	.499E+06	.477E+06	.554E+06	.600E+06	.608E+06	.631E+06	.696E+06	.735E+06	.755E+06
80	BRPROD	.429E+06	.407E+06	.484E+06	.530E+06	.538E+06	.561E+06	.626E+06	.665E+06	.685E+06*
81	SLAY	.264E+05	.295E+05	.347E+05	.253E+05	.286E+05	.359E+05	.389E+05	.417E+05	.389E+05*
82	TPEGPR	678.	722.	820.	635.	703.	839.	895.	899.	837. *

Historical Data, 1960-1978 (continued)

83	SEPROD	496.	562.	660.	475.	543.	685.	741.	794.	737.	•
84	AEPROD	683.	727.	826.	641.	710.	846.	903.	906.	843.	•
85	XB	.279E-02	-.857E-03	-.133E-02	.173E-02	0.	.424E-02	-.416E-03	-.165E-02	-.607E-03	•
86	XM	.163E-03	.895E-03	.739E-03	.275E-02	.311E-02	-.992E-03	.127E-02	.483E-04	.785E-03	•
87	XP	.164E-02	.234E-02	.170E-02	.442E-02	.383E-02	-.185E-02	.146E-02	.146E-02	.408E-02	•
88	XC	.427E-02	-.886E-03	.242E-02	.821E-03	-.184E-03	.696E-03	.131E-02	.580E-03	.212E-03	•
89	XSG	.663E-03	-.296E-03	0.	.566E-03	.815E-03	-.819E-03	0.	-.530E-03	-.559E-03	•
90	XEG	.111E-02	.851E-03	.130E-02	-.264E-02	.831E-03	.149E-02	.504E-03	-.239E-03	-.490E-03	•
91	XBC	.217E-03	-.559E-03	.205E-03	.384E-03	.227E-04	.461E-03	-.545E-03	-.380E-04	-.216E-03	•
92	XOF	.603E-02	.124E-01	.113E-01	.658E-03	.109E-01	-.127E-02	.103E-02	-.157E-01	.491E-02	•
93	XNF	.365E-01	.214E-01	.123	-.494E-02	.341E-01	.261E-02	.355E-01	.161E-02	-.467E-02	•
94	WB	.363E-01	.320E-01	.296E-01	.279E-01	.265E-01	.286E-01	.293E-01	.261E-01	.259E-01	•
95	WM	.377E-01	.376E-01	.385E-01	.383E-01	.384E-01	.392E-01	.374E-01	.341E-01	.312E-01	•
96	WP	.310E-01	.301E-01	.348E-01	.357E-01	.362E-01	.350E-01	.352E-01	.370E-01	.386E-01	•
97	WC	.189E-01	.176E-01	.145E-01	.163E-01	.153E-01	.151E-01	.139E-01	.151E-01	.139E-01	•
98	WSG	.129E-01	.111E-01	.116E-01	.116E-01	.120E-01	.117E-01	.111E-01	.110E-01	.108E-01	•
99	WEG	.130E-01	.141E-01	.113E-01	.874E-02	.954E-02	.974E-02	.879E-02	.720E-02	.701E-02	•
100	WBC	.266E-01	.234E-01	.210E-01	.183E-01	.169E-01	.176E-01	.153E-01	.140E-01	.135E-01	•
101	WOF	.195	.201	.188	.201	.194	.193	.189	.193	.193	•
102	WNF	.626	.631	.647	.642	.647	.648	.658	.662	.665	•
104	BFC	12.1	11.8	11.3	12.0	12.0	14.0	13.8	13.0	12.7	•
105	MKC	123.	126.	129.	138.	148.	145.	150.	150.	153.	•
106	PKC	13.8	14.9	15.7	17.8	19.8	18.8	19.6	20.4	22.7	•
107	CHC	14.8	14.1	16.4	17.3	17.1	17.9	19.6	20.4	20.7	•
108	SGC	4.10	4.00	4.00	4.20	4.50	4.20	4.20	4.00	3.80	•
109	EGC	13.9	14.8	16.4	12.6	13.8	16.1	17.0	16.5	15.4	•
110	BRC	77.0	75.3	76.0	77.5	77.6	79.7	77.1	76.9	75.7	•
111	OFC	497.	529.	561.	563.	595.	591.	594.	547.	561.	•
112	TBF	.407E+05	.401E+05	.389E+05	.416E+05	.421E+05	.497E+05	.494E+05	.471E+05	.470E+05	•
113	TMK	.415E+04	.429E+04	.442E+04	.477E+04	.521E+04	.514E+04	.536E+04	.542E+04	.568E+04	•
114	TPK	.464E+05	.507E+05	.540E+05	.618E+05	.695E+05	.667E+05	.702E+05	.738E+05	.840E+05	•
115	TCH	.497E+05	.479E+05	.564E+05	.600E+05	.600E+05	.635E+05	.702E+05	.738E+05	.766E+05	•
116	TSG	.138E+05	.136E+05	.138E+05	.146E+05	.158E+05	.149E+05	.150E+05	.145E+05	.141E+05	•
117	TEG	467.	503.	564.	437.	484.	572.	609.	597.	570.	•
118	TBC	.259E+04	.256E+04	.261E+04	.269E+04	.272E+04	.283E+04	.276E+04	.278E+04	.280E+04	•
119	TOF	.167E+07	.180E+07	.193E+07	.195E+07	.209E+07	.210E+07	.213E+07	.198E+07	.208E+07	•
120	BVPROD	.308E+06	.324E+06	.303E+06	.371E+06	.416E+06	.454E+06	.418E+06	.431E+06	.391E+06	•
121	FDEM	.831E+04	.102E+05	.963E+04	.109E+05	.123E+05	.120E+05	.124E+05	.131E+05	.132E+05	•
122	DBCPR	4.58	4.25	4.10	3.75	3.66	3.70	3.43	3.16	3.09	•
123	DBOPR	3.61	3.52	3.13	3.05	3.57	3.05	2.79	2.52	2.29	•

