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IN SPAIN

By

Javier Fernández

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ABSTRACT

AN ECONOMIC ANALYSIS OF THE SUNFLOWERSEED SECTOR IN SPAIN

By

Javier Fernández

This research is focused on the potential consequences that the evolution of the Common Agricultural Policy (CAP) of the European Union (EU) could have on the Spanish sunflowerseed sector. The study analyses the effects that different compensatory payments levels granted in the oilseeds and cereal sectors could have on the total area planted with sunflowerseed in Spain, as well as on the Spanish production, consumption and net trade of sunflowerseed, sunflowerseed oil and sunflowerseed meal.

Econometric models are developed to simulate the historical evolution of supply and demand in the Spanish sunflowerseed sector during the 1970-1995 period. The study of supply is carried out independently of the analysis of demand, and prices and compensatory payments levels are treated as exogenous variables. Net trade is deduced residually from the results obtained in the supply and demand models.

The analysis of supply is mainly concentrated on the simulation of the Spanish sunflowerseed acreage in relation to alternative models accounting for the formation of farmers' expectations about gross margins per hectare in the production of sunflowerseed and of its alternatives.

Due to a lack of official sources about agricultural costs of production in Spain, the present study constructs relevant variable costs of production series, extrapolating the information obtained from different available case studies on the production of rain fed and irrigated sunflowerseed and of rain fed wheat.

The results of the supply analysis suggest that rain fed and irrigated sunflowerseed producers form their expectations about gross

margins according to the same rational expectation model. The analysis of supply also confirms that the farmers' expectations about gross margins in the production of rain fed wheat influence significantly the Spanish rain fed sunflowerseed acreage.

The analysis of demand is mainly focused on the consumption of bottled sunflowerseed oil and indicates inelastic own price, cross price and income elasticities for the demand of bottled sunflowerseed oil.

The supply and demand estimations are utilized to generate relevant projections for the 1996-2005 period. The projection process is done according to five alternative scenarios, being the future levels of compensatory payments the only exogenous variable that changes among scenarios.

To Antonio Salido, my grandfather, for keeping me well informed about the recent evolution of the Spanish agricultural sector.

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INTRODUCTION

The sunflowerseed sector is an important component of Spanish agriculture. Oil varieties of sunflowerseed were introduced in 1964 for the first time and, currently, the production of sunflowerseed is generalized in many zones of Spain. Moreover, sunflowerseed production is an important source of income for Spanish farmers, especially in the Southern and Central regions of Spain. The consumption of sunflowerseed oil in Spain has grown very significantly during the last 20 years. Sunflowerseed oil was in 1995 the second vegetable oil most consumed in Spain.

Historically, the development of sunflowerseed production can be explained in terms of agricultural policies that have sustained sunflowerseed prices at levels well above those prevailing in the international market. Although Spain did not enter the European Community (EC) until 1986, agricultural policies related to the sunflowerseed sector were already very similar in Spain and in the EC-10: in the EC-10, prices were also guaranteed above world market levels although at higher levels than in Spain.

Since Spain's accession to the EC, Spain's agricultural policies in the sunflowerseed sector have moved progressively toward the implementation of the Common Agricultural Policy (CAP) of the EC. A transitional period of five years was established for the integration of the Spanish oilseeds sector in the CAP regulatory mechanisms; in 1991, the Spanish sunflowerseed sector was fully integrated into the CAP.

In 1992, the European Commission undertook a deep reform of the regulatory mechanisms of the CAP in the oilseeds sector. Since 1992, public intervention in the sunflowerseed market has been eliminated and sunflowerseed prices have been freely determined by the market; these prices have decreased dramatically and have been at similar levels to those prevailing in the international market. Sunflowerseed oil prices have also decreased profoundly.

However, the deflationary trend in sunflowerseed oil prices has not affected very significantly consumption patterns in the Spanish vegetable oils market: there have been moderate increases in the consumption per capita of sunflowerseed oil and, in general, only relatively modest decreases in the per capita consumption of bottled olive oil, the primary competitor with sunflowerseed oil.

In order to compensate oilseeds producers for the fall in prices, the European Commission has established a system of deficiency payments per hectare. As a matter of fact, since 1992, Spanish sunflowerseed producers have been receiving a much higher proportion of their gross revenues by means of deficiency payments than by selling sunflowerseed in the market.

Since 1993, the compensatory payments scheme have also been applied to other arable crops, such as cereals. However, in the case of cereals the deficiency payments were initially established at much lower levels than for oilseeds; besides, the intervention price policy is still maintained in the cereal sector, although the real value of the intervention prices is being progressively reduced.

The shift to the compensatory payments system, along with extraordinarily dry weather from 1992 to 1995, has encouraged a major expansion of sunflowerseed production.

For example, the area planted with sunflowerseed in Spain was 50% higher during the 1992-1995 period than during the 1985-1991 period (Ministerio de Agricultura, 1994). Sunflowerseed yields have decreased after CAP reform; however, during the 1992-1993 period, the increase in the sunflowerseed acreage resulted in a significant rise in the production of sunflowerseed, sunflowerseed oil and sunflowerseed meal.

In 1994 and, especially, in 1995, sunflowerseed yields have been at even lower levels, mainly due to the effects of a severe and persistent drought, and this has affected negatively the production of sunflowerseed and sunflowerseed products.

The final effects that the reform of the CAP mechanisms regulating the oilseeds market could have on the Spanish sunflowerseed sector are still unclear, and would depend on the future compensatory payments levels granted in the production of sunflowerseed and other competing arable crops. There is growing concern about the consequences that the potential future evolution of the levels of compensatory payments, granted by European Union (EU) to sunflowerseed and other arable crops producers, could have on the total area planted with sunflowerseed in Spain; this would also affect the Spanish production of sunflowerseed, sunflowerseed oil and sunflowerseed meal.

On the demand side, there is also interest about potential future developments in the vegetable oils market under an environment characterized by relatively low sunflowerseed oil prices. The analysis of this question could help to answer policy issues related to the levels of consumption, and the degree of self-sufficiency, in the sunflowerseed oil and sunflowerseed meal markets.

I. Objectives of the Study.

The study focuses on the effects of the reform of the CAP mechanisms for oilseeds and other arable crops markets, on the Spanish sunflowerseed sector. The primary objective of the research is to increase the understanding of the consequences that the end of the intervention price policy for oilseeds, and the reform of the CAP in competing arable crops, could have in the Spanish sunflowerseed sector.

This dissertation focuses on the analysis of supply, although some attention is also given to the study of demand in the sunflowerseed sector. Thus, the main research problem in this dissertation consists of the evaluation of how the total area planted with sunflowerseed in Spain, could be affected by the possible future evolution in the levels of the compensatory payments that the EU grants to arable crops producers. The study performs a sensitivity analysis, trying to determine how different scenarios, constructed according to potential future levels of compensatory payments, could affect the total number of hectares planted with sunflowerseed in Spain during the 1996-2005 period.

An additional issue that this study addresses is the analysis of the effects of the decline in sunflowerseed prices on sunflowerseed yields and, consequently, on the Spanish production, consumption and net trade of sunflowerseed; as well as on the Spanish consumption, production and net trade of sunflowerseed oil and sunflowerseed meal.

The specific objectives of this dissertation are related to the development of an econometric commodity analysis adapted to the sunflowerseed sector in Spain. This requires the construction of supply and demand models that are utilized to simulate consumption and production in the Spanish sunflowerseed, sunflowerseed oil and sunflowerseed meal markets.

The study uses annual data at the national level. For the analysis of supply, this dissertation constructs series on gross revenues, gross margins and variable costs for rain fed and irrigated sunflowerseed, and for rain fed wheat; these series cover the 1964-1995 period. The econometric simulation of the historical data on sunflowerseed area, yields and production, as well as on the production of sunflowerseed oil and sunflowerseed meal, is focused on the 1970-1995 period. The simulation of the historical data on demand for sunflowerseed oil is concentrated on the 1980-1995 period; the simulation of the historical data on sunflowerseed meal consumption on the 1977-1995 period; and, finally, the simulation of the demand for sunflowerseed by the sunflowerseed oil industry focuses on the 1970-1995 period again.

In marketing analysis, it is common to find studies where supply and demand models are developed simultaneously, by means of multi-equational systems in which market prices are determined by the interaction of supply and demand. This study does not use that approach, and performs separated and unrelated supply and demand analyses, where prices and compensatory payments are exogenously determined.

For the 1970-1991 period, this methodology could be justified because sunflowerseed price levels were strongly influenced by the guaranteed prices that were institutionally determined, first by the Spanish Ministry of Agriculture, and later by the EC.

For the 1992-1995 period, the variable most relevant to explain the evolution of the sunflowerseed supply has been the levels of deficiency payments granted to farmers, which are also determined by the policy maker. In relation to sunflowerseed prices, they have been around world market levels since 1992, and it is very unlikely that the Spanish production alone could have a significant effect on the international prices for sunflowerseed and sunflowerseed oil.

Moreover, this study does not intend to model the actions of the policy maker, as has been done in some previous markets studies (Meilke and Griffith, 1983; Meilke and de Gorter, 1988). Therefore, the analysis gives an exogenous character to sunflowerseed prices -even after the reform of the CAP- and to the levels of direct payments per hectare.

Although sunflowerseed prices are treated as an exogenous variable, the study models sunflowerseed oil and sunflowerseed meal prices. Sunflowerseed oil prices are set as a function of sunflowerseed prices: hence, sunflowerseed prices are identified as the main historical determinant of sunflowerseed oil prices; in fact, after CAP reform, market sunflowerseed prices are, perhaps, the only factor influencing sunflowerseed oil prices in Spain. On the other hand, sunflowerseed meal prices are econometrically related to soybean meal prices.

In the study, net trade on sunflowerseed, sunflowerseed oil, and sunflowerseed meal is determined residually from the results of the supply and demand analysis. This orientation is very common in the literature, and it is not difficult to find examples of its utilization (Josling, 1967; Ferris et al, 1971; Kalaitzis, 1978; Peterson, 1981).

Hence, this dissertation does not model net trade in sunflowerseed and sunflowerseed products. This approach could be justified because the Spanish volume of trade in these commodities is relatively small, especially if compared with domestic consumption and production. Thus, the assumption that net trade has a residual character seems to fit well the historical evolution of the Spanish sunflowerseed sector.

In the analysis of supply, the most refined models are focused on the simulation of the evolution of the annual area planted with sunflowerseed. Expected gross margins per hectare are included as independent variables, and this represents an innovation with respect to previous studies about the sector. The utilization of gross margins type variables permits the concentration of information obtained from a wide range of different variables, such as prices, compensatory payments and costs of production.

The large decrease in sunflowerseed prices, along with the increase in the acreage planted with sunflowerseed that has resulted from the reform of the CAP, gives a special justification for the utilization of gross margins as independent variables. Thus, the recent evolution of the area planted with sunflowerseed cannot be explained with the use of sunflowerseed prices alone. Moreover, a lack of degrees of freedom prevents the analysis of the historical development of the sunflowerseed acreage only in terms of the compensatory payments that were established after the reform of the CAP. Besides, the utilization of gross margins also permits to include into the econometric analysis of supply, the significant decreases in variable costs that have arisen since the reform of the CAP in the sunflowerseed sector.

The main difficulty to use gross margins in the supply analysis, is that, in Spain, there are not official publications providing time series data about costs per hectare in the production of sunflowerseed, or of any other crop. Thus, in order to be able to compute gross margins series, this study uses data on variable costs of production that have been obtained from different case studies about costs in the production of sunflowerseed, and of its alternatives in the agricultural production process.

Hence, this dissertation constructs variable costs and gross margins series on the production of rain fed sunflowerseed and wheat and of irrigated sunflowerseed, from the information provided in these case studies. The construction of the gross margins series has granted the opportunity to test different econometric models, accounting for the formation of farmers expectations about gross margins.

In the analysis of domestic demand the study simulates the quantities consumed of bottled sunflowerseed oil, of sunflowerseed meal, and the quantities of sunflowerseed that the oil industry crushes. In the specific study of the demand for bottled sunflowerseed, the retail prices of bottled olive oil are included in the analysis, due to the high degree of substitutability in consumption between bottled olive oil and bottled sunflowerseed oil. All the study of demand is performed using single equation techniques.

The primary economic actors in the study are the farmers producing sunflowerseed, the consumers consuming sunflowerseed oil, and, to a lower extent, the farms consuming sunflowerseed meal. Other actors that are of interest to the study, are sunflowerseed oil and sunflowerseed meal producers and distributors. However, the modelling effort does not focus so much on them, due to the lack of available secondary data sources.

Other economic agents that could have also some influence on the Spanish sunflowerseed sector are input suppliers, credit institutions, extension services, etc. Nevertheless these actors are not specific to the sunflowerseed sector, but to the whole Spanish agriculture, and consequently are not included in the study, in order to keep the analysis within the confines of a dissertation.

II. Organization of the Thesis.

The results of this study are presented in the next six chapters. Chapter II includes descriptions of the Spanish agriculture and of the

Spanish sunflowerseed sector. Chapter III is focused on the development of gross margins series for the production of sunflowerseed and wheat in Spain.

Chapter IV and V are devoted to the econometric analysis of supply and demand, respectively. In both chapters, the results of the simulation models used to forecast production, consumption and trade are presented and evaluated.

In Chapter VI, the supply and demand models are utilized to perform short to medium term forecasts. Specifically, the forecasts concentrate on the 1996-2005 projection period, and are developed according to five different scenarios related to the potential future evolution of the levels of the compensatory payments, granted by the CAP to sunflowerseed and wheat producers. The results of these forecasts are also utilized to provide some policy recommendations.

Finally, Chapter VII presents a summary of the results and some concluding comments.

CHAPTER II

BACKGROUND AND SETTING

The purpose of this chapter is to provide background information relevant to the objectives of the study. First, it presents an introduction to the recent evolution of the Spanish agricultural sector. It continues with a description of the sunflower sector in Spain, focusing on the analysis of production, consumption, prices and net trade, within this sector.

I. The Spanish Agricultural Sector.

Agriculture continues to form an important component of the Spanish economy although its relative importance has declined. Spain has experienced substantial agricultural growth and modernization since the 1960s. Except for some agricultural practices, in very specific crops, Spanish agriculture is highly mechanized. Agriculture has also become more specialized and more commercially oriented.

The improvement of irrigation practices, as well as a more developed extension system, also explain the increases in productivity. In general, irrigated areas, horticultural and livestock production have been expanding, while marginal dry farmed areas and their associated crops have been contracting.

Spanish agriculture is less developed, structurally and technically, than in most EU countries, partly because of relatively low levels of capital application. Besides, if compared with other EU members, the Spanish agriculture is conditioned by, on average, adverse agro-climatic conditions. An important proportion of the land is semi-arid or mountainous. Low rainfall levels are an usual problem, especially in Southern Spain.

The presence of structural constraints also prevents, to some extent, the development of the Spanish agriculture. In 1994, agriculture employed 10.7% of the workforce, but accounted only for 4.6% of GDP (MAPA, 1994). The farm population has decreased and the age of those remaining has increased. Moreover, although the average Spanish farm was only 13.8 hectares in 1994, land is very unevenly distributed. Sixty per cent of holdings are less than 5 hectares and account for 8.4% of the utilized agricultural land, being most of these holdings concentrated on Northwestern Spain; on the other hand, only 2.1% of landholdings are over 100 hectares, but they comprise 39.8% of agricultural land (MAPA, 1989).

The principal products of the Spanish agriculture are fruits and vegetables, milk, beef, poultry and eggs, pigmeat, and cereals (mainly wheat and barley). Mediterranean products, such as wine and olive oil, are also important, especially in the less developed regions. Agricultural exports are an important component of trade, representing between ten and twenty percent of total exports, depending on the year (Salmon, 1991). Citrus, fresh and processed vegetables, cereals, wine and vegetable oils are the main commodities exported.

Nonetheless, Spain is highly dependent on feedgrains imports, and especially on imported corn and soybeans (MAPA, 1994). Moreover, an increasing proportion of agricultural trade is with other EU members. Until recently, trade with the EU has been roughly in balance. However, in the 1990s, food imports from EU countries are growing faster than exports.