Historical Data, 1960-1978 (continued)

124	DSCPR	4.34	4.85	3.73	3.88	4.18	3.67	3.49	2.98	2.77 *
125	BCFD	941.	.101E+04	730.	708.	672.	196.	113.	122.	125. *
126	BOFD	.330E+04	.496E+04	.424E+04	.426E+04	.540E+04	.569E+04	.634E+04	.660E+04	.682E+04*
127	SCFD	.406E+04	.422E+04	.465E+04	.595E+04	.624E+04	.616E+04	.590E+04	.633E+04	.628E+04*
128	SOYCON	986.	.105E+04	.115E+04	.129E+04	.146E+04	.160E+04	.214E+04	.190E+04	.224E+04*
129	MKFD	931.	830.	838.	768.	747.	782.	596.	640.	565. *
130	BCDIS	.498E+04	.499E+04	.478E+04	.473E+04	.485E+04	.440E+04	.423E+04	.430E+04	.429E+04*
131	BODIS	.379E+04	.554E+04	.484E+04	.494E+04	.616E+04	.643E+04	.713E+04	.743E+04	.775E+04*
132	SCDIS	.443E+04	.459E+04	.502E+04	.619E+04	.652E+04	.646E+04	.631E+04	.675E+04	.640E+04*
133	MKDIS	.508E+04	.512E+04	.526E+04	.554E+04	.596E+04	.585E+04	.595E+04	.606E+04	.624E+04*
134	DGBOP	3.64	3.33	3.08	2.76	2.87	2.67	2.48	2.23	2.22 *
135	DGSCP	3.90	3.61	3.33	2.99	3.18	3.14	3.09	3.15	2.99 *
136	BCSTK	-.108E+04	903.	-168.	-712.	-113.	151.	453.	140.	827. *
137	BOSTK	-375.	45.0	-33.0	-179.	-73.0	841.	-.139E+04	-245.	871. *
138	SCSTK	-271.	318.	-489.	-.107E+04	119.	192.	-653.	26.0	727.
139	BCAV	.540E+04	.482E+04	.499E+04	.493E+04	.490E+04	.439E+04	.420E+04	.415E+04	.423E+04*
140	BOAV	.387E+04	.532E+04	.483E+04	.501E+04	.604E+04	.650E+04	.739E+04	.743E+04	.775E+04*
141	SCAV	.228E+04	.191E+04	.251E+04	.328E+04	.283E+04	.175E+04	.236E+04	.206E+04	.153E+04*
142	MKAV	.504E+04	.494E+04	.520E+04	.549E+04	.559E+04	.567E+04	.590E+04	.605E+04	.623E+04*
143	BCTR	-413.	164.	-213.	-200.	-54.0	3.00	37.0	150.	64.0 *
144	BOTR	-82.0	221.	8.00	-71.0	121.	-28.0	-254.	-4.00	-3.00 *
145	SCTR	.217E+04	.268E+04	.251E+04	.291E+04	.449E+04	.471E+04	.396E+04	.469E+04	.487E+04*
146	BFTR	.990E+05	.770E+05	.860E+05	.460E+05	.700E+04	.510E+05	.760E+05	.400E+05	.790E+05*
147	PKTR	-.280E+05	.320E+05	.790E+05	.290E+05	-.150E+05	.650E+05	.530E+05	.300E+04	.370E+05*
148	CHTR	.200E+04	-.200E+04	.100E+05	0.	-.800E+04	.400E+04	.600E+04	.300E+04	.110E+05*
149	SGTR	-.200E+04	0.	.100E+04	.200E+04	.300E+04	.100E+04	.400E+04	.100E+04	-.100E+04*
150	MKTR	35.0	177.	62.0	47.0	363.	177.	53.0	9.00	6.00 *
151	EGTR	-.400E+04	.200E+04	-.600E+04	-.500E+04	-.600E+04	-.120E+05	-.140E+05	-.340E+05	-.170E+05*
152	BCPROD	.432E+04	.572E+04	.483E+04	.422E+04	.479E+04	.454E+04	.465E+04	.429E+04	.506E+04*
153	BOPROD	.350E+04	.537E+04	.480E+04	.483E+04	.596E+04	.734E+04	.600E+04	.718E+04	.862E+04*
154	SCPROD	.201E+04	.223E+04	.210E+04	.220E+04	.215E+04	.194E+04	.170E+04	.208E+04	.225E+04*
155	AFDEM	0.	0.	0.	0.	0.	0.	0.	0.	0. *
156	BCFDC	941.	.101E+04	730.	708.	672.	196.	113.	122.	125. *
157	BOFDC	.330E+04	.496E+04	.424E+04	.426E+04	.540E+04	.569E+04	.634E+04	.660E+04	.682E+04*
158	SCFDC	.406E+04	.422E+04	.465E+04	.595E+04	.624E+04	.616E+04	.590E+04	.633E+04	.628E+04*
159	NFQ	213.	221.	268.	265.	280.	331.	291.	301.	295.

ZTAB 1960 1969 0 0 0 0 0 0 0 0 0 0 0

Historical Data, 1960-1978 (continued)