Spanish agricultural policy has been traditionally oriented toward the attainment of self sufficiency in food. As a consequence, there has been a strong public intervention in the Spanish agricultural markets during the last half of the century. After the Spanish civil war, agricultural policies were oriented toward self sufficiency in basic food staples, such as cereals. A special agency, the Servicio Nacional de Cereales (SNC), was created within the Spanish Ministry of Agriculture (Ministerio de Agricultura, Pesca y Alimentación), in order to undertake price and marketing policies that promoted the national production of wheat and other cereals. SNC was later enlarged to the Servicio Nacional de Productos Agrarios (SENPA). SENPA guaranteed the purchase price for a wider range of crops, including cereals and oilseeds, and it subsidized seeds and fertilizers.

In the 1960s, due to increased growth in the demand for meat, agricultural policy was reoriented to support the expansion of the livestock sector. In 1968, the Fondo the Ordenación y Regulación de Productos Agrarios (FORPA), was created to establish intervention prices for certain crops, livestock products, and vegetable oils. Other functions of FORPA were the regulation of foreign trade, and the administration of subsidies and other producer aids. SENPA was integrated into FORPA, and specialized on the regulation of cereals, oilseeds and other arable crops markets.

During the 1970s, FORPA initiated a process of harmonization of its market regulation and price policy mechanisms with those of the CAP. This new orientation to Spain's agricultural policy intended to facilitate accession to the EC. As a result, the agricultural policy systems of Spain and of the EC began to be based on similar mechanisms, years before Spain entered the EC (Tamames, 1990).

In 1986, Spain joined the EC, now EU. From that year onwards, Spain's agricultural policy has been developed within the institutional framework of the EU. FORPA interventions in the market have been coordinated with the European Agricultural Guidance and Guarantee Fund (EAGGF), the agency administering the CAP. Since the mechanisms of agricultural policy in Spain were already similar to those in the EC, the adoption of CAP affected intervention levels and the number of commodities covered rather than requiring the development of unfamiliar management methods (USDA, 1990).

Nevertheless, there were three important differences between the Spanish intervention system and that in the CAP. First, in Spain, sales of a number of commodities (wheat, tobacco and sugar beets), were directed through public agencies. Second, in Spain, the state controlled trade in cereals, vegetable oils, milk products, cotton, tobacco and meat, which together represented a substantial proportion of total agricultural trade. Finally, the breath of the state intervention was less in Spain.

To gradually accommodate Spanish agriculture to CAP, some restrictions to agricultural trade between Spain and the EC were established during a transitional period. Two transitional models were agreed, one for fresh fruits and vegetables and other for the rest of agricultural products.

The general model was one of seven years, with completion by the first of January of 1993. For fresh fruits and vegetables the transition was supposed to extend over ten years (MAPA, 1987). However, in practice, and due to the introduction of the Single European Market in 1993, which embodied the elimination of all trade barriers within the EU, full integration was achieved also in 1993 for the fresh fruits and vegetables sector. Thus, all agricultural tariffs with the EU have been progressively abolished, and other trade restrictions, such as the state control of agricultural trade and marketing for some commodities, have ended.

Apart from the peculiarities established for the different subsectors of the Spanish agriculture, in general Spanish institutional prices and subsidies have converged progressively toward the levels prevailing in the different commodity programs of the CAP. For most products, institutional price levels were higher under CAP than under former Spanish agricultural policies.

Today CAP is undergoing a major reform process. This reform effort is taking place due to both internal and external pressures. Internal pressures for reform have resulted from the very high growth of budgetary spending under the CAP, and its effect of stimulating excess agricultural supply. External pressures for reform have come from negotiations in the Uruguay round of the GATT.

The reform of CAP includes more realistic product pricing, quantity restrictions and land set-aside schemes. As a result, for many commodities, intervention prices have been declining in nominal terms during the 1990s (European Commission, 1993). To compensate for this fall in prices, there is a tendency toward an increase of the relative importance of direct deficiency payments as a form of subsidization to farmers.

II. The Sunflowerseed Sector in Spain.

The development of the Spanish production of sunflowerseed has been a key factor in order to satisfy ,with internally produced raw materials, the demand for vegetable oils in Spain. Since the 1970s, sunflowerseed oil has been the second vegetable oil most consumed in Spain[1]. Apart from sunflowerseed oil, the sector also produces an important quantity of sunflowerseed meal, that, to a modest extent, has helped to reduce Spain's imports of livestock feeds. The rest of the chapter, describes the structure of the sunflowerseed sector in Spain. An understanding of the sector provides the framework for the econometric models that are developed in later chapters of the dissertation.

II.a. Production.

II.a.1. *Sunflowerseed Production.*

The Spanish production of sunflowerseed has expanded dramatically during the years of the 1970-1995 period. Since the late 1960s, the rate of growth of the area planted with sunflowerseed has been impressive. In 1960, the planted acreage was 3,600 hectares, and included only non oil varieties that were directed toward human consumption. In 1964, oil varieties suited for industrial purposes, were introduced for the first time. The area planted with sunflowerseed then was 12,646 hectares, small figure if compared with the 1,378,729 hectares planted in 1994 (MAPA, 1994).

The growth of the total acreage planted with sunflowers has been accompanied by a parallel increase in the Spanish production of

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[1]Olive oil has, up to 1995, remained as the most consumed oil.

sunflowerseed. In 1964, Spain produced 10,900 tons of sunflowerseed. This quantity increased to 415,807 tons in 1975, and continued to grow up to 915,343 tons in 1985. In 1994, 986,900 tons of sunflowerseed were produced in Spain (MAPA, 1994). Almost all the production corresponds to oil varieties of sunflowerseed.

In the early 1990s, Spain was the second sunflowerseed producer in the EU, after France, and shared around 5% of total world production (European Commission, 1993). However, Spain is not a major sunflowerseed exporter in the international market. The Spanish volume of trade in sunflowerseed tends to be very small; Spain usually exports very low quantities of sunflowerseed and only in bad harvest years imports significant sunflowerseed amounts. During the 1990s, France has lead the world export market; the US and Argentina are also very important exporters.

Historically, the production of sunflowerseed has been mostly concentrated in Southern and Central Spain. The most traditional sunflowerseed producer provinces in Spain, are Sevilla, Córdoba and Cádiz, located in Southern Spain, and Cuenca and Badajoz, located in Central Spain. Together, they accounted for about 65% of the area planted with sunflower, and for over 70% of the sunflowerseed produced in Spain during the 1985-1993 period (MAPA, 1993).

Most of the area planted with sunflowerseed is rain fed. For example, the rain fed acreage accounted for around 85% of the total sunflowerseed area during the 1985-1994 interval. Nonetheless, the proportion of the area that is irrigated has increased substantially during the 1980s and the 1990s. Moreover, during the 1985-1994 period, the irrigated production of sunflowerseed contributed, on average, to nearly 35% of total national production (MAPA, 1994).

Furthermore, irrigated land is an scarce resource in Spain. Therefore, although the area planted with irrigated sunflowerseed has expanded considerably in Spain during the 1980s and 1990s, it could never reach the levels already achieved by the area planted with rain fed sunflowerseed.

Productivity per hectare -around 360 Kg. per rain fed hectare, and 1,200 Kg. per irrigated hectare in 1995- has historically been below the average of the EU, and of the main world producers. Besides, yields have experienced a relatively high degree of variability over the years, depending highly on weather conditions (Gómez-Arnau, 1988); the amount of rain that falls in spring has a significant influence over the quantity of seed per hectare harvested in summer.

Under extreme circumstances, weather has also been a factor influencing farmers' planting decisions. Very dry falls and winters have usually been accompanied by a decrease in the area planted with cereals and by an increase in the area planted with sunflowerseed. For example, from 1991 to 1995, there has been a very severe drought in Spain, that has been accompanied by a substantial increase in the area planted with sunflowerseed. This could be explained by the relatively good resistance that the deep and extensive root system of sunflowers provides against dry weather.

Apart from climatic conditions, some authors argue that the relatively low yields characteristic of the Spanish sunflowerseed production could be explained because the seed varieties that have been adopted by farmers are not the most appropriate for Spain (Montero and Moro, 1988).

In any case, the implantation of hybrid seed varieties has become increasingly common. In the early 1990s, hybrid seeds varieties accounted for nearly 90% of the total seed planted in Spain (de la Rosa, 1992). The result is that yields, although still low if compared with other European countries, are significantly higher than in the 1960s and 1970s, when mostly non-hybrid varieties were used.

Rain fed sunflowers are planted in March and April, albeit in some Northern provinces of Spain it is possible to plant sunflowers as late as May. Up to the early 1980s, the planting process was done with cereal

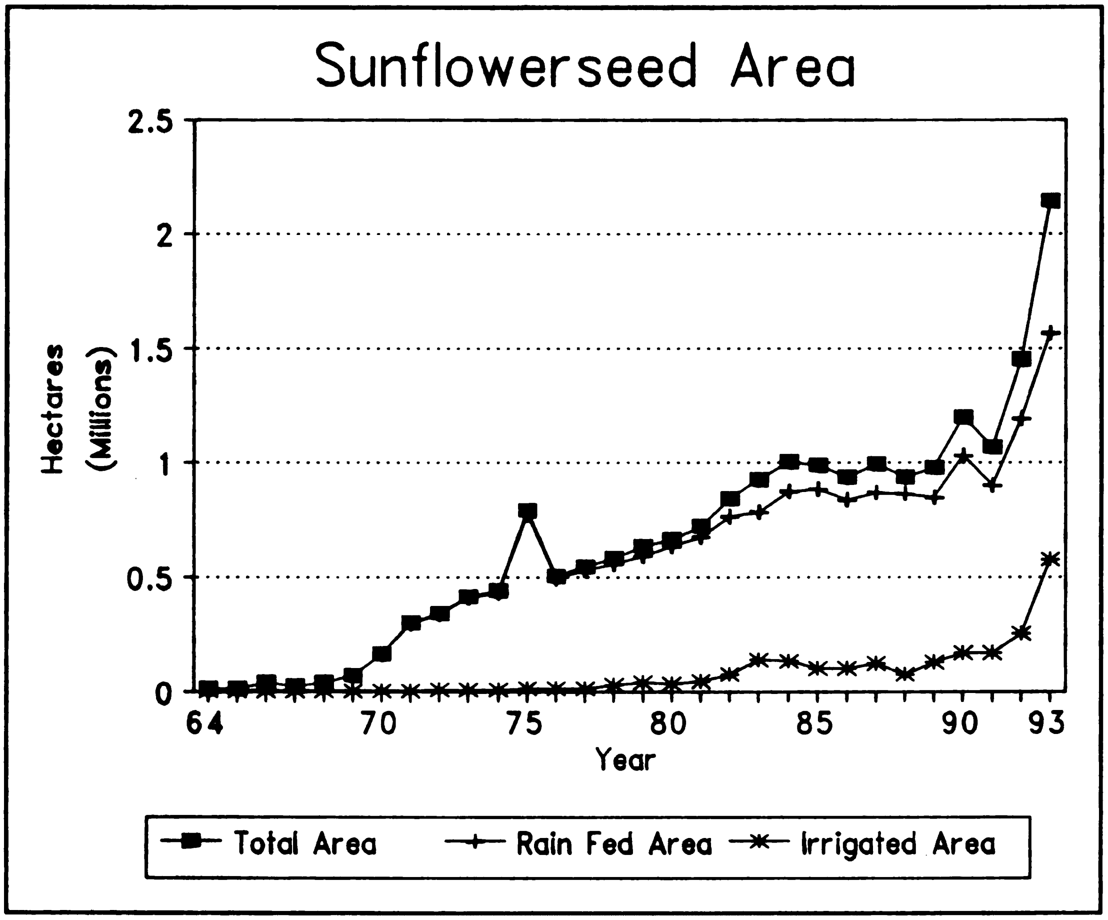

Figure 2.1. Rain Fed, Irrigated and Total Sunflowerseed Area in Spain, (1964-1993).

Source: MAPA.

planters; since the late 1980s, the use of higher precision planters is generalized (Koipesol, 1987). Normally, the crop is not fertilized, except in the case of irrigated production. Most of the rain fed sunflowerseed produced is harvested in the months of August and September. However, the sunflowerseed planted in the Northern provinces is harvested in October. The harvest is done using cereal harvesters with slight modifications.

Usually, rain fed sunflowers are grown in rotation with cereals, especially wheat. It is recommended that sunflowerseed be grown once every three or four years. Planting wheat or barley, leaving the land idle during the next year, and planting sunflowerseed the following year is perhaps the most advisable agricultural rain fed production procedure (Puerta, 1980).

However, in practice many rain fed farmers plant sunflowerseed every two years, following a cereal-sunflowerseed rotational pattern. It is not uncommon either to plant sunflowerseed in consecutive years if a favorable ratio of gross revenues to variable costs persists, although this practice is not very recommendable from the point of view of soil conservation (del Valle, 1987).

Irrigated sunflowerseed is mainly planted as a first crop, although it has also found a wide acceptance as a second crop in irrigated land. However, yields are significantly lower for irrigated sunflowerseed as a second crop than for irrigated sunflowerseed as a first crop. If produced as a first crop, irrigated sunflower is usually planted in late Spring and the harvest takes place as late as October.

In the case of irrigated sunflowerseed as a second crop, double cropping with irrigated sunflower being planted immediately after irrigated winter wheat is perhaps the most common option (Alba, 1990). To a lesser extent, irrigated sunflowerseed is planted also after irrigated corn. A third option, that is becoming increasingly common, is to plant irrigated sunflowerseed after irrigated extensive fresh vegetables (carrots, potatoes, etc) (de la Rosa, 1992). In this case irrigated sunflower is planted around March.

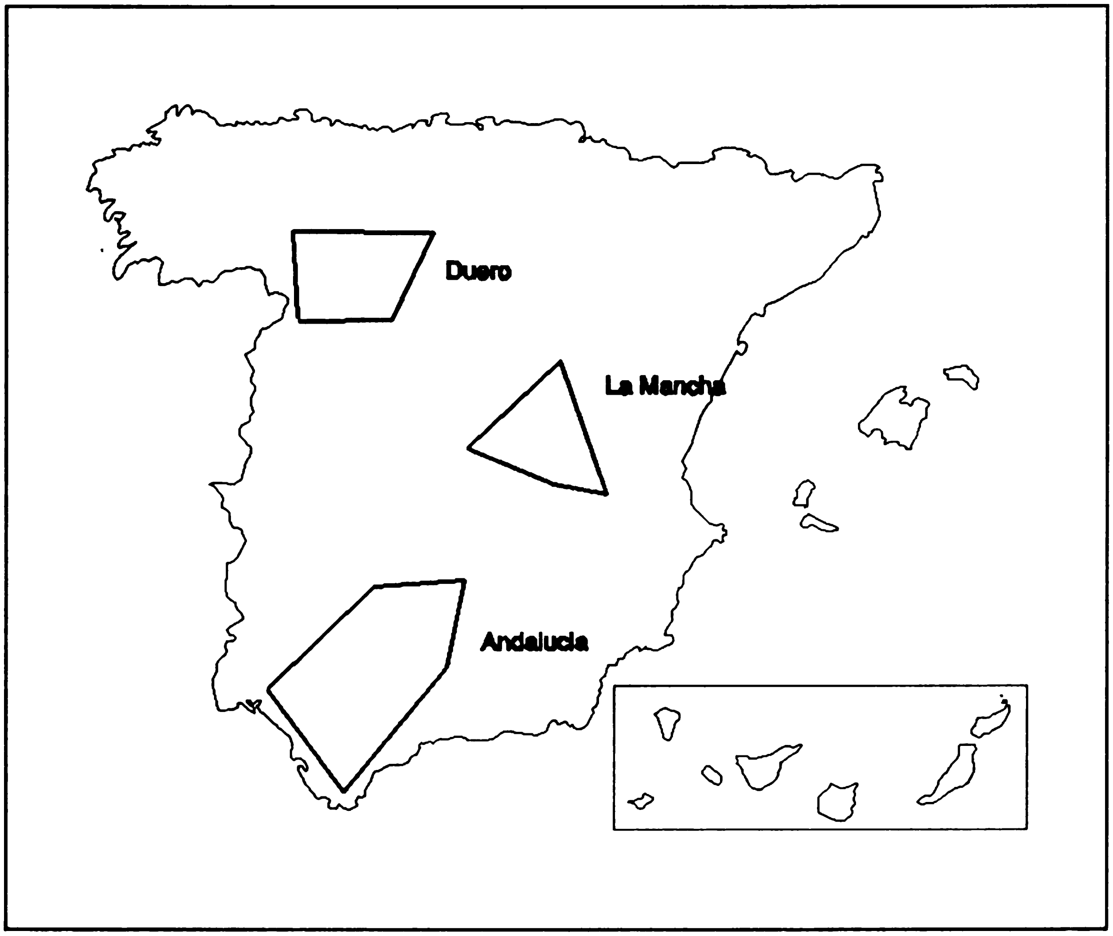

Figure 2.2 Major Sunflowerseed Producer Zones in Spain.

The average size of the typical sunflowerseed farm in Spain is relatively large. Most farms usually growing sunflowerseed are of medium and large size. About 59% of sunflowerseed farms are between 10 and 100 hectares and they comprise 47% of the land planted with sunflowers. Landholdings larger than 100 hectares account for 11% of the sunflowerseed farms and they comprise around 48% of the land planted with sunflowers. On the other hand, 30% of the farms producing sunflowerseed are below 10 hectares but they account only for 5% of the land producing sunflowerseed (Junta de Andalucía, 1989).

As a result, sunflowerseed production has been characterized by a high degree of mechanization and, consequently, by relatively low costs per unit of output. Nevertheless, even if there is a high degree of mechanization and the size of the typical farm is relatively large, there is still a large number of farmers engaged in the production of sunflowerseed; therefore, the Spanish sunflowerseed supply could be considered practically as perfectly competitive.

Perhaps the main factor explaining the expansion of sunflowerseed production in Spain, is the existence of agricultural and food policies aimed toward Spain's self sufficiency in vegetable oils. In the early 1960s the Ministerio de Agricultura, Pesca y Alimentación (MAPA) tried to promote the production of safflower. However the introduction of safflower in Spain failed, due, in part, to the bad resistance of the crop to existing pests and diseases.

The policy effort turned then toward the introduction of sunflowerseed. Sunflowerseed has a high yield of oil per seed. Seeds from the different sunflower varieties contain from 38% to 50% oil, and about 20% protein[2]. The oil extracting process does not require advanced technology, and is relatively cheap. Moreover, the agronomic characteristics of sunflowerseed, and the fact that is highly resistant to

[2]From the sunflowerseed meal obtained in the extracting process.

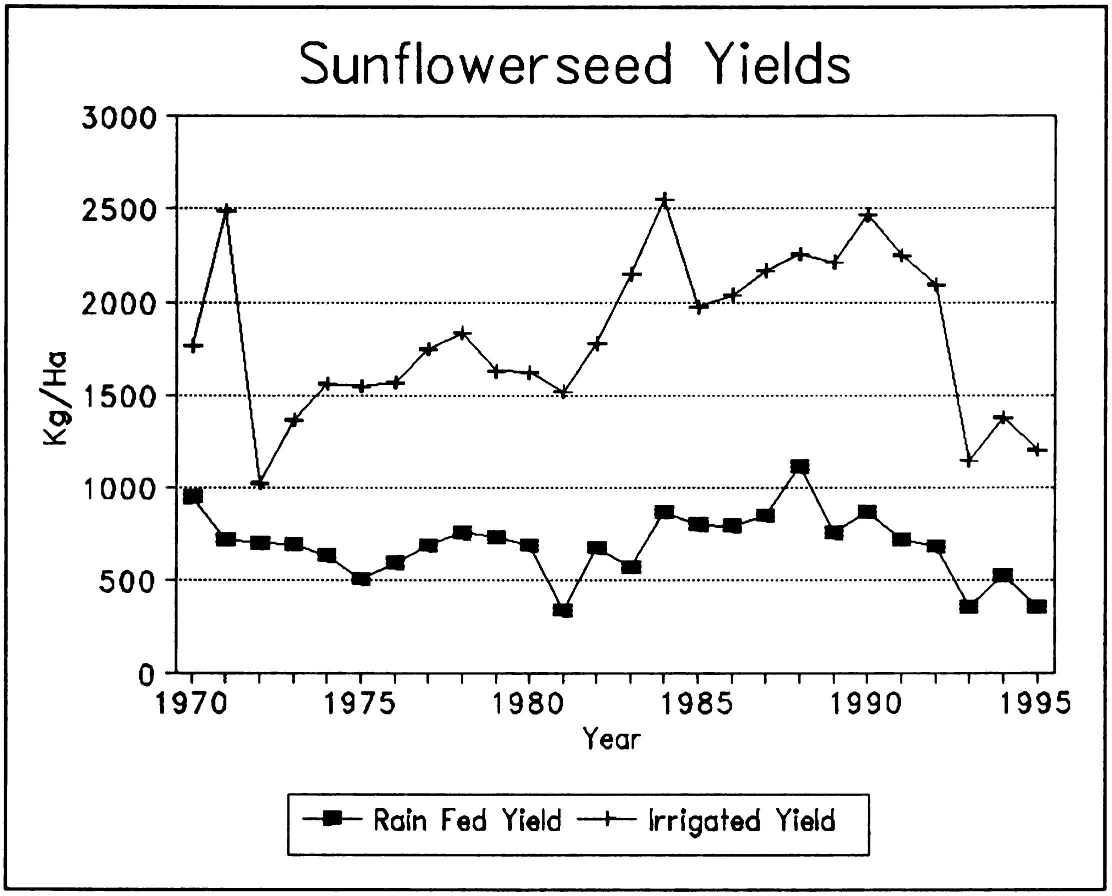

Figure 2.3. Average Rain Fed and Irrigated Sunflowerseed Yields in Spain, (1970-1995).

Source: MAPA.

dry weather, make this crop very adaptable to the zones of Spain that have been traditionally specialized in cereal production.

Because of the reasons mentioned so far, MAPA has pursued a policy tending to promote the production of sunflowerseed. This policy began in 1965 when a guaranteed price for sunflowerseed was introduced. Previous to that year sunflowerseed prices had been freely dictated by the market. The guaranteed price consisted in a minimum contractual price that SENPA established every year, and that the crushing industry had to pay to sunflower farmers.

The crushing industry had the obligation of buying all the sunflowerseed that farmers offered, at the minimum contractual price. A monthly premium was added to this minimum contractual price. This premium intended to cover the storage costs in which farmers could incur since the harvest month.

MAPA acted in two different forms to compensate the crushing industry for having to pay this minimum contractual price. First, FORPA had the obligation of buying, at a previously established acquisition price, all the unrefined sunflowerseed oil that the crushing industry was willing to offer. This oil was sold after by FORPA to the refining and bottling industry at the so called *precio de cesión*, or selling price.

Second, MAPA controlled all external trade in vegetable oils, and this helped to maintain the sunflowerseed oil prices at levels that could compensate the whole sunflowerseed oil industry for the high domestic sunflowerseed prices. A subsidy per kilogram of seed crushed was occasionally granted to the crushing industry, as part of the Spanish policy of self sufficiency in vegetable oils.

The minimum contractual price policy established by MAPA held during the 1960s, the 1970s and part of the 1980s. In fact, the minimum contractual price policy could be regarded truly as an intervention price policy, similar in many aspects to the regulatory system that was utilized in the EC during these same years. The difference with the intervention price policy of the EC, was that MAPA did regulate but did not intervene directly in the sunflower wholeseed market. Direct public intervention, with FORPA as a buying agent, took place only in the sunflowerseed oil market, where a true intervention price, the acquisition price, was established.

On the other hand, prices in the sunflowerseed meal subsector were freely dictated by the market, and were very linked to the prices of soybean meal. Finally, the result of the minimum contractual price policy was a rapid expansion of the area planted with sunflowerseed in Spain; thus, sunflowerseed production became an important income source for Spanish farmers during the 1970s and the 1980s (Santana, 1986).

When Spain joined the EC in 1986, the minimum contractual price policy was abandoned. Spain adopted the EC's normative framework and regulatory mechanisms in the oilseeds subsector. The new policy introduced direct public intervention in the wholeseed market. Two types of institutional prices were set each agricultural year for sunflowerseed: a target price and a basic intervention price. A subsidy to the crushing industry, for the transformation of seed into oil was also established each year. Besides, during the 1986-1990 period, a system of export restitutions was introduced for the sunflowerseed oil that was directed toward the international market.

In relation to the EC's institutional prices, the *target price* could be regarded as the one that would have been desirable to achieve, in order to support farmers' income. It was used as the base to compute the intervention prices, as well as the subsidy to the crushing industry and the export restitutions.

The *intervention price* was the price that would be received by farmers if they decided to sell sunflowerseed under the system of public intervention; furthermore, at the established basic intervention price, EAGGF, through SENPA, had the obligation of buying all the sunflowerseed that farmers were willing to offer.

Previous to Spain's adoption of the EC's regulatory framework, guaranteed prices were much higher in the EC than in Spain. Therefore, during a transitional period of ten years Spanish target and basic intervention prices were supposed to converge progressively toward the levels prevailing in the EC-10. In practice, this approximation of intervention prices was performed only until 1991. This was because the reform of the oilseeds sector regulatory system, which, as noted, eliminated intervention prices, was put into practice in 1992.

Farmers had to harvest a minimum quantity of 100 metric tons to be able to sell sunflowerseed to SENPA. If sunflowerseed was sold to SENPA three or more months after harvest, a monthly premium was added to the price. This premium was equal to an average of the storage costs, computed for the whole EC.

Moreover, a maximum guaranteed quantity was fixed every year for Spain. In the case that the Spanish national production of sunflowerseed had exceeded that maximum guaranteed quantity, the target price and the basic intervention price for the following year would have been reduced proportionately, up to a pre-established downward limit.

For all the other countries in the EC, except for Portugal, the maximum guaranteed quantity was fixed jointly. Thus, for the EC-10, all European producers were penalized if the total production of the EC-10 exceeded the maximum guaranteed quantity. On the other hand, due to the accession treaty signed in 1985, for Spain and Portugal the maximum guaranteed quantities were established separately, on a national basis. The establishment of separated maximum guaranteed quantities was supposed to hold during a transitional period of ten years (European Commission, 1986).

During the six years that the intervention price policy was present in Spain, the Spanish production of sunflowerseed never exceeded the maximum guaranteed quantity that was pre-established every year (Junta de Andalucía, 1992). The same cannot be said about the EC-10, where the total production exceeded frequently the maximum guaranteed quantity. For example, in 1991 there was a maximum guaranteed quantity for Spain of 1,411,800 metric tons, but the Spanish production was only of 1,025,494 metric tons. In that same year, production in the EC-10 was 48% higher than the maximum guaranteed quantity.

The intervention price policy implied that, by world market standards, the EC's sunflowerseed oil industry had to pay relatively high prices for the sunflowerseed bought from EC farmers. A subsidy per ton of seed crushed was established to compensate the crushing industry. To have access to this aid, crushers had to buy domestically produced sunflowerseed at a price at least equal to the basic intervention price. During a transitional period of five years, the criteria to compute the subsidy was different for the EC-10, and for Spain and Portugal.

For Spain, a subsidy of 2.5 pesetas per kilogram of sunflowerseed crushed was granted in 1986. For the next four years this aid increased annually in direct relationship to the upward adjustment of the Spanish target price to the EC-10 target price.

In the EC-10, the subsidy per ton of sunflowerseed crushed was equal to the difference between the EC-10 sunflowerseed target price and the world price for sunflowerseed. Thus, the subsidies were significantly higher in the EC-10 than in Spain; however, during that period, the Spanish vegetable oils market was much more protected than the EC market and, therefore, in Spain sunflowerseed oil was sold at higher prices than in the EC-10.

In 1991, the EC's criteria for computing the subsidy was established also in Spain. The aid received that year by Spanish crushers was equal to the difference between the Spanish target price and the world price. Nevertheless, in 1991 the Spanish sunflowerseed target price was still lower than the EC-10 target price and, therefore, the subsidy that Spanish crushers received was also lower. In 1992, with the reform of the regulatory mechanisms for the oilseeds sector in the EU, the subsidy to the crushing industry was completely abolished.

After Spain's accession to the EC the relative isolation of the Spanish oil markets from the rest of the world was still maintained, in order to protect the Spanish oil industry. For Spain, a number of special protective market arrangements were established during a period of five years, from 1986 to 1990, in order to avoid potential disruptive effects, especially on the olive oil sector, of Spain's accession to the EC.

This period was known as the *stand-still period*, and was characterized mainly by the institutional control of the amounts of vegetable oils commercialized in the Spanish market. On the other hand the direct public intervention in the sunflowerseed oil market, that accompanied the previous minimum contractual price policy, was abandoned under the EC's regulatory framework.

The intervention price policy of the EC in the oilseeds sector, was put into practice for the last time in 1991. As noted elsewhere, a deep reform of the regulatory mechanisms of the oilseeds sector in the EU, was undertaken in 1992. The reform of the oilseeds sector, is part of a much broader reform effort that includes all arable crops (cereals, oilseeds and protein crops) under CAP.

For arable crops in general, the new CAP has implied lower intervention prices and the reliance on direct deficiency payments per hectare, as a form of compensation to farmers. For oilseeds, and consequently for the sunflowerseed sector, the reform has gone much further. In fact, the new regulatory mechanism for oilseeds did eliminate intervention prices abruptly in 1992; on the other hand, the rest of arable crops under CAP have only experienced gradual, although sometimes significant, decreases in the real value of the intervention prices.

Thus, in the oilseeds sector, intervention prices have been fully eliminated. Prices are now freely dictated by the market, just as back in 1964. The result is that the prices that farmers have been receiving for oilseeds since 1992 have been close to the world market levels (Campo Andaluz, 1994).

Nonetheless, farmers engaged in oilseeds production have also received much higher deficiency payments per hectare than farmers specialized in other arable crops (although, since 1993, the compensatory payments for other arable crops, such as cereals, have also grown at considerably faster rates than the compensatory payments for oilseeds). These compensatory payments are granted per harvested hectare and determined on a regional basis, depending on the average regional yields obtained over a reference period (European Commission, 1992).

Moreover, since world market prices are at much lower levels than the institutional prices traditionally guaranteed by the EC, after CAP reform sunflowerseed producers' gross revenues have depended mainly on the deficiency payments per hectare, and only marginally on the revenue obtained by selling sunflowerseed at the market price. Thus, on average for the 1992-1994 interval, around 80% of the average gross revenue of sunflowerseed producers in Spain, came from direct compensatory payments (Actualidad Agraria, 1994).

For sunflowerseed, compensation per hectare involves two payments, one at the start of the marketing year and the other at the end. The mechanism to determine the total compensatory payment that a farmer engaged in sunflowerseed production will finally receive, is as follows.

First, a *reference price* is established at the beginning of the marketing year. This reference price is not a politically established price, as the target price of the previous regulatory regime, but is computed as a function of an average of the prices of sunflowerseed and sunflowerseed oil in several markets of the EU, during the past marketing year. For example, for 1993 the initial reference price was of 163 ECU/MT.

The next step consists of establishing a payment *reference amount*. This reference amount is used to calculate the compensatory payments in the different zones that produce sunflowerseed. For example, in 1992, 1993 and 1994, the reference amounts have been of 116.8, 118 and 124.4 ECU/MT, respectively. For 1995, the reference amount was fixed at 143.6 ECU/MT. The reference amount stays fixed during the marketing year, unless there is a substantial variation of the reference price.

The compensatory payments that farmers receive vary for the different agricultural zones. Farmers whose land is located in highly productive zones receive higher payments per hectare than farmers whose land is situated in low productivity areas. For Spain, there are two slightly different procedures to determine the territorial compensatory payments per hectare of sunflowerseed: one for rain fed production, and the other for irrigated production.

The compensatory payments received by rain fed sunflowerseed producers are determined by multiplying the payment reference amount, by the average yields for rain fed cereals in each district or *comarca* (the Spanish equivalent to a county in the USA) during the reference period 1989-1991. These yields are not calculated on an individual basis and, therefore, are the same for all farmers whose land is situated on the same comarca.

Thus, for example, in 1994, the reference amount was 124.4 ECU/MT. Therefore, a farmer that cultivated sunflowerseed, in a plot of land situated in a district, whose average rain fed cereal yield, for the established 1989-1991 reference period, was 3.2 metric tons of cereal per hectare, would have received a compensatory payment of 398.08 ECU per cultivated hectare in 1994.

Obviously, Spanish farmers do not receive their deficiency payments in ECUs, but in pesetas. The final payment in pesetas, is determined by the value of the agricultural conversion rate of the ECU on the first of July of the marketing year[3]. Since on the first of July of 1994 the value of the agricultural conversion rate of the ECU was 192.319 pesetas, the farmer of the previous example would have received a payment of 76,558 pesetas per harvested hectare of sunflowerseed.