PREDETERMINED DATA		1960	1961	1962	1963	1964	1965	1966	1967	1968	1969
1	DRET	0.	0.	.109E+05	.112E+05	.114E+05	.120E+05	.127E+05	.112E+05	.119E+05	.118E+05
2	BREP	0.	0.	.121	.120	.167	.124	.107	.117	.133	.121
3	CULL	0.	0.	.174	.126	.110	.127	.141	.130	.137	.129
4	NEWR	0.	0.	.666	.631	.671	.618	.614	.705	.695	.766
5	DCOST	1.06	1.06	1.04	1.03	1.00	.913	.885	.851	.818	.814
6	FO	0.	0.	0.	0.	8.10	7.36	6.90	6.63	6.77	5.91
7	CP	0.	0.	0.	0.	0.	0.	3.00	3.00	5.31	5.43
8	ADPRV	33.6	36.0	38.3	37.2	36.6	41.9	40.3	39.3	38.2	43.1
9	VSCAER	0.	0.	0.	0.	0.	-.316E-01	.111	.850E-02	.399E-01	-.284E-01
10	L2BHC	0.	13.0	64.0	-31.0	93.0	87.0	43.0	117.	45.0	-16.0
11	ADPRCB	22.0	22.5	25.1	23.4	25.5	28.8	26.3	23.8	23.7	25.3
12	ADPRD	5.97	5.75	5.62	5.39	5.57	5.54	5.42	5.27	5.03	4.93
13	ADPRN	0.	0.	0.	0.	30.6	35.7	34.2	32.0	31.8	33.9
14	FEED	0.	0.	0.	0.	1.00	.890	.873	.851	.821	.818
15	DG	33.6	36.0	38.3	37.2	28.5	34.5	33.4	32.7	31.4	37.2
16											
17	YR	.196E+04	.196E+04	.196E+04	.196E+04	.196E+04	.197E+04	.197E+04	.197E+04	.197E+04	.197E+04
18	BH2	.199E+04	.200E+04	.207E+04	.204E+04	.213E+04	.222E+04	.226E+04	.238E+04	.242E+04	.240E+04
19	BRET	.438E+04	.451E+04	.515E+04	.488E+04	.528E+04	.613E+04	.591E+04	.558E+04	.557E+04	.587E+04
20	DWPR	6.41	6.74	6.48	6.49	6.46	5.90	5.57	5.23	4.99	4.88
21	DBPR	5.38	5.38	4.57	5.00	4.77	4.21	4.20	4.06	3.84	3.75
22	DSI	72.9	76.7	81.2	95.5	100.	98.0	106.	110.	113.	122.
23	DGOPR	4.09	3.99	3.77	3.48	3.25	3.01	2.85	2.67	2.55	2.49
24	WERR	0.	0.	-11.2	2.98	21.6	24.5	11.8	14.8	-27.5	-52.4

Historical Data, 1960-1978 (continued)

PREDETERMINED DATA

		1960	1961	1962	1963	1964	1965	1966	1967	1968	1969
25											
26	DCPR	6.41	6.19	5.87	5.98	5.83	4.66	4.48	4.42	4.36	4.48
27	DSBPR	1.25	1.22	1.15	1.24	1.19	1.14	1.12	1.06	1.03	1.12
28	DRPR	5.92	6.28	5.62	5.24	5.81	4.66	4.53	4.37	4.11	3.98
29	DOPR	5.10	5.18	4.33	4.56	4.61	4.11	4.01	3.84	3.65	3.62
30	DPIC	97.1	102.	98.8	98.2	100.	90.0	84.5	79.5	76.8	75.2
31	DSPR	4.69	3.85	4.35	4.60	4.44	4.05	3.94	3.89	3.56	3.65
32											
33											
34	FORIR	211.	279.	276.	276.	257.	269.	276.	285.	297.	324.
35	TCLB	.140E+05	.138E+05	.142E+05	.142E+05	.139E+05	.139E+05	.138E+05	.139E+05	.140E+05	.140E+05
36	TIA	.183E+04	.186E+04	.188E+04	.199E+04	.201E+04	.206E+04	.209E+04	.215E+04	.220E+04	.223E+04
37											
38	RICE	65.8	61.4	63.0	62.7	64.1	59.0	59.1	59.8	60.5	63.6
39	ROSIA	17.4	15.8	14.8	17.3	32.6	28.4	24.6	25.5	32.2	42.1
40	OICA	4.60	2.90	2.60	2.40	2.10	1.40	1.20	1.00	1.00	1.00
41	ODCA	15.6	16.2	16.9	14.8	14.7	112.	10.4	9.90	6.60	22.5
42	FAL	.654E+04	.691E+04	.662E+04	.663E+04	.665E+04	.646E+04	.631E+04	.605E+04	.591E+04	.581E+04
43	DHPR	31.0	35.0	39.2	33.3	30.9	37.5	33.6	28.2	28.8	29.6
45	PPS	4.29	3.83	3.67	4.64	5.58	4.51	5.08	6.86	7.42	6.46
46	PREP	.625	.604	.582	.561	.539	.518	.497	.475	.454	.432
47	HCRAT	4.83	5.65	6.67	5.57	6.14	8.04	7.49	6.37	6.60	6.60
48	DYOPR	20.6	21.9	23.5	24.7	30.4	32.2	32.2	33.0	34.4	36.4
49	DADPR	16.1	17.4	18.4	19.6	20.0	20.9	21.1	18.7	17.8	17.5