For irrigated sunflowerseed, the procedure to determine territorial deficiency payments is practically the same, although in this case the final compensatory payment would be determined by the average district

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[3]In 1992, there were different green rates for specific crops (for example, there were different green rates of the ECU for oilseeds and cereals). In 1993, the green rate system was abolished; consequently, in 1993 and 1994, the agricultural conversion rate of the ECU was the same for every crop, and was computed multiplying the value of the ECU on the first of July of each marketing year, by a conversion factor. In 1995, the conversion factor was abolished, and the agricultural conversion rate of the ECU in pesetas was just determined by the value of the ECU on the first of July.

yield for irrigated cereals, during the reference period 1989-1991. Of course, yields, and therefore payments per hectare, tend to be much higher for irrigated production than for rain fed production. Thus, for rain fed production the range of cereal yields used to determine the final payments has gone from 0.9 MT/Ha. to 4.3 MT/Ha., while for irrigated production the range covers from 4.0 MT/Ha. to 8.3 MT/Ha.

At the end of the marketing year, before the second payment, the reference price is computed again, following the same technical procedures as for the reference price utilized at the beginning of the marketing year. If the difference between the initial and subsequent reference price is above 8%, the payment reference amount is readjusted.

This can result in both lower and higher final compensatory payments to the farmers, depending on the sign of the difference between the final and the initial reference price. The readjustment is equal to the difference in percentage points between the final reference price and the upper (lower, if the final reference price is below the initial reference price) fluctuation bound for the initial reference price.

In 1992 there was not any evidence of a significant change in the reference price during the marketing year, and therefore farmers received the whole second payment as it was initially established for the end of the marketing year.

However, in 1993 the computed final reference price was of 193 ECU/MT. The initial reference price was 163 ECU/MT, and had an upper 8% fluctuation bound of 176 ECU/MT. Hence, the final reference price was 10% higher than the upper fluctuation bound. This resulted in a final payment reference amount 10% lower and, of course, in a 10% decrease of the compensatory payment granted to farmers (El País, 1993). This readjustment was performed at the time of the second payment to farmers, at the end of the marketing year.

In 1994, an increase of the reference price also resulted in a 5% decrease of the compensatory payment granted to sunflowerseed farmers. For

1995, no readjustments in the compensatory payments are expected due to changes in the sunflowerseed reference price.

As noted elsewhere, during the intervention price regime, intervention prices were kept at lower levels for Spain than for the EC-10. The reason for that situation was that the accession treaty of Spain to the EC, established a transitional period of ten years to adjust institutional prices in the oilseeds sector. Consequently, for 1992, 1993 and 1994, the payments reference amounts, and therefore the direct payments per hectare, were kept at lower levels for Spain than for the EC-10. Since 1995 onwards, deficiency payments per hectare will be kept at the same levels for Spain and the EC.

In order to receive compensatory payments, farmers must leave fallow each year a certain percentage of their land. The European Commission fixes this percentage every year, although it cannot be, in any case, below 10%[4]. In 1992, that percentage was set at 15%, and was established in a rotational basis; consequently, the 15% of the land left fallow by a farmer in 1992, could not be used to fulfill set-aside requirements during the five following years.

In 1993, the rotational set-aside was maintained at 15%, although from that year onwards, a non-rotational set-aside has been also authorized but at a higher rate (which in the specific case of 1993 was 20%). The non-rotational set-aside must be left idle during five consecutive years.

In 1994, set-aside requirements were exactly the same as in 1993. Nonetheless, for 1995, EAGGF has reduced its set-aside conditions, requiring only a 12% rotational set-aside, or a 17% non-rotational set-aside (European Commission, 1994). From 1996 onwards, the rotational set-aside is expected to be 10% and the non-rotational set-aside 13%.

EAGGF also grants compensatory payments for the land left idle in fulfillment of the land set-aside requirements. The mechanisms to

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[4]This minimum percentage was established in the EU-USA Blair House agreements.

determine these compensatory payments are exactly the same as for cultivated land. However, in the case of land left fallow, the reference amounts are much lower than for cultivated land. For 1992, 1993 and 1994 these reference amounts were 35, 45 and 57 ECU/MT, respectively. For 1995, the reference amount was set also at 57 ECU/MT.

Besides, the payment reference amounts per idle hectare are the same for all arable crops. For example, in 1994, a farmer whose land was located in an agricultural district with a historical cereal yield equal to 3.2 MT/Ha., would have received a compensatory payment of 182.4 ECU for each hectare of sunflowerseed, or of any other arable crop, left idle to fulfill the set-aside requirements.

There are some established limits to the compensatory payments that EAGGF grants to the EU farmers that plant sunflowerseed and other oilseeds. As a matter of fact, Spanish sunflowerseed farmers face two sets of norms limiting the sunflowerseed area that can be planted in Spain. The first set of limitations is established in terms of all arable crops, that is, in terms of all cereals, all oilseeds and all protein crops planted in Spain. The second set of limits is specific for sunflowerseed production.

In relation to the limitations established in terms of the area planted with arable crops, the procedure is different for rain fed and for irrigated production. For rain fed production, EAGGF, through MAPA, establishes for each Spanish region or *Comunidad Autónoma* (the Spanish equivalent to a state in the USA), a maximum guaranteed area that can be planted with arable crops. This maximum guaranteed area is determined by the average of the hectares planted with rain fed arable crops in each region, during the 1989-1991 period.

If in any given year, the acreage planted with rain fed arable crops in one region, exceeds the maximum guaranteed area granted to that region, then the compensatory payments granted per hectare to all rain fed arable crops are reduced proportionately. The reduction is effective in the same marketing year, and takes place when farmers receive the second compensatory payment, at the end of the marketing year.

Thus, if the total area planted with rain fed arable crops in one region exceeds by 1% the guaranteed area for that region, then the established compensatory payments for the different arable crops in that region are reduced also by 1%[5]. Moreover, there is an additional penalization measure: for the next marketing year, farmers are required to reduce their planted area proportionally, in addition to the set-aside requirements, and without compensation. Thus, in the previous example, they would be required to reduce the area planted next year with arable crops by 1%; however, this only affects farmers that did receive compensatory payments the year that the violation took place.

So far, there has been very few cases in which the regional planted areas have exceeded the regional maximum guaranteed rain fed areas for arable crops in Spain. For the main regions in sunflowerseed production, Andalucía and, to a lower extent, Castilla-La Mancha, the rain fed acreage planted with arable crops had never exceeded the regional maximum guaranteed area before 1995. For 1995, no penalization is expected in Andalucía and a small penalization is expected in Castilla-La Mancha.

In relation to irrigated production, the limitation mechanisms are similar to those for rain fed production, although there are some differences exclusively peculiar to irrigated arable crops. First, for irrigated arable crops, the maximum guaranteed area is not established on a regional basis, but on a national basis for all Spain. As a matter of fact, two different national maximum guaranteed irrigated areas are established: one for irrigated corn and the other for the rest of irrigated arable crops. Irrigated sunflowerseed production is only affected by the second one.

The second difference arises from the penalization procedure. For irrigated production of arable crops, the penalization consists in a 1.5% decrease of the compensatory payments, for each percentage point that the total irrigated acreage planted in Spain with arable crops, different from

[5]This reduction does not affect the compensation granted for fulfilling the set-aside requirements.

corn, exceeds the national maximum guaranteed area. However, this rule only applies if the planted acreage exceeds the maximum guaranteed area by 10% or less.

If the planted area exceeds the maximum guaranteed acreage by more than 10%, the penalization procedure changes: in this case, the compensatory payments for all Spain would be determined by territorial rain fed cereal yields, instead of by the higher territorial irrigated cereal yields. In any case, for the next marketing year, farmers in all Spain[6] would be required to reduce their irrigated area planted with arable crops, different from corn, by the same percentage points that the planted national acreage exceeded the maximum guaranteed area; this is done apart from the set-aside requirements, and without compensation.

In 1993, the area planted with arable crops, different from corn, was about 280,000 hectares higher than the established maximum guaranteed area, that was of 716,779 hectares. In part, the cause of this situation was that 1993 was an extraordinarily dry year[7]. Therefore, irrigation water was severely limited, and in many zones irrigated corn could not be produced.

As a result, irrigation hectares that were planted traditionally with corn, were planted instead with other arable crops, especially with sunflowerseed due to its good resistance to dry weather. The European Commission accepted that this was an uncommon situation, and decided, exceptionally, to lower the degree of penalization for Spanish irrigated arable crops (ABC, 1993). Thus, the European Commission decided to compensate for the fact that the area planted with irrigated corn fell 240,000 hectares shorter from the maximum guaranteed area for irrigated corn, permitting to add, exceptionally, these 240,000 hectares to the maximum guaranteed area for the other arable crops.

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[6]Except those farmers that did not plant irrigated arable crops or that did not apply for compensatory payments the year that the violation of the rule occurred.

[7]This was aggravated by the fact that 1992 was also very dry.

The consequence was that EAGGF only reduced by 8.1% the compensatory payments to farmers producing irrigated arable crops different from corn. Therefore, the irrigated production of sunflowerseed was only penalized by 8.1%. In relation to 1994, the area planted with irrigated arable crops exceeded again the maximum guaranteed area. In fact, for 1994, the sanction consisted in a decrease of 10.2% of the compensatory payments for irrigated arable crops (ABC, 1994). For 1995, no sanction is expected for irrigated arable crops different from corn.

The *second set of limitations* refers exclusively to the total area planted with oilseeds, and more specifically with sunflowerseed, in Spain. Except for 1993, EAGGF has established every year a maximum area that can be planted with sunflowerseed, irrigated or rain fed, and that can be subjected to deficiency payments.

Up to 1994, the maximum guaranteed area for sunflowerseed was settled on a national basis for all Spain. Thus, in 1992, a maximum guaranteed area, that could be planted with sunflowerseed and that could be subjected to compensatory payments, was established for the whole country. In 1993, there was no limit to the area that could be planted with sunflowerseed in Spain, apart from the general limitations established in terms of arable crops.

Since 1994 onwards, EAGGF has established again limits to the total area that could be planted with sunflowerseed in Spain. This is a direct consequence of the *Blair House* agreement, signed by the EU and the USA in December of 1992, and, to some extent, of the final agreement on the *Uruguay Round* of the GATT, signed in December of 1993. On the other hand, the Uruguay Round does not consider that the direct payments per hectare to oilseeds producers in the EU are a cause of trade distortion, and, therefore, does not require a reduction of the compensatory payments levels.

The obligations acquired by the EU in the Blair House agreement required that EAGGF reduced the area planted with oilseeds that could be subjected to compensatory payments (MAPA, 1993). Consequently, in 1994, EAGGF established a *gross maximum guaranteed area* for the Spanish production of sunflowerseed of 1,441,000 hectares.

Moreover, the Blair House agreement required that the rotational set-aside requirements (15% of total land, for 1994) had to be deducted from the gross maximum guaranteed area. This resulted in a *net maximum guaranteed area* of 1,200,000 hectares, which was the maximum area that Spanish farmers could plant with sunflowerseed in 1994, without being subjected to penalization.

So far, for Spain, the maximum guaranteed areas for oilseeds have been established separately for sunflowerseed, rapeseed, soybeans and flax. Nonetheless, the guaranteed areas have been much smaller for the other oilseeds than for sunflowerseed, because the production of these other oilseeds in Spain is very small.

Also, and as occurred with the maximum guaranteed quantities under the intervention price regime, for 1992 and 1994, the maximum guaranteed areas for oilseeds were fixed jointly for the EC-10, and separately, on a national basis, for Spain and Portugal.

Nevertheless, from 1995 onwards, and due to the finalization of the transitional period for the integration of the Spanish oilseeds sector into the EU, the maximum guaranteed area will be established jointly for all the EU-12 countries. This maximum guaranteed area is also established jointly for all oilseeds (soybeans, sunflowerseed, rapeseed and flax).

For example, the gross maximum guaranteed area for all oilseeds planted in the EU-12 was 5,128,000 hectares for 1995. This is equal to the average area planted with oilseeds in the EU during the 1989-1991 period. Due to the Blair House agreements, this gross maximum guaranteed area is expected to remain at the same level during the next years.

Again, EU farmers will be allowed to plant only the net maximum guaranteed area. If sunflowerseed producers plant more hectares than they are allowed to do, they are subjected to penalization. In fact for each 1% that the sunflowerseed planted area exceeds the maximum guaranteed area, the established deficiency payment per hectare planted with sunflowerseed is reduced by 1%[8].

Moreover, this reduction is effective for the same marketing year in which the acreage violation occurs, and takes place at the time of the second payment to farmers, at the end of the marketing year. Besides, this penalization can be combined with the penalties resulting from the violation of the limitations established in terms of arable crops.

In 1992, the maximum guaranteed area granted to Spain was of 1,411,000 hectares of sunflowerseed[9]. For that same year, the final planted area was 1,449,104 hectares, only 2% higher than the maximum guaranteed area. At the end, for different reasons, such as inappropriate fulfillment of the set-aside requirements, the percentage of hectares that did not qualify for the payments was higher than 2%, and the full compensatory payment was granted to these hectares that did fulfill all the requirements (ABC, 1993). Therefore, no penalization was issued to sunflowerseed producers.

In 1993 the area planted with sunflowerseed expanded dramatically, and reached 2,064,200 hectares. There are several possible explanations to this huge increase.

First, almost anyone could plant sunflowerseed: MAPA did not establish any qualifying requirements to receive the compensatory payments, as it was done later in 1994. Second, farmers were, and are, being paid for planting sunflowerseed but not for obtaining high yields per hectare, as it was done under the intervention price regime; deficiency payments proved to be attractive to farmers, and they could be obtained even with low inputs applications per hectare. And third, Spain was experiencing a very severe drought and, in many zones of Spain,

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[8]Again, this reduction does not affect the compensatory payments received for fulfilling the set-aside requirements.

[9]The Blair House agreement had not been signed yet, and it was not necessary to subtract the set-aside requirements from the maximum guaranteed area.

planting sunflowerseed proved to be the only viable alternative (Actualidad Agraria, 1993).

In any case, perhaps the most important explanation for the large sunflowerseed areas registered after CAP reform is that the compensatory payments for the production of sunflowerseed were established at very high levels; consequently, and as it will be shown later in this dissertation, farmers could expect significantly higher gross margins in the production of sunflowerseed than in the production of other competing crops, such as cereals.

The result has been that, after CAP reform, sunflowerseed has tended to be massively planted in Spain: it has even been heavily planted in regions of Northern Spain, where the production of sunflowerseed has never been a traditional alternative to cereal production.

Moreover, in 1993, there was little risk of being penalized for planting sunflowerseed *per se*, since a national maximum guaranteed area for sunflowerseed was not established. In fact, for that year, there were only two possible sources of penalization: one possible penalization due to an increase in the reference price of sunflowerseed, and the other due to potential penalties set in terms of arable crops.

In fact, in 1993, sunflowerseed deficiency payments suffered a 10% penalization due to the increase in the reference price for sunflowerseed. Furthermore, farmers producing irrigated sunflowerseed experienced an additional decrease in their deficiency payments. As noted, this was because the total area planted with irrigated arable crops, different from corn, was larger than the national maximum guaranteed area for irrigated arable crops, different from corn. Thus, in 1993, the rain fed production of sunflowerseed was subjected to a 10% penalization, while the irrigated production of sunflowerseed was subjected to a 18.1% penalization.

In 1994, due to the establishment of a net maximum guaranteed area of 1,200,000 hectares, Spain could not afford to plant a so large sunflowerseed acreage as in 1993. If that had been the case, Spanish sunflowerseed producers would have experienced a very severe penalization.

To prevent this situation, MAPA established some rules that introduced qualifying requirements for those farmers who intended to receive compensatory payments per hectare planted with sunflowerseed. These rules have been present in 1994 and 1995 and have proven as very effective policy instruments in containing the growth of the sunflowerseed area in Spain. Furthermore, the same restrictions that were established in 1994 nd 1995 are expected to hold for 1996 also.

Thus, to qualify for compensatory payments in sunflowerseed, Spanish farmers must accomplish the following requirements. First, if they plant rain fed sunflowerseed their land must be located in a *comarca* with assigned rain fed cereal yields above 2 MT/Ha. Farmers who planted sunflowerseed during the period 1989-1991 are not affected by this norm.

Second, they must plant a minimum established dosage of certified hybrid seed. So far, the minimum application of certified hybrid seeds has bee 2.5 Kg/Ha for rain fed sunflowerseed production and 4.5 Kg/Ha for irrigated sunflowerseed production.

Third, if farmers want to receive compensatory payments, they can only plant up to 50% of their land with sunflowerseed, once the set-aside requirements are fulfilled; they can only plant the rest of the land with other arable crops different from sunflowerseed.

For example, if in 1994 a farmer had 100 hectares, and followed a rotational land retirement pattern, then he would have had to dedicate 15 hectares to fulfill the land set-aside requirements, he could have planted up to 42.5 hectares with sunflowerseed, and in the remaining 42.5 hectares, he could have only planted other arable crops different from sunflowerseed.

And fourth, an perhaps most important, if a hectare planted with an oilseed receives compensatory payments in any given year, this hectare cannot be planted with sunflowerseed the next year. Thus, in 1994, farmers could not plant sunflowerseed on the hectares that they planted with oilseeds (sunflowerseed, soybeans, rapeseed and flax) in 1993, and still receive compensatory payments.

As a result of these measures, the area planted with sunflowerseed decreased to 1,349,242 hectares in 1994. However, this area was still larger than the net maximum guaranteed area for sunflowerseed. In part, this could have been motivated because 1994 was also a very dry year. As a consequence of this situation EAGGF penalized farmers, reducing by 4% the established deficiency payments[10].

Since the penalization due to an increase in the reference price for sunflowerseed was 5%, then the total penalization for the production of rain fed sunflowerseed, in 1994, was equal to 9% of the deficiency payment.

Moreover, for irrigated sunflowerseed, this penalization was around 19.2%. This was because the area planted with irrigated arable crops, different from corn, exceeded the national maximum guaranteed area for irrigated crops, different from corn, by about 6.8% (ABC, 1994).

As noted, for 1995 a gross maximum guaranteed area of 5,128,000 hectares has been established jointly for all farmers planting oilseeds in the EU-12. A net maximum guaranteed area of about 4,500,000 is obtained after deducting the 12% rotational set-aside requirement. According to the law, if the total area planted with oilseeds in the EU-12 exceeds the net maximum guaranteed area by 5% or less, then all farmers planting oilseeds in the EU-12 would be penalized jointly.

Nonetheless, a 5% decrease in the compensatory payments is the maximum penalization that would be shared jointly by the EU-12. If, in any given year, the total area planted with oilseeds in the EU exceeds the maximum guaranteed area by more than 5%, then the decreases in the compensatory payments superior to 5%, would be concentrated only on those countries which plant an oilseeds area higher than the average acreage that was planted, in these countries, over the period 1989-1991.

[10]Although the final planted area was 12% higher than the net maximum guaranteed area, the established compensatory payment declined only by 4%. This was because a portion of the planted area did not fulfill the requirements that MAPA established to qualify for the compensatory payments.

In fact, for 1995 the total acreage planted with oilseeds in the EU-12 has been below the net maximum guaranteed area. Therefore, Spanish farmers have not been penalized for that concept.

Moreover, in 1995 Spanish sunflowerseed producers have not been penalized for increases in the reference price. Furthermore, as noted, there have been no penalizations in terms of irrigated arable crops for all Spain, and in terms of rain fed arable crops there have been no penalizations for the main sunflowerseed producer regions. Therefore, for 1995 Spanish sunflowerseed producers are expected to receive the full compensatory payment.

II.a.2. *Sunflowerseed Oil and Meal Production.*

Sunflowers are primarily grown to be crushed and to produce vegetable oil. The production of sunflowerseed meal is also relevant. Nonetheless, the dynamics of the sector can be understood much better in terms of sunflowerseed oil production, being sunflowerseed meal only a by-product that results after the oil extraction process.

The impressive growth in the production of sunflowerseed in Spain, has been accompanied by a parallel expansion in the domestic production of sunflowerseed oil and sunflowerseed meal. In 1975, Spain produced 165,000 tons of sunflowerseed oil and 198,000 tons of sunflowerseed meal; these amounts augmented to 375,000 tons of oil and 425,000 tons of meal in 1985. In 1994, 455,000 tons of sunflowerseed oil and 506,000 tons of sunflowerseed meal were produced in Spain (MAPA, 1995).

The value of processing is mainly from the output of oil. Ten tons of sunflowerseed usually yield around 4.3 tons of oil and about 4.9 tons of meal. The oil content of sunflowerseed tends to be fairly stable, although has increased slightly over the years.

Moreover, the price of sunflowerseed oil has always been significantly higher than the price of sunflowerseed meal. For example, in 1988 the wholesale price for refined sunflowerseed oil was 159.39 pesetas per liter, while the average price paid by farmers for sunflowerseed meal was only 24.66 pesetas per kilogram. Therefore, although the oil yield is below the yield of meal per ton of crushed sunflowerseed, oil is the most valuable product obtained from the processing of sunflowerseed.

In Spain, the sunflowerseed oil industry could be subdivided into three industries, according to the different vertical stages of production in the food chain. These industries are the crushing industry, the refining industry and the bottling industry. The crushing industry has its origins in the cotton processing industry, and to a lower extent, in the olive oil industry and in the soybean processing industry. The refining industry has its origins in the olive oil industry and in the soybean processing industry. Finally, the bottling industry has its origins in the olive oil industry (Cejudo, 1980).

Historically, the main activity of the cotton industry has been the textile processing of cotton. However, in the 1950s, the cotton industry, also developed plants that specialized in the production of cottonseed oil as a complementary activity. The amount of cottonseed crushed in Spain experienced an important increase during the 1950s, and reached a maximum quantity of 170,000 metric tons in 1962.

However, after 1962 the amounts of cottonseed crushed declined progressively. This created excess capacity in the cottonseed oil crushing industry, and induced, in the mid 1960s, the adaptation of the industry to the processing of the newly introduced sunflowerseed. Over the years, this modification of the cottonseed oil industry, has resulted in the development of a relatively large number of plants specializing exclusively in the crushing of sunflowerseed.

Moreover, since 1962 Spain has imported large quantities of soybeans for use as livestock feed. As a consequence, Spain has developed a soybean industry with few processing plants but with a relatively large crushing capacity. Soybean processing plants are mainly located near important seaports, where the imported soybeans are delivered. Although the main function of the soybean industry has been the crushing of soybeans for the production of soybean meal and soybean oil, the industry has also specialized, as a complementary activity, in the crushing of sunflowerseed.

Most sunflowerseed oil is obtained using solvent based technology (Baquero, 1988). Nonetheless, part of the sunflowerseed oil produced in Spain is also obtained by means of extruder/expeller processing. The origin of this second type of technique comes from the olive oil industry, and more specifically from the procedures that some olive oil processing plants have developed to produce *orujo* oil (*aceite de orujo*). The orujo oil is a low quality type of olive oil, that is obtained in a second crushing, from the refuse of the olives that is left after the first crushing process.

During the early 1980s there were around 30 sunflowerseed crushing plants in Spain. The number of crushing plant is smaller today. Small scale crushing plants have disappeared from the market, and in general, it could be said that a minimum production of 100 metric tons of oil per day is necessary for a plant to be profitable. In 1991, there were only 23 sunflowerseed crushing plants in operation, and their average crushing capacity was of 6,650 metric tons of seed per day (MAPA, 1992). Although the number of crushing plants has decreased during the last years, there is still excess capacity in the crushing industry. The result is a relatively high degree of competition among crushing plants, that, historically, has permitted farmers to receive prices above the minimum levels guaranteed by MAPA. Around 50% of the crushing industry is financed with foreign capital.

Sunflowerseed oil cannot be directed toward human consumption unless it is previously refined. During the 1950s Spain imported substantial quantities of crude soybean oil. As a consequence, some soybean oil refining plants were established in Spain. During the 1970s, the consumption of soybean oil decreased significantly, and these plants were adapted to refine sunflowerseed oil. Moreover, since the 1970s, the olive oil industry has also refined sunflowerseed oil as a complementary activity.

The bottling industry performs the functions of bottling the oil and distributing it to wholesalers and to retail chains. In this industry, the growth of the importance of foreign capital has been very important during the last ten years. The Italian food multinational *Ferruzzi* is the group with the highest presence in the sector. The degree of vertical integration is very high between the refining and the bottling industry. On the other hand, there is still little vertical integration between the crushing and the refining industry, even if integration between these industries has been augmenting progressively during the last few years. In 1991, only around 10% of the crushing plants performed refining and bottling activities (MAPA, 1992).

As noted elsewhere, the different agricultural policies that have tried to promote the production of sunflowerseed have also had an effect on the sunflowerseed oil industry. Up to 1992, the main effect of the minimum contractual price and the intervention price policies was that the industry had to pay higher prices for sunflowerseed than those prevailing in the international market. Nevertheless, different measures served to compensate the industry for having to pay relatively high sunflowerseed prices. These measures included, the public intervention in the sunflowerseed oil market up to 1985, the state control of trade in oils up to 1990, and the subsidy granted to the crushing industry from 1986 to 1991. Since 1992, the industry has been paying sunflowerseed prices approximately equal to those prevailing in the world market, and therefore, MAPA has abolished all compensatory measures to the industry.

II.b. Consumption.

Most sunflowerseed produced in Spain is crushed to produce sunflowerseed oil and sunflowerseed meal. Only a very small proportion of the sunflowerseed produced is directed toward other uses.

Thus, part of the crop is reutilized in the farm as seed. This means that although most of the seeds planted are hybrid seeds, some proportion of the harvest is still replanted. Besides, some sunflowerseed is utilized directly as livestock feed. Finally, a small proportion of the sunflowerseed produced corresponds to non oil varieties that are suited for human consumption.

For example, in 1992, after deducting net trade and stock variation from the resulting production, around 1,330,000 tons of sunflowerseed were available in the Spanish market; of that quantity, 98% was crushed, 1.3% went into human consumption, 0.6% was reutilized as seed, and only around 0.1% was used as livestock feed (MAPA, 1993).

The growth of sunflowerseed oil and sunflowerseed meal consumption in Spain, has been parallel to the development of sunflowerseed production. Thus, in 1973 the human consumption of bottled sunflowerseed oil in Spain was of 98,000 metric tons, while the livestock sector used 114,000 tons of sunflowerseed meal. In 1983, 267,000 tons of bottled oil and 334,000 tons of meal were consumed in Spain. In 1992, the consumption of bottled sunflowerseed oil was 312,000 tons, and the consumption of sunflowerseed meal was 580,000 tons (MAPA 1993; AFOEX 1993).

II.b.1. *Sunflowerseed Oil Consumption.*

The major use of sunflowerseed oil is as cooking oil. Besides, virtually all sunflowerseed cooking oil is sold bottled. However, there are also other uses for sunflowerseed oil.

A relatively small proportion of total sunflowerseed oil consumption is used as a raw material by the food processing industry, in the production of food items such as canned vegetables, canned fish, margarine, mayonnaise, etc. Before Spain's accession to the EC, the use of sunflowerseed oil by the food processing industry tended to be fairly small. Thus, on average for the 1973-1985 period, only 7% of all sunflowerseed oil consumed in Spain was utilized by the food processing industry (MAPA, 1987).

However, accession to the EC has encouraged the production of sunflowerseed, and consequently the production and utilization of sunflowerseed oil. As a result, during the 1986-1993 period, a higher proportion of total sunflowerseed oil consumption has gone into food processing. On average for the 1986-1993 period, 14% of all sunflowerseed oil consumed in Spain was utilized by the food processing industry (MAPA, 1994).

Sunflowerseed oil can also go into inedible uses, such as the production of cosmetics, paints and soaps. The sunflowerseed oil that has a high degree of acidity, and that is not suited for human consumption, is directed toward these inedible uses. Generally, only a very small proportion of the total sunflowerseed oil consumption in Spain goes into inedible uses. For example, on average for the 1980s, only 1% of all sunflowerseed oil consumed in Spain went into inedible uses (MAPA, 1991).

The production of sunflowerseed, and to a much lower extent of sunflowerseed oil, are subjected to a relatively high degree of variability from year to year. However, the consumption of sunflowerseed oil has followed much more stable trends over the years, and is not subjected to sharp annual variations. Furthermore, since the late 1970s, sunflowerseed oil has been the *second vegetable oil most consumed in Spain*, after olive oil.

Traditionally, Spain has always been an olive oil consuming country. For hundreds of years olive oil was the only vegetable oil consumed in Spain. However, in the late 1940s, and due to increased population growth, the olive oil sector started to experience difficulties for satisfying all the Spanish demand for vegetable oils.

Olive trees can only be grown in very specific parts of Spain. Another historical constraint to the expansion of olive oil production, comes from the fact that olive production has traditionally been very labor intensive. Until very recent dates the degree of mechanization in the olive sector has been relatively low (Mataix, 1988). As a consequence of the impossibility of a significant expansion of domestic olive oil production, in the early 1950s, Spain started to import soybean oil to satisfy its demand for vegetable oils. In the late 1950s, the consumption of soybean oil was generalized in the Spanish society.

Soybean oil was sold in Spain under the generic label *aceite vegetal* (vegetable oil). In the early 1970s soybean oil changed its name to *aceite de mezcla de semillas* (seed oil). Cottonseed oil and safflower oil, as well as their mixture with sunflowerseed oil or soybean oil, and even the mixture of soybean and sunflowerseed oils, could also be sold under the name *aceite de mezcla de semillas*. Nonetheless, the domestic production of cottonseed and safflower oils, and their presence in the Spanish market, was, very small in the 1970s[11] (Tió, 1983).

In the 1960s, the Spanish economy experienced very high rates of growth and industrialization; Spain began to be considered as a developed country. Economic development was accompanied by a substantial increase in the demand for white meats, specially poultry and pork meats. The result was a considerable expansion in domestic livestock production.

The development of the Spanish livestock sector demanded increasing imports of livestock feeds that were not produced in Spain, especially corn and soybeans. In order to process imported soybeans, Spain developed an important soybean crushing industry. Although the primary goal of the industry was to produce soybean meal, the resulting soybean oil was also directed toward the domestic market. Consequently, in the 1960s, Spain reduced its soybean oil imports and started to produce domestically its own soybean oil requirements. As a result, in 1970 Spain was self-sufficient in vegetable oils.

The development of soybean oil production in Spain, was the consequence of a policy that intended to facilitate soybean imports[12], in order to promote the growth of the Spanish livestock sector. This policy was not coordinated with the policy measures that, since the mid 1960s, encouraged the production of sunflowerseed on the Spanish farms (Tió, 1983). Moreover, historically, the production of olive oil has been also supported by means of direct public intervention in the olive oil market,

[11]It is still very small in the 1990s.

[12]For example, from 1962 to 1970 the tariff for imported soybeans was only 5%. Since 1971 imported soybeans have been subject to zero tariff in Spain.

with FORPA as a buying agent. The result was that, since the early 1970s, Spain, apart from producing important quantities of soybean oil and olive oil, started to produce also substantial amounts of sunflowerseed oil. Since then, the domestic market has not been able to absorb the total Spanish production of vegetable oils.

In the early 1970s, sunflowerseed oil found a wide acceptance in the Spanish market, and was able to compete with olive oil and with soybean oil. Moreover, around the mid 1970s, an increasing production of the relatively cheap sunflowerseed oil along with an already large production in the soybean oil sector, resulted on a significant downward pressure on olive oil consumption (MAPA, 1980).

The policy of MAPA consisted in protecting those oils that were produced with domestic raw materials. The government regarded as a problem the relatively low prices and the large production of soybean and sunflowerseed oils, especially due to its possible effects on prices, sales and profit margins in the olive oil sector.

Moreover, the olive oil sector needed to be protected since it was an important source of employment in some of the most depressed regions in South-Central Spain. On the other hand, the olive oil sector could not be protected at the expense of the sunflowerseed sector, which was becoming an major source of income for many farmers in South-Western Spain (BCA, 1983).

The result was that, since 1977 to 1990, MAPA established very strict quotas and marketing procedures, for the soybean oil that could be sold in the Spanish market. In 1977, only 170,000 metric tons of soybean oil could be sold in the Spanish market. In 1978, the quota was reduced to 120,000 tons, and from 1979 to 1989 only 100,000 tons of soybean oil were permitted in the Spanish oil market. In 1990, 123,000 tons of soybean oil were allowed to be sold in the Spanish market. Moreover, from 1977 to 1990, all soybean oil sold in Spain had to be marketed by MAPA.