Historical Data, 1960-1978 (continued)

PREDETERMINED DATA		1960	1961	1962	1963	1964	1965	1966	1967	1968	1969
50	DSSAL	71.3	81.0	80.6	88.3	100.	101.	109.	123.	131.	139.
51											
52	DMKPR	3.48	3.49	3.50	3.24	8.35	7.68	8.07	7.89	9.26	9.50
53	BRSW	1.10	1.10	1.10	1.10	1.10	1.11	1.11	1.11	1.14	1.22
54	EGY	225.	225.	225.	225.	217.	226.	225.	224.	224.	229.
55	CHPI	0.	0.	0.	0.	20.4	12.9	12.4	13.4	12.7	8.35
56	EGPI	0.	0.	0.	0.	10.8	5.55	4.33	8.81	6.06	2.75
57	DPOPR	0.	0.	0.	0.	39.7	39.5	35.1	31.0	31.3	28.0
58	DEGPR	0.	0.	0.	0.	27.0	29.6	24.7	24.2	22.5	20.2
59	DPCAM	0.	0.	0.	0.	7.92	7.06	6.76	6.52	6.34	6.33
60	DPCAL	0.	0.	0.	0.	6.77	6.10	5.92	5.72	5.55	5.55
61	DCONPR	0.	0.	0.	0.	6.86	6.23	6.09	5.88	5.68	5.63
62											
63											
64	OTEG	11.5	11.5	11.6	10.3	8.70	8.70	5.80	6.10	6.08	5.90
65	POP	30.3	30.6	30.9	31.2	31.6	31.9	32.3	32.6	32.9	33.3
66	NBRP	90.9	88.7	95.4	90.8	105.	128.	133.	144.	149.	151.
67	NMKRP	6.54	6.21	6.65	7.09	8.07	9.50	10.5	12.1	13.2	14.4
68	NPKRP	91.9	94.8	102.	99.6	99.8	124.	125.	117.	124.	115.
69	NCRP	83.9	77.0	77.9	64.1	69.7	71.3	67.4	67.8	76.0	70.0
70	NSGRP	82.9	86.7	91.9	98.2	102.	121.	132.	150.	166.	165.
71	EGRP	50.2	49.2	48.6	53.1	51.5	63.1	52.2	55.4	54.3	50.8
72	BCRP	13.7	14.6	14.8	16.0	17.0	17.7	17.7	17.8	17.8	17.7
73	OFP	9.86	9.80	11.1	12.7	13.2	16.3	16.8	19.5	20.6	21.5

Historical Data, 1960-1978 (continued)