The consequence of this restrictive policy was that, since 1977, the soybean oil has virtually disappeared from the Spanish market for bottled oils. MAPA marketed all the soybean oil quota, and tended to avoid selling soybean oil to the bottling industry. Instead, soybean oil was mainly sold to the food processing industry. Part of the quota was directed also toward direct human consumption in institutions that were, somehow, related to the government: social security centers, federal buildings, hospitals, prisons, etc.

Thus, since 1977 MAPA did not allow soybean oil to compete with sunflowerseed oil in the bottled oils market, the market where most sunflowerseed oil is sold. Nonetheless, Spain has continued to import substantial amounts of soybeans and to produce significant quantities of soybean oil and soybean meal.

Moreover, the Spanish soybean crushing industry is one of the largest in Europe, only behind the German and the Dutch soybean processing industries. The soybean meal produced is still consumed domestically, but most soybean oil produced has been directed toward the export market. As a matter of fact, for many years, soybean oil exports have exceeded even olive oil exports.

The production of rapeseed on the Spanish fields, and the consumption of rapeseed oil in the Spanish oil market, began to be introduced in the late 1970s. At that time, it was thought that rapeseed oil consumption could reach significant levels in the future. However, in 1981 there was an event in which adulterated rapeseed oil affected seriously the health of several thousand persons (INC, 1985). Since then, the Spanish consumer has developed a high degree of aversion against rapeseed oil, and rapeseed oil has practically disappeared from the market.

In any case, the Spanish consumption of soybean oil, rapeseed oil, and any other oil different from sunflowerseed oil and olive oil[13], was very small during the 1980s. Consequently, the presence of these oils in the bottled oils market had very little significance during that period.

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[13]Corn oil, safflower oil, cottonseed oil, etc.

For example, in 1978, the sales of bottled vegetable oils, different from olive oil and sunflowerseed oil, were 129,000 metric tons. For that same year 205,000 tons of bottled sunflowerseed oil and 255,000 tons of bottled olive oil were sold. On the other hand, in 1990, the sales of bottled olive oil and sunflowerseed oil accounted, together, for over 614,000 tons, while the sales of other bottled vegetable oils were just of 15,300 tons. Only 8,600 tons of soybean oil were sold in 1990 in the bottled oils market. They were sold mixed with sunflowerseed oil and under the name *aceite de mezcla de semillas* (AFOEX, 1991).

The liberalization of the Spanish oil market was one of the conditions for Spain's accession to the EC. Marketing quotas for soybean oil, or for any other vegetable oil, were not compatible with the EC's normative framework. Nevertheless, the stand-still arrangement still permitted, among other things, the establishment of market quotas for soybean oil and the monopoly of MAPA in the marketing of soybean oil during the 1986-1990 period.

Since 1991, the market quotas for soybean oil have been abolished and the marketing of soybean oil has been liberalized. As a consequence, consumption of soybean oil has increased. Thus, in 1990, the consumption of soybean oil was only of 85,200 tons, while in 1991, 1992 and 1993 was of 151,000, 145,800, and 175,000 tons respectively (MAPA, 1994). Nonetheless, during the 1990s, soybean oil consumption levels are still well below sunflowerseed oil consumption levels, and the bulk of the Spanish soybean oil production still goes to the export market[14].

Furthermore, most soybean oil consumed in Spain is still utilized by the food processing industry. On average, for the 1991-1993 period, around 9% of total soybean oil consumption went into inedible uses, nearly 81% was utilized by the food processing industry, and only 10% was bottled and sold directly to the public.

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[14]Soybean oil exports are mostly directed to countries in Northern Africa and the Middle East.

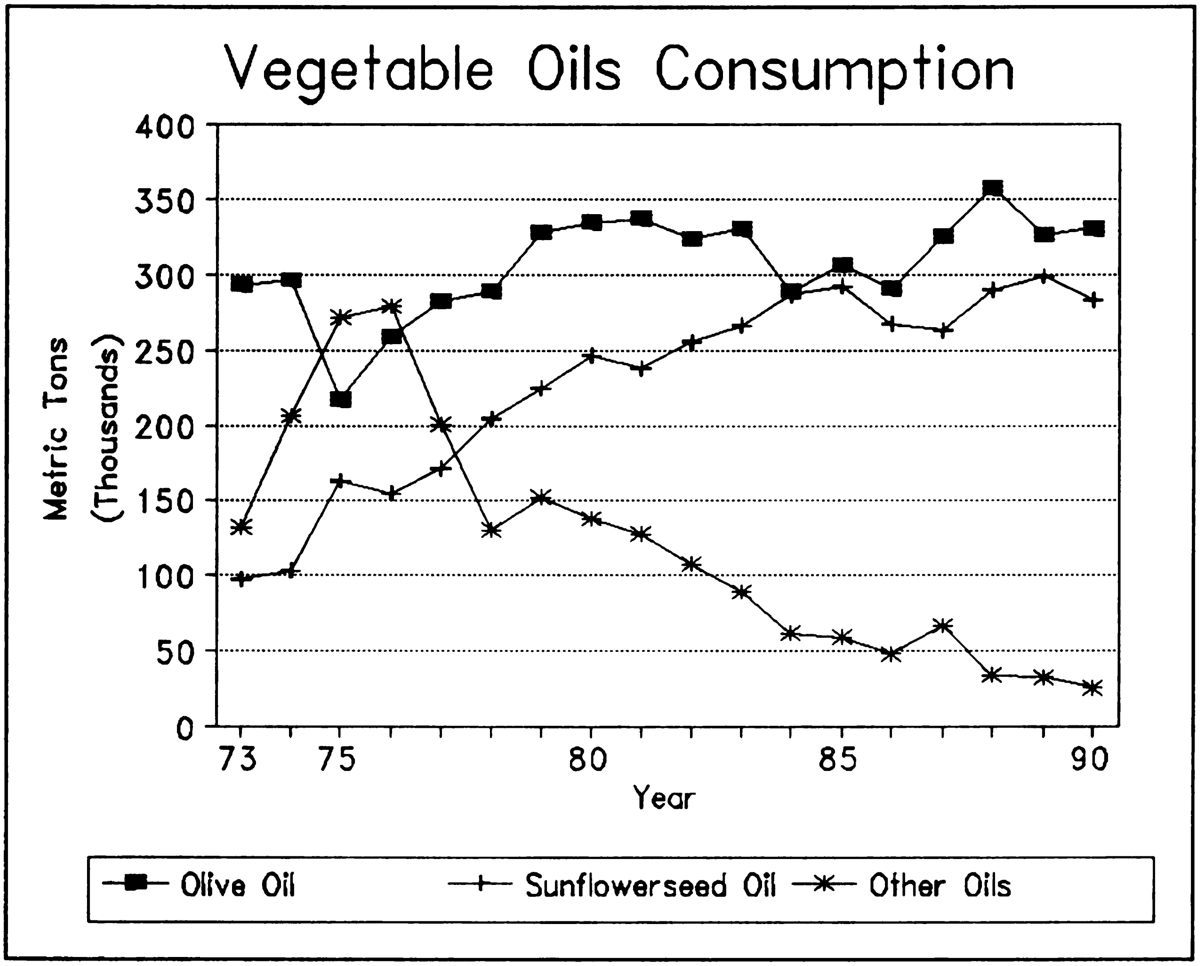

Figure 2.4. Sales of Bottled Olive Oil, Bottled Sunflowerseed Oil and Other Oilseeds Bottled Oil in Spain, (1973-1990).

Source: AFOEX.

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Soybean oil is now competing with sunflowerseed oil mainly as a raw material for the food processing industry, although the degree of competition has not increased dramatically. Thus, the end of the stand-still period has not resulted in an increase of the quantities of soybean oil sold in the Spanish bottled oils market.

Therefore, the domestic utilization of soybean oil is still at relatively low levels. Although the Spanish consumer was used to soybean oil during the 1970s, so far he/she is not consuming it now. It is possible that soybean oil consumption will spread again in the future. Nonetheless, most key informants consulted think that a strong emergence of soybean oil in the bottled oils market is unlikely to occur, at least during the next ten years.

In fact, since 1977, sunflowerseed oil and olive oil have monopolized the fats and oils market in Spain. In the 1990s, the consumption of other vegetable oils is still very small, especially in the bottled oils market. Besides, other fats such as butter and margarine are seldom used in Spain for cooking purposes, and have very little importance in the Spanish diet.

Olive oil can be classified into four different categories according to its degree of acidity: *Extra, Fino, Corriente* and *Lampante*. The Extra olive oil is the one with the lowest degree of acidity, and therefore the oil that is sold at a higher premium. The Lampante olive oil is not suited for human consumption since its degree of a acidity is higher than three grades. Most olive oil consumed in Spain is under the categories Extra and Fino (MAPA, 1994).

Moreover, most olive oil is refined before consumption. This is done in order to lower its degree of acidity. However, high quality olive oil with a low degree of acidity can be consumed directly, without being previously refined. The olive oil that is consumed without being refined is known as virgin olive oil. Virgin olive oil comprises a relatively small proportion of olive oil total sales in the bottled oils markets.

During the 1980s, this proportion was equal to 4.5% of the total bottled olive oil sales (AFOEX, 1990).

Although most olive oil is sold to the public bottled and through retailer chains, some portion of the sales takes place in consumer co-operatives, where the oil is sold in large containers (*garrafas*). Since almost all sunflowerseed oil consumed is bottled oil, it seems plausible to assume that sunflowerseed oil competes in the market with bottled olive oil, instead of with the olive oil sold in garrafas in the consumer co-operatives.

Besides, there are not many available statistical series on the sales of oil in consumer co-operatives, while, in the case of bottled oil, this data is available from AFOEX (the Spanish association of oil refiners and bottlers). Therefore, the olive oil sold in co-operatives is not taken into account in the present analysis; this dissertation considers that bottled olive oil and garrafa olive oil sales belong to different segments of the Spanish oils market.

The end of the stand-still period has coincided in time with the reform of the CAP mechanisms regulating the oilseeds sector at the farm level. As noted elsewhere, since 1992, sunflowerseed oil crushers have paid the sunflowerseed prices determined by the world market. Thus, the Spanish sunflowerseed prices are at much lower levels than before 1992.

As a result, the price premium for olive oil over sunflowerseed oil increased significantly during the 1992-1994 period. However this did not result in very important changes in consumption patterns in the bottled oils market. Consumption per capita of bottled olive oil experienced only modest decreases, and the consumption of bottled sunflowerseed oil increased modestly if compared with the figures prevailing before the end of the stand-still period (MAPA, 1994).

In 1995 there was an even more significant increase -around 150 pesetas- in the price premium for olive oil. This was produced by an exceptionally low olive harvest in 1994, caused by the severe drought that

has affected Spain during the first half of the 1990s[15]. As a result, there has been more important increases -around 10%- in the consumption of bottled sunflowerseed oil, and similar decreases in the consumption of bottled olive oil. Hence, it seems that the consumption of sunflowerseed oil only changes importantly in the presence of very sharp variations in the price premium for olive oil.

II.b.2. *Sunflowerseed Meal Consumption.*

As noted elsewhere, the economics of the sunflowerseed sector are understood much better in terms of sunflowerseed oil production and consumption than in terms of sunflowerseed meal production and consumption: sunflowerseed oil is much more valuable than sunflowerseed meal, which could be regarded just as a by-product.

Spain satisfies its livestock feed needs mainly with imported soybeans and corn, rather than with domestically produced sunflowerseed meal. Historically, sunflowerseed meal production alone, could have never satisfied the domestic livestock feed needs. Nonetheless, sunflowerseed meal is also utilized in the livestock industry. Sunflowerseed meal is especially well suited for ruminant rations because of its high fiber content. Sunflowerseed meal is also commonly used by the hog sector and, to a lower extent, in the poultry sector (Montero and Moro, 1988).

Although sunflowerseed meal has a lower protein content than soybean meal, the nutritional characteristics of sunflowerseed meal are somehow similar to soybean meal. Consequently, sunflowerseed meal competes with soybean meal in the livestock feeds market.

As a matter of fact, the Spanish sunflowerseed meal market is very influenced by the soybean meal market. Large amounts of soybean meal are produced in Spain from imported soybeans. Spain also imports directly significant quantities of soybean meal. Moreover, the volume of sunflowerseed meal consumption is much smaller than the volume of soybean

[15] The olive harvest has also been very short in 1995; this will very likely result in high olive oil prices also for 1996.

meal consumption. On average for the 1980s, the Spanish livestock sector consumed only two tons of sunflowerseed meal, for each ten tons of soybean meal consumed (MAPA, 1992).

Animal consumption of sunflowerseed meal has been subjected to much more variability than the human consumption of sunflowerseed oil and, historically, has been very influenced by fluctuations in the production of sunflowerseed. Because of the relatively high degree of substitutability between sunflowerseed meal and soybean meal, the Spanish livestock sector has easily absorbed increases in sunflowerseed meal production.

The Spanish consumption of sunflowerseed meal has augmented importantly during the 1980s and 1990s, probably as a consequence of the fact that more sunflowerseed meal has been available in the market, due to an increase in the amounts of sunflowerseed domestically produced and crushed.

Therefore, the consumption of sunflowerseed meal is becoming more generalized in the Spanish feeds market; in fact, it seems that, in the 1990s, there is an increasing trend in the amounts consumed of sunflowerseed meal, although the consumption of sunflowerseed meal is still at much lower levels than the consumption of soybean meal. In any case, most key informants consulted considered that, perhaps, the main factor influencing the consumption of sunflowerseed meal in Spain is the magnitude of the price premium paid for soybean meal over sunflowerseed meal.

Agricultural policy has focused on the production of sunflowerseed at the farm level and on the production and consumption of sunflowerseed oil, rather than in the production and consumption of sunflowerseed meal. This could be because, sunflowerseed meal production has never been, on a scale, a viable alternative to avoid the massive imports of soybeans and corn that Spain has carried out during the last 30 years. Consequently, MAPA has never pursued policies tending to protect domestically produced sunflowerseed meal, or to promote sunflowerseed meal consumption.

II.c. Prices.

Sunflowerseed and sunflowerseed oil prices have been highly affected by the agricultural policies prevailing at the different stages of the food chain. As noted, the sector has been liberalized only since 1992, when sunflowerseed prices began to be freely determined by the market. Previous to that year, the minimum contractual price policy, from 1965 to 1985, and the intervention price policy, from 1986 to 1991, helped to keep sunflowerseed prices at higher levels than the international prices for this commodity.

As noted elsewhere, the minimum contractual price policy was effective from 1965 to 1985. In fact, the prices actually received by farmers during this period were usually above the minimum contractual prices that MAPA established each year. This could be explained by the excess capacity existing in the crushing industry and by competition among crushing firms (MAPA, 1984).

On the other hand, from 1985 to 1991, during the intervention price policy period, the prices received by farmers tended to be below the intervention prices guaranteed by EAGGF. The explanation for this tendency comes from the fact that not all the farmers did sell sunflowerseed to MAPA, even when the market price was below the intervention price. This could have been partly due to a lack of knowledge of small and medium scale farmers, about the functioning of the intervention mechanisms (Junta de Andalucía, 1991). In any case the sunflowerseed prices received by farmers experienced moderate increases after accession to the EC, probably caused by the higher guaranteed prices granted under the EC's regulatory framework.

From 1992 onwards, the reform of the mechanisms of the CAP regulating the oilseeds sector, has lead to domestic sunflowerseed prices around the levels dictated by the international market. Consequently, these prices are at much lower than before the reform of the CAP. Moreover, the importance of prices as signals for the agricultural supply of sunflowerseed has decreased. This is because market prices play a much less important role, in determining sunflowerseed producers' gross revenues, than the direct compensatory payments granted by MAPA since 1922.

Historically, relatively high sunflowerseed prices, have resulted also in higher sunflowerseed oil prices in Spain than in the international market. From 1965 to 1985, the public intervention of FORPA in the sunflowerseed oil market and the isolation of the Spanish vegetable oils markets, were the key factors to maintain relatively high domestic prices for sunflowerseed oil.

During that period MAPA did also establish a maximum retail price for sunflowerseed oil: retailers could not sell sunflowerseed oil at prices above the maximum retail price. This was done to avoid the possible inflationist effects, in the vegetable oils market, of public intervention in the sunflowerseed oil market.

In any case, during the 1970s and the early 1980s, retail prices of sunflowerseed oil tended to average about ten pesetas below the maximum retail price that MAPA established (MAPA, 1985).

Previous to Spain's accession, the policy to support the crushing industry was different in Spain and in the other EC countries. In the EC-10, EAGGF did not intervene in the sunflowerseed oil market, but granted a subsidy to the crushing industry.

Thanks to this subsidy, the EC crushing industry was paying the same for domestically produced sunflowerseed than for imported sunflowerseed, even if the prices received by sunflowerseed producers were much higher in the EC than abroad.

The subsidy to the industry, and the fact that the EU's vegetable oils market has historically been subjected to very low protection levels, helped to maintain the EC's sunflowerseed oil prices at competitive levels in the international market.

The intervention of FORPA in the Spanish sunflowerseed oil market ended in 1986, with the accession of Spain to the EC. However, the subsidy to the crushing industry was not fully operative in Spain until the end of the stand-still period, in 1991[16].

As noted, the other key mechanism utilized to maintain relatively high domestic sunflowerseed oil prices in Spain, previous to accession to the EC, was the monopoly of MAPA of all external trade in vegetable oils. Moreover, the stand-still arrangement still permitted, during the 1986-1990 period, a strict control by MAPA of all the quantities of sunflowerseed oil traded, even with the other EC countries. In fact, MAPA was supposed to allow sunflowerseed oil imports only if the annual national production of sunflowerseed oil was not able to satisfy domestic consumption.

Another consequence of the stand-still arrangement, was that Spain's imports of sunflowerseed oil or of any other vegetable oil, from 1986 to 1990, were subjected to strict price controls. Imported vegetable oils were sold in Spain at the prices determined by the domestic market. These prices were higher than the prices determined by the international sunflowerseed oil market (MAPA, 1991).

Sunflowerseed oil prices declined importantly in 1991, as a consequence of the end of the stand-still period. The decrease of sunflowerseed oil price was accentuated in 1992 and 1993 as the repercussions of the end of the stand-still period became more evident in the Spanish oils market; to some extent, the lower sunflowerseed prices that resulted after CAP reform were also responsible for sharp declines in the sunflowerseed oil price after 1992.

In any case, sunflowerseed oil prices have always been below olive oil prices, the main substitutive product of sunflowerseed oil. Due to the relatively high degree of mechanization of sunflowerseed production, olive oil production results on a higher cost per unit of output than sunflowerseed oil production. Besides, the Spanish consumer has always

[16]In fact, this subsidy was only fully operative during 1991. In 1992, the subsidy to the crushing industry was abolished, due to the reform of the CAP in the oilseeds sector.

regarded olive oil as a high quality product, if compared with sunflowerseed oil (BCA, 1983).

On average for the 1980s, the retail price for olive oil tended to be 1.4 times the retail price for sunflowerseed oil (MAPA, 1990). However, due to the end of the stand-still period and the reform of the CAP in the oilseeds sector, the price premium for olive oil over sunflowerseed oil has increased during the 1990s. Thus, on average for the 1991-1994 period, olive oil prices have been 2.27 times higher than sunflowerseed oil prices (MAPA, 1994). In 1995, due to bad olive harvests, the price premium for olive oil over sunflowerseed oil have increased even more.

Production costs and consumer preferences are not the only factors explaining the price differences between olive oil and sunflowerseed oil. As a matter of fact, agricultural and food policies tending to promote the production and facilitate the consumption of olive oil, have also affected olive oil prices.

Since the 1960s, MAPA has set an intervention price in the olive oil market. This intervention price policy has served to support the incomes of olive oil producers, but has lead also to an upward pressure on olive oil prices. On the other hand, since 1979, MAPA has also granted to olive oil producers a direct production subsidy per ton of oil produced. This production subsidy could have helped to moderate the inflationist effects of the intervention price policy on the olive oil market (Santana, 1986).

The EU, in order to protect the Italian olive oil production, has also established public intervention in the olive oil market since the 1960s. As a matter of fact, before Spain's accession to the EC, intervention prices for olive oil were higher in the EC-10 than in Spain. Consequently, accession to the EC has generated higher intervention prices in the Spanish olive oil market. This could have contributed to increase, from 1986, the price premium for olive oil over sunflowerseed oil, even at the retail level (Junta de Andalucía, 1990).

In order to reduce the inflationist effects on olive oil prices of public intervention in the olive oil market, the EC-10 has established a

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consumption aid since 1979. The olive oil bottling industry receives this consumption aid for each liter of bottled olive oil delivered into the market. For example, in Spain, for 1992, the consumption aid was of 67.2 pesetas per liter, while for 1993 was of 79.2 pesetas per liter (MAPA, 1994).

The bottling industry must reduce the price of each liter of bottled olive oil sold in the market by an amount equal to the consumption aid. In Spain, the aid to olive oil consumption has not been effective until 1991, just at the end of the stand-still period. Most key informants think that the introduction of the consumption aid in Spain has helped to moderate, to some extent, the increase in the price premium for olive oil over sunflowerseed oil.

On the other hand, the European Commission considers that, during the 1990s, olive oil consumption in the EU seems to be less affected than in the past by price competition from other vegetable oils (European Commission, 1992). Apparently, this is true in the case of Spain. As noted elsewhere, the end of the stand-still period and the reform of the CAP has resulted in an increase of the price premium for olive oil over sunflowerseed oil, but consumption per capita of olive oil and sunflowerseed oil during the 1992-1994 period has remained at levels similar to those prevailing before 1992. Nevertheless, the sharp increase in olive oil prices in 1995, has had a more significant impact on the consumption of sunflowerseed oil and olive oil.

The European Commission also estimates that olive oil consumption appears to be more sensitive to fluctuations in the price of olive oil, increases in consumer incomes, and efforts to improve product quality and promote consumption (European Commission, 1992). Therefore, since 1993, EAGGF's policy in the olive oil sector has been based in lower intervention prices for olive oil, and in an increase of the relative importance of direct production subsidies as a mean of supporting the olive oil producers' revenues. The consumption aid has also decreased

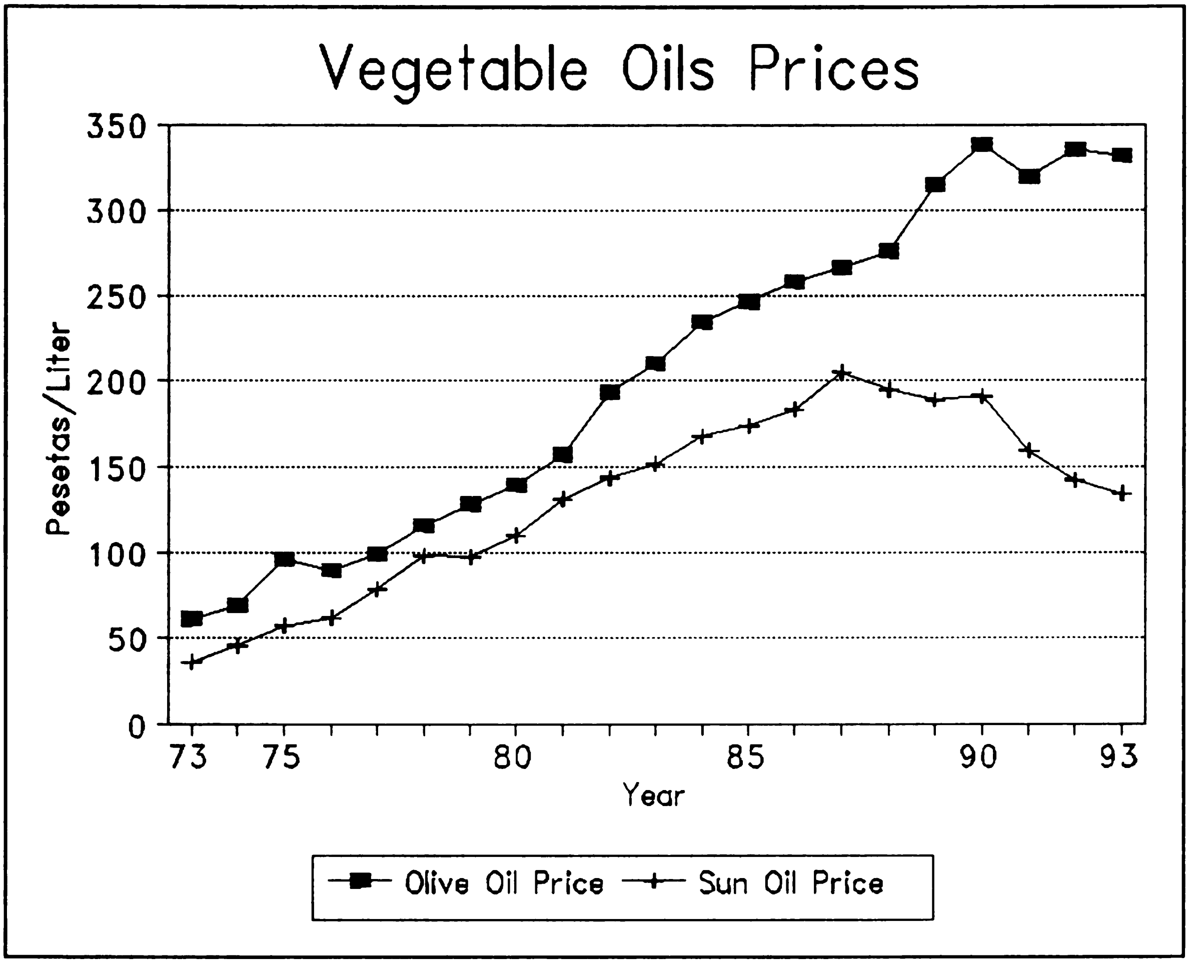

Figure 2.5. Retail Prices for Bottled Olive Oil and Bottled Sunflowerseed Oil in Spain, (1973-1993).

Source: MAPA and Subdirección General de Comercio Interior del Ministerio de Economía y Hacienda.

since 1993, and some key informants consider that this type of aid is very likely to disappear in the near future.

In relation to sunflowerseed meal prices, MAPA has always practiced a policy of non intervention in the sunflowerseed meal market. Therefore, sunflowerseed meal prices in Spain are freely determined by the market. As a matter of fact, sunflowerseed meal prices are very linked to soybean meal prices. Nevertheless, the Spanish feed market has always paid a significant premium for soybean meal over sunflowerseed meal because of the higher protein content of soybean meal.

In Spain and in the rest of the EU, oilseeds imports are subjected to a zero tariff. Therefore, the Spanish soybean and soybean meal prices are very linked to the international soybean and soybean meal prices. Nonetheless, soybean meal prices tend to be higher in the Spanish market than in the Rotterdam market. One of the reasons why Spanish soybean meal prices are higher than Rotterdam prices may be that port facilities in Holland are more adequate to handle large quantities of soybeans than Spanish port facilities (Pelach, 1981).

II.d. Trade.

Historically, external trade in the sunflowerseed sector has been subjected to strict restrictions and public controls. From the 1960s to Spain's accession to the EC, MAPA had a monopoly of all trade in sunflowerseed and sunflowerseed oil. All sunflowerseed and sunflowerseed oil exports were performed by MAPA, and only MAPA could import sunflowerseed and sunflowerseed oil when it was estimated necessary to satisfy the internal needs.

Moreover, imports of sunflowerseed and sunflowerseed oil were subjected to a variable import levy. This import levy was designed to bring the world price of imported sunflowerseed and sunflowerseed oil up to the domestic level. Sunflowerseed meal imports were not monopolized by MAPA but they were also subjected to a variable import levy.

As a result of this protectionist policy, the Spanish sunflowerseed sector was relatively isolated from the international market (Camilleri, 1984). Consequently, before accession to the EC, the volume of external trade in sunflowerseed, sunflowerseed oil and sunflowerseed meal, tended to be very small, especially if compared with the total amounts produced and consumed of these commodities.

Thus, the Spanish sunflowerseed sector had little reliance on the export market. On average from 1971 to 1985, Spain's sunflowerseed exports were equal to 0.7% of total sunflowerseed production, while sunflowerseed oil exports were equal to 2.5% of total sunflowerseed oil production, and sunflowerseed meal exports equal to 9.5% of total sunflowerseed meal production (MAPA, 1986).

On the other hand, for this same period, sunflowerseed imports accounted only for 1.5%[17] of total sunflowerseed consumption, and sunflowerseed meal imports were equal to 4% of total sunflowerseed meal consumption. Sunflowerseed oil imports were a little higher but still remained at low levels, being equal to only 11% of total sunflowerseed oil consumption (MAPA, 1986).

Sunflowerseed, sunflowerseed oil and sunflowerseed meal production were less protected in the EC than in Spain. As a matter of fact, the EC has a zero tariff for sunflowerseed and sunflowerseed meal imports. Sunflowerseed oil production is protected by means of a variable import levy. However, this variable levy has always been at low levels. This is because, historically, sunflowerseed oil prices in the EC have been at levels close to the international market. Therefore, the degree of protection was much lower in the EC-10 than in Spain (Solbes, 1979), where trade in vegetable oils was monopolized exclusively by MAPA, and where the crushing industry was compensated by means of public intervention in the sunflowerseed oil market, instead of by direct production subsidies.

[17]The year 1981 was not utilized in the computation of this figure. This is because, in 1981, there was a very small sunflowerseed crop which forced the government to import large amounts of sunflowerseed.

After Spain's accession to the EC in 1986, the Spanish variable levies on sunflowerseed and sunflowerseed meal were supposed to be progressively eliminated during a transitional period of ten years. In practice, however, all protective arrangements for trade in sunflowerseed and sunflowerseed meal, both with the EU and with the rest of the world, were eliminated in 1992. This was due both to the reform of the CAP in the oilseeds sector and to the Single European Market agreement. Consequently, Spanish sunflowerseed imports from any country in the world have been subjected to a zero tariff since 1992.

Moreover, before Spain's accession to the EC, the EC-10 intervention prices for sunflowerseed were higher than the Spanish minimum contractual prices for sunflowerseed. Therefore, since 1986, the higher institutional prices for sunflowerseed achieved through accession to the EC, have also encouraged the production of sunflowerseed, sunflowerseed oil and sunflowerseed meal in Spain. This has stimulated exports in the Spanish sunflowerseed sector.

Hence, as a result of policy changes tending to facilitate imports and exports, the Spanish volume of trade in sunflowerseed and sunflowerseed meal has increased slightly after Spain's accession to the EC. Thus, from 1986 to 1994, Spain exported 3.6% of its sunflowerseed production and 2.2% of its sunflowerseed meal production. For this same period, Spain imported 4.9% of its total sunflowerseed consumption and 9.3% of its sunflowerseed meal consumption (MAPA, 1994; USDA, 1995). Sunflowerseed imports have increased more significantly in 1994 and 1995, due to decreases in the sunflowerseed area (as a consequence of MAPA's restrictions to sunflowerseed production) and, especially, to bad sunflowerseed harvests caused by extremely dry weather conditions.

Nevertheless, the relative importance of the external trade of these commodities is still very low. In any case, since Spain entered the EU, a significant percentage of the external trade in sunflowerseed and sunflowerseed meal takes place with other EU countries. Thus, from 1986 to

1994, 62% of all external trade in sunflowerseed and 53% of all trade in sunflowerseed meal was with other EU countries (MAPA, 1994).

On the other hand, the Spanish sunflowerseed oil sector continued to have a high degree of protection until the end of the stand-still period, in 1991. The stand-still provisions required MAPA and EAGGF to establish, before each agricultural year, a balance sheet with their predictions on the Spanish consumption and production of sunflowerseed oil. MAPA had the obligation to allow sunflowerseed oil imports into Spain, only if the actual sunflowerseed oil production, in any given year, was not able to satisfy the expected sunflowerseed oil consumption. The result of this policy was that, during the stand-still period, Spain imported very small amounts of sunflowerseed oil. Consequently, from 1986 to 1990, Spain imported only 0.7% of its sunflowerseed oil consumption.

After the stand-still period, all the quantitative restrictions to sunflowerseed oil imports were eliminated. Furthermore, in 1991, a 13.7% tariff was imposed for sunflowerseed oil imports from other EC countries. This tariff was supposed to be progressively abolished during a period of five years. However, in 1993, due to the Single European Market agreement, all tariffs within the EU have been suspended, and consequently, trade in sunflowerseed oil with the rest of the EU has been fully liberalized. Also, since 1993, Spain has adopted the EU's variable levy for sunflowerseed oil imports from non EU members.