PREDETERMINED DATA

		1960	1961	1962	1963	1964	1965	1966	1967	1968	1969
74	NFP	81.1	82.5	85.5	91.8	100.	111.	119.	130.	137.	140.
75	PCE	.161E+05	.180E+05	.205E+05	.243E+05	.267E+05	.316E+05	.356E+05	.397E+05	.432E+05	.471E+05
76	P1	.114	-.411E-01	.366E-01	-.120	.622E-01	.934E-01	-.359E-01	-.965E-02	-.148E-01	-.146E-01
77	P2	-2.32	-.687E-01	.325E-01	-.712E-02	.441E-01	.615E-01	.256E-01	.521E-01	.351E-01	.604E-01
78	P3	.125	.144E-01	.330E-01	-.910E-01	-.832E-01	.119	-.687E-01	-.158	.869E-02	-.100
79	P4	.337E-01	-.103	-.244E-01	-.266	-.131E-02	-.792E-01	-.131	-.943E-01	.746E-01	-.104
80	P5	.219E-01	.274E-01	.224E-01	-.449E-02	-.432E-01	.609E-01	.834E-02	.408E-01	.472E-01	-.306E-01
81	P6	-.479	-.366E-01	-.482E-01	.167E-01	-.117	.102	-.265	-.284E-01	-.704E-01	-.904E-01
82	P7	-1.78	.509E-01	-.248E-01	.108E-01	-.268E-01	-.636E-01	-.723E-01	-.829E-01	-.533E-01	-.247E-01
83	P8	-2.11	-.231E-01	.898E-01	.640E-01	-.496E-01	.109	-.442E-01	.603E-01	.603E-02	.199E-01
84	T	1.00	2.00	3.00	4.00	5.00	6.00	7.00	8.00	9.00	10.0
85	SOYRES	-553.	-562.	-578.	-820.	-840.	-558.	-530.	-489.	-423.	-414.
86	BCEXT	.745	.745	.745	.745	.745	.745	.745	.745	.745	.745
87	CNSDO	43.0	37.0	55.0	91.0	81.0	130.	129.	136.	136.	145.
88	DGBAP	0.	0.	4.07	4.33	4.05	3.58	3.95	3.83	3.95	3.86
89	DGOP	0.	0.	3.60	3.74	3.50	3.09	3.74	3.71	3.83	3.75
90	DGCP	0.	0.	4.19	4.65	4.35	3.84	4.03	3.91	4.02	4.05
91	DGSP	0.	0.	0.	4.49	4.20	3.71	3.91	3.79	3.91	3.83
92	EGCON	.602	.601	.597	.600	.601	.660	.661	.660	.659	.691

ZTAB 1970 1978 0 0 0 0 0 0 0 0 0 0 0

Historical Data, 1960-1978 (continued)

PREDETERMINED DATA

		1970	1971	1972	1973	1974	1975	1976	1977	1978
1	DRET	.118E+05	.117E+05	.129E+05	.119E+05	.127E+05	.137E+05	.137E+05	.118E+05	.112E+05
2	BREP	.128	.127	.918E-01	.100	.126	.126	.117	.111	.115
3	CULL	.910E-01	.105	.128	.120	.115	.118	.124	.115	.116
4	NEWR	.692	.759	.686	.725	.811	.856	.809	.706	.667
5	DCOST	.790	.764	.715	.713	.802	.741	.689	.631	.595
6	FD	5.62	5.54	5.27	5.23	5.61	4.90	4.56	3.74	3.41
7	CP	5.53	5.55	6.48	7.48	9.10	9.84	7.42	4.00	0.
8	ADPRV	37.8	36.1	41.6	38.5	38.5	35.2	37.3	32.8	33.2
9	VSCAER	-.817E-01	.520E-02	-.741E-01	-.551E-01	-.147E-01	.741E-01	.183E-01	.252E-01	.430E-02
10	L2BHC	16.0	101.	-67.0	-41.0	-6.00	-20.0	35.0	13.0	-49.0
11	ADPRCB	22.2	21.9	23.6	21.5	21.1	19.0	19.1	15.9	16.4
12	ADPRD	4.99	5.12	5.35	4.82	4.78	4.98	4.80	4.30	3.94
13	ADPRN	31.5	30.9	33.6	32.8	33.8	30.5	32.2	27.1	27.7
14	FEED	.795	.784	.731	.758	.810	.718	.661	.581	.538
15	DG	32.2	30.5	36.3	33.3	32.9	30.2	32.8	29.1	29.8
16										
17	YR	.197E+04	.197E+04	.197E+04	.197E+04	.197E+04	.198E+04	.198E+04	.198E+04	.198E+04
18	BH2	.242E+04	.252E+04	.245E+04	.241E+04	.241E+04	.255E+04	.259E+04	.221E+04	.222E+04
19	BRET	.518E+04	.502E+04	.556E+04	.512E+04	.509E+04	.455E+04	.459E+04	.387E+04	.402E+04
20	DWPR	4.62	4.27	4.14	3.78	3.65	3.72	3.44	3.18	3.12
21	DBPR	3.62	3.53	3.14	3.06	3.60	3.06	2.81	2.53	2.28
22	DSI	133.	136.	140.	150.	172.	171.	183.	188.	199.
23	DGOPR	2.36	2.28	2.12	1.94	2.76	2.57	2.32	1.87	1.56
24										
25	BPFT	4.78	4.90	4.62	4.65	4.55	4.03	4.22	4.50	4.16
26	DCPR	4.41	4.09	3.78	3.92	4.22	3.69	3.53	3.00	2.77
27	DSBPR	1.03	.988	.894	.802	.826	1.06	1.02	.852	.704
28	DRPR	3.92	3.82	3.41	3.30	3.82	3.31	3.12	2.70	2.45
29	DOPR	3.52	3.42	3.07	3.00	3.37	2.97	2.59	2.38	2.34
30	DPIC	70.8	65.3	63.2	60.9	57.8	58.4	55.6	50.4	47.8
31	DSPR	3.70	3.57	3.18	3.43	3.70	3.42	3.04	2.82	2.79
32										
33										
34	FORIR	349.	362.	350.	342.	369.	386.	386.	389.	403.
35	TCLB	.147E+05	.154E+05	.155E+05	.155E+05	.158E+05	.158E+05	.156E+05	.153E+05	.155E+05
36	TIA	.220E+04	.242E+04	.250E+04	.254E+04	.259E+04	.262E+04	.265E+04	.269E+04	.274E+04

<u>Historical Data, 1960-1978 (continued)</u>

PREDETERMINED DATA		1970	1971	1972	1973	1974	1975	1976	1977	1978
37										
38	RICE	64.2	61.1	59.1	61.4	61.2	62.1	64.0	67.9	68.3
39	ROSIA	42.9	42.7	44.8	44.8	38.1	37.9	39.8	41.7	53.1
40	OICA	1.00	.700	3.40	.500	.600	.900	.900	.300	.400
41	ODCA	21.5	24.5	3.30	9.60	6.70	6.60	7.90	11.5	30.4
42	FAL	.586E+04	.579E+04	.562E+04	.545E+04	.513E+04	.504E+04	.509E+04	.529E+04	.506E+04
43	DHPR	26.7	27.1	30.1	26.2	23.8	26.3	24.5	20.5	19.9
45	PPS	7.83	7.13	5.92	6.82	9.95	7.99	7.87	8.44	8.51
46	PREP	.411	.389	.368	.347	.325	.304	.282	.261	.239
47	MCRAT	6.07	6.63	7.98	6.68	5.65	7.11	6.94	6.83	7.08
48	DYOPR	33.1	34.4	38.2	37.2	38.6	38.5	36.5	34.3	39.2
49	DADPR	16.2	15.2	18.4	17.5	15.5	13.3	12.5	11.6	11.4
50	DSSAL	140.	151.	154.	167.	190.	191.	205.	214.	220.
51										
52	DMKPR	9.36	10.2	9.69	8.39	9.84	9.39	8.23	7.83	8.24
53	BRSW	1.43	1.43	1.44	1.34	1.34	1.34	1.34	1.34	1.48
54	EGY	225.	228.	229.	225.	228.	229.	229.	229.	227.
55	CHPI	9.56	8.73	3.95	6.23	9.01	1.92	-1.36	2.29	1.85
56	EGPI	5.91	5.47	-2.77	3.11	7.43	-1.88	-3.65	.839	.854
57	DPOPR	26.8	26.6	25.2	23.7	23.4	19.7	15.5	15.8	15.4
58	DEGPR	21.0	21.2	16.5	17.9	18.8	13.7	11.1	12.5	12.9
59	DPCAM	6.20	6.12	5.69	6.24	6.71	5.71	5.37	4.87	4.41
60	DPCAL	5.44	5.32	5.01	5.22	5.58	4.89	4.58	4.15	3.87
61	DCONPR	5.46	5.35	5.06	5.30	5.71	4.97	4.60	4.16	3.78
62										
63										
64	OTEG	5.50	5.00	5.40	5.80	6.60	6.40	7.20	6.50	6.00
65	POP	33.6	34.0	34.4	34.7	35.1	35.5	35.8	36.2	37.0
66	NBRP	154.	156.	177.	188.	218.	236.	297.	351.	424.
67	NMKRP	15.7	17.0	20.9	21.6	26.6	30.6	34.2	36.9	41.5
68	NPKRP	115.	116.	150.	162.	181.	215.	252.	325.	353.
69	NCRP	65.9	71.9	59.7	76.0	88.6	97.6	99.1	130.	140.
70	NSGRP	162.	160.	196.	223.	264.	322.	369.	481.	589.
71	EGRP	48.2	54.8	46.5	56.0	68.2	69.9	72.4	76.4	94.4
72	BCRP	17.8	17.9	18.7	19.1	21.5	25.5	27.7	31.8	37.0
73	OFP	20.4	22.1	23.0	29.1	32.6	38.3	45.2	62.4	71.9

Historical Data, 1960-1978 (continued)

PREDETERMINED DATA

		1970	1971	1972	1973	1974	1975	1976	1977	1978
74	NFP	151.	164.	164.	195.	228.	267.	311.	389.	467.
75	PCÈ	.515E+05	.575E+05	.677E+05	.808E+05	.987E+05	.116E+06	.140E+06	.175E+06	.207E+06
76	P1	-.493E-01	-.719E-01	.131	-.117	-.752E-02	-.773E-01	.768E-01	-.586E-01	.716E-02
77	P2	.134E-01	-.387E-02	.206	-.141	.524E-01	-.183E-01	-.426E-01	-.147	-.656E-01
78	P3	-.676E-01	-.775E-01	.258	-.977E-01	-.473E-01	.201E-01	.219E-02	.292E-01	-.983E-01
79	P4	-.135	.458E-02	-.183	.668E-01	-.274E-02	-.585E-01	-.139	.448E-01	-.109
80	P5	-.898E-01	-.969E-01	.210	-.506E-01	.147E-01	.432E-01	-.179E-01	.394E-01	.218E-01
81	P6	-.126	.457E-01	-.162	.948E-02	.416E-01	-.132	-.118	-.172	.302E-01
82	P7	-.701E-01	-.780E-01	.457E-01	-.155	-.339E-01	.129E-01	-.692E-01	-.892E-01	-.301E-01
83	P8	-.125	-.311E-02	.411E-01	.605E-01	-.423E-01	.408E-02	.121E-01	.974E-01	-.401E-01
84	T	11.0	12.0	13.0	14.0	15.0	16.0	17.0	18.0	19.0
85	SOYRES	-470.	-382.	-378.	-398.	-409.	-233.	183.	-194.	81.8
86	BCEXT	.745	.745	.745	.745	.737	.746	.746	.746	.746
87	CNSDO	370.	369.	365.	238.	284.	295.	413.	414.	425.
88	DGBAP	3.66	3.35	3.09	2.77	2.90	2.69	2.49	2.24	2.23
89	DGOP	3.55	3.22	2.97	2.66	2.65	2.40	2.37	2.13	2.14
90	DGCP	3.93	3.63	3.35	3.01	3.19	3.16	3.12	3.20	3.02
91	DGSP	3.62	3.35	3.09	2.77	2.94	2.91	2.87	2.64	2.79
92	EGCON	.689	.689	.690	.690	.690	.691	.690	.697	.696

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