The consequence of these new policies, is that the relative importance of sunflowerseed oil imports has increased a little since the end of the stand-still period. Thus, from 1991 to 1994, Spain has imported 1.2% of its sunflowerseed oil consumption. Moreover, from 1986 to 1994, 32% of Spain's sunflowerseed oil imports came from other EU countries. Nonetheless, the Spanish consumption of sunflowerseed oil is still almost entirely satisfied with domestic production.

During the stand-still period, a system of export restitutions was also introduced for the Spanish sunflowerseed oil sector. EAGGF subsidized Spanish sunflowerseed oil exports to non EC countries. The subsidy was paid for each metric ton of sunflowerseed oil exported, and was equal to the difference between the Spanish target price for sunflowerseed and the international market price for sunflowerseed.

Thus, from 1986 to 1990, an increasing sunflowerseed oil production and a policy of export restitutions helped to increase the Spanish sunflowerseed oil exports.

During that period, Spain's exports of sunflowerseed oil were equal to 16% of its national production. At the end of the stand-still period, the system of export restitutions was eliminated. However, Spanish exports of sunflowerseed oil declined only slightly, and were equal to 13% of total domestic production for the 1991-1994 period.

Hence, Spain has still exported relevant amounts of sunflowerseed oil even after the elimination of the export restitution system of the stand-still agreement. This is because, since 1991, the domestic sunflowerseed oil prices have remained at levels that are competitive in the international market.

In the sunflowerseed oil sector, the percentage of Spanish exports to other EU countries has remained on the low side, even after accession to the EU. During the 1986-1994 period, only 25% of Spain's sunflowerseed oil exports went to other EU members.

Also, even after accession to the EU, external trade still has a relatively small weight within the Spanish sunflowerseed sector. The volume of trade in sunflowerseed and sunflowerseed products, has certainly increased after accession, but it still remains at relatively low levels. The Spanish sunflowerseed sector is still mainly oriented toward the satisfaction of the internal consumption needs.

Furthermore, the importance of the Spanish production of sunflowerseed, sunflowerseed oil and sunflowerseed meal, is relatively small in the international markets for these commodities. For example, in the 1989-92 period, Spain shared only 0.01% of total world trade in

sunflowerseed and less than 5% of total world trade[18] in sunflowerseed oil (MAPA, 1994). Although the Spanish olive oil production has a significant impact in the international olive oil market, the same cannot be said about the Spanish sunflowerseed and sunflowerseed oil productions, and the international sunflowerseed and sunflowerseed oil markets.

[18]Argentina is the main sunflowerseed oil exporter in the world, with around 36% of total world trade during the 1989-1992 period. It is very unlikely that Spain, with its share of total world trade, could have a significant effect on the world market price of sunflowerseed oil.

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CHAPTER III

DEVELOPMENT OF GROSS MARGINS SERIES

One of the objectives of this study is the utilization of gross margins series in the analysis of the Spanish supply of sunflowerseed. Gross margins in the production of any given crop, are defined as the gross revenue per hectare less variable costs per hectare.

Since this study is only concerned with the development of short to medium term predictions, fixed costs are not considered. Thus, due to the relatively static nature of the analysis, the study does not take into account the effects that costs such as depreciation on fixed capital, interest on fixed capital, repairs on fixed assets and property taxes, could have on the area planted with sunflowerseed in Spain.

Moreover, this dissertation incorporates expected gross margins in the production of sunflowerseed and of its alternative crops, as independent variables influencing the evolution of the area planted with sunflowerseed in Spain. The use of gross margin type variables has two main theoretical advantages. First, gross margins present concentrated information from several variables, and thereby conserve on degrees of freedom; second, its use reduces problems of intercorrelation among different independent variables (Ferris, 1995).

The utilization of gross margins is very common in the literature, and usually leads to improved results. A good example of the use of gross margins can be found on the econometric study that Ferris et al (1971) conducted for several agricultural sectors in the United Kingdom, Ireland, Denmark and Norway.

Previous to the analysis presented in this dissertation, the gross margin approach had never been used in the analysis of the sunflowerseed sector in Spain. Apart from the theoretical considerations already outlined, the main rationale to use gross margins for the analysis of the Spanish sunflowerseed supply is based on practical reasons.

Thus, before the reform of the CAP in the oilseeds sector, the evolution of the Spanish sunflowerseed area could be explained accurately with the use of sunflowerseed real prices alone. However, since the reform of the CAP, sunflowerseed prices have had only a marginal influence on the sunflowerseed acreage, due to the nominal decline in sunflowerseed prices and to the introduction of compensatory payments in the sector.

On the other hand, deficiency payments have been granted only since 1992; therefore, it is not possible to explain the historical evolution of the Spanish sunflowerseed area in relation to the levels of compensatory payments only, due to a degrees of freedom shortage. Finally, as will be shown later in this chapter, the reform of the CAP in the sunflowerseed sector has resulted in a significant decrease in variable costs per hectare in the production of rain fed and irrigated sunflowerseed.

Hence, the use of gross margins is especially advisable in the analysis of the Spanish sunflowerseed supply: gross margins per hectare are perhaps the only analytical tool that permits to incorporate all the variables that have been influencing the Spanish sunflowerseed acreage during the 1970s, the 1980s and the 1990s.

A deficiency of farm level data exists in Spain. In fact, the main difficulty to utilize gross margins per hectare in the analysis of supply, is that there are no official publications providing time series data about representative costs per hectare in the production of sunflowerseed, or of any other crop. Thus, in order to be able to estimate gross margins series, this study uses data on variable costs of production that the author has gathered from different available case studies about costs in the production of sunflowerseed and of its alternatives.

These studies concentrate on the main sunflowerseed producing regions of Spain. This dissertation assumes that they can describe accurately the evolution of the Spanish sunflowerseed sector from 1964 - the year in which oil varieties of sunflowerseed were first introduced in

Spain- to 1995. However, the selected case studies do not cover all the years of the 1964-1995 period; therefore, this chapter also utilizes the case studies to extrapolate costs for these years for which no data is available.

Furthermore, most of the selected case studies, provide distinct data on costs for the rain fed and for the irrigated production of sunflowerseed. Accordingly, this chapter develops different gross margins series for the rain fed and for the irrigated sunflowerseed production. As a consequence, in Chapter IV, the rain fed and irrigated sunflowerseed acreages are treated separately; therefore, independent models are developed for the irrigated and rain fed supply of sunflowerseed.

In the case of rain fed production, there are few crops, in the main producer provinces, that could be identified as alternatives to planting sunflowerseed.

For example, in the provinces of Cádiz and Sevilla, only wheat and sugar beets could be regarded as alternatives to rain fed sunflowerseed production. In the province of Córdoba, wheat and, to a lower extent barley, are the alternatives to planting rain fed sunflowerseed. In the province of Cuenca, wheat and barley could be considered as the alternative crops to the production of rain fed sunflowerseed.

Since the variety of alternatives changes geographically, most of the key informants consulted estimated that wheat could be the only crop that could be considered as an alternative to sunflowerseed production at the national level. Therefore, in order to facilitate the analysis of the Spanish rain fed sunflowerseed supply, this chapter develops gross margins series for rain fed sunflowerseed and for rain fed wheat.

In relation to the irrigated production of sunflowerseed, there is a much wider range of alternative crops. A large number of products can compete with sunflowerseed for irrigated land. Irrigated wheat, irrigated corn, irrigated soybeans and rapeseed, cotton and even some extensive fresh vegetables such as carrots and potatoes, could be regarded as alternatives to planting irrigated sunflowerseed (de la Rosa, 1992).

Moreover, during the extreme drought of the 1992-1995 period, severe water restrictions to irrigated agricultural production have been in effect: thus, irrigated sunflowerseed production has been substituting even high water demanding crops such as rice.

Hence, it is very difficult to select just one or two crops as the alternatives to the irrigated production of sunflowerseed. Due to the large number of potential alternatives, the development of gross margins series for all of them would be beyond the scope of a dissertation. Moreover, the inclusion of so much information in the econometric modeling of the irrigated sunflowerseed acreage would produce severe multicollinearity problems and important degrees of freedom shortages.

Consequently, the approach adopted here consists of constructing gross margins series only for irrigated sunflowerseed and not for its potential alternatives. This method could also be justified due to the relatively small importance that the irrigated sunflowerseed acreage has in relation to the total sunflowerseed area.

Finally, it is worth noting that the present chapter focuses on the estimation of historical *actual gross margins* in the production of sunflowerseed and of its alternative crops, which are conceptually different from the different specifications about *expected gross margins* that are developed in Chapter IV of this dissertation.

In any case, the construction of historical actual variable costs of production, gross revenues and gross margins series, is strictly necessary in order to develop the expected gross margins models tested in the analysis of supply that takes place in Chapter IV.

I. <u>Sunflowerseed Rain Fed Production.</u>

The author made two one month trips to Spain to collect secondary data relevant to this study. A great deal of the effort was focused on locating possible case studies that could be used to develop variable costs of production series for the Spanish sunflowerseed sector. The richest sources of information that the author was able to find were concentrated on the production of rain fed sunflowerseed.

Fortunately, for the 1964-1975 period, a study on the costs of production of rain fed sunflowerseed was already available. This study was developed by Cañas (1977) and covered all the years of the mentioned interval. The study by Cañas provided total costs of production for Cádiz, Córdoba and Sevilla, the three main producer provinces of Andalusia, by far the most important sunflowerseed producer region of Spain. The costs presented in the Cañas' study vary little among the provinces. Nonetheless, this dissertation uses an average of the costs of production in the three provinces, weighted according to the relative importance of the area planted with sunflowerseed in each of the provinces.

As noted elsewhere, the present study focuses on the construction of *variable* costs of production series. However, the Cañas' study used techniques that measured only *total* costs in the production of sunflowerseed, without specifying what percentage of these costs could be considered as fixed costs and what percentage could be regarded as variable costs.

To solve this problem, this dissertation carries out an estimation of the proportion of fixed costs to total costs. This estimation was based on the information provided by Guerrero (1977), on a case study that presented detailed information on variable and fixed costs in the rain fed production of sunflowerseed in Andalusia. Thus, according to Guerrero, fixed costs accounted for 31% of total costs in 1976. The present study applies this same assumption to the data on total costs in the production of sunflowerseed that Cañas developed for the 1964-1975 period.

For the 1976-1995 interval, not a single study was available covering all the years of the period. However, Guerrero provided case studies for the years 1976, 1982, 1986 and 1990 in different editions of his book, *Cultivos Herbáceos Extensivos* (1977; 1983; 1987; 1991).

The case studies presented in Guerrero's book were carried out by the Agricultural Engineering School of the University of Córdoba, and were focused on the variable costs of producing sunflowerseed in the *Campiña de Córdoba*, an agricultural belt that most key informants have identified as fairly representative of the typical sunflowerseed producer zone in Spain. These case studies also contain some technical input-output relationships and economic information that can help to gain insight into the costs of producing sunflowerseed in Spain.

Although yields tend to vary among producer regions, most key informants consider that there is no reason to think about significant interregional differences in the costs of producing sunflowerseed. This is because sunflowerseed uses relatively few inputs, and because practically the same agricultural tasks are performed across regions.

Only small amounts of herbicide and insecticide are used in the production of sunflowerseed. The crop is not fertilized under rain fed conditions, and consequently, differences in the costs of production do not arise from differences in soil quality. There is no reason either, to think about important differences in the costs of fuel and labor, among the different producer regions. Therefore, it seems reasonably safe to assume that the costs of producing sunflowerseed in the *Campiña de Córdoba* could provide a good representation of the costs of producing sunflowerseed at a national level.

Since the different case studies that Guerrero presents are focused on the same zone, and are carried out by the same source, they can be regarded as rather consistent over time. Therefore they can be used to make the necessary extrapolations for these years in which no data are available. Nonetheless, for the years 1989 and 1994, the data on costs of production for rain fed sunflowerseed are taken directly from other two available case studies. These case studies were developed independently by the Cámara Agraria de Sevilla (1990), and by the Cátedra de Fitotecnia II of the University of Córdoba (1994).

The study of the Cámara Agraria focuses on the province of Sevilla, while the study of the University of Córdoba focuses on the whole Andalusian region. This last study is especially important, since it is the only one available after the reform of the CAP mechanisms regulating the oilseeds sector was put into practice.

The information that these two case studies present seems to be compatible with the data provided in the case studies published by Guerrero. Moreover, most key informants consulted agree that the six selected case studies provide an acceptable representation of the variable costs of production on the typical Spanish farm producing sunflowerseed. Nonetheless, these case studies are not perfect, and they were slightly corrected when the author was able to detect any deficiencies or inconsistencies in the data that they presented.

The author also examined other case studies that were available in Spain. However, for different reasons, the information that they provide has not been included in this dissertation.

Nieto and Contreras (1980) constructed an index number series that reflected the total costs of production per hectare of rain fed sunflowerseed in Spain during the 1970-1979 interval. However, this dissertation uses, instead, the information presented in the Cañas (1977) study, first because the later study covers a more extended period, and second because the information that it presents is much more detailed and is not limited to the presentation of index numbers.

The Cámara Agraria de Sevilla (1978), also published a study on the total costs of producing sunflowerseed in the province of Sevilla. Nonetheless, there were some serious inconsistencies between the data presented in this study and the information that Guerrero provided in his 1976 and 1982 case studies. Most key informants recommended the study by Guerrero (1977; 1983) over the study of the Cámara Agraria de Sevilla. Besides, the study of the Cámara Agraria de Sevilla assumed that rain fed sunflowerseed production used fertilizer. However, almost all authors, and all farmers consulted, estimate that rain fed sunflowerseed is very rarely fertilized in Spain. This is because fertilization does not lead to significant improvements in yields.

Ballesteros (1980) made a study in which costs of production were estimated for La Mancha region, during the 1970s decade. This study provides a very good understanding of the evolution of the sector from 1964 to 1978. Nevertheless, the cost estimations that this study presents are excessively low if compared with other studies, and therefore, are not included in this dissertation.

De la Rosa (1992) realized an estimation of the costs of production of irrigated and rain fed sunflowerseed for 1992 in the province of Cádiz. Most key informants consulted about his article considered that it displayed an acceptable description of the agricultural tasks performed in sunflowerseed production after the reform of the CAP, but that the estimation of the costs of production is not very reliable.

Finally, Bazán (1994) described the cost of several agricultural tasks performed in the production of several rain fed crops in Southern Spain. However, his study was not specifically focused on sunflowerseed production. Consequently, this dissertation employed the results obtained by the University of Córdoba (1994) instead of Bazán's study.

The selected case studies describe the agricultural production practices performed in each of the available years. They are designed to represent an average size farm of around 100 hectares, which, in relation to the information reported in Chapter II, could be regarded as a good representation of the typical Spanish farm producing sunflowerseed.

These case studies dissagregate the data on costs of production, according to the different agricultural tasks that are necessary to produce sunflowerseed. For example, each of the case studies present the cost of plowing, applying herbicides, seeding, and so on. The selected case studies also provide some information about input utilization in these agricultural tasks.

The methodology applied in this chapter to make variable costs projections from the selected case studies, is as follows. The agricultural tasks, described in the different case studies, were classified according to nine possible categories: preparation of soil, herbicide, seed, seeding, soil disinfection, thinning, harvesting, cleaning, and transport and loading.

The interest on operating capital is also included in every case study, as a source of variable costs. For all the case studies, this interest is below the interest for a typical commercial loan. This is because in Spain farmers have many facilities to obtain subsidized credit. The Ministry of Agriculture provides subsidies to financial institutions for the reduction of interest rates, and there are several programs in which farmers can participate to obtain subsidized credit. The assumption that this dissertation adopts is that the interest on operating capital provided in each case study, holds until the year in which the next case study is available.

Production costs vary over time as input prices and quantities change. Since the production techniques also change over time, not every agricultural task is necessarily present in all the case studies utilized in this dissertation. The category labeled preparation of soil is the broadest one. It includes agricultural tasks in which a tractor and some other agricultural device is used: plowing, passing the disk harrow, passing the chisel plow, etc.

In the case of the tasks related to the following categories: preparation of soil, seeding, harvesting, cleaning, thinning of plants, and transport and loading, the case studies provide data on the utilization of fuel, tractor driver hours and part-time agricultural laborer hours. However, the full cost of these agricultural tasks cannot be fully explained according to these three inputs alone. This is because the cost of utilizing these inputs is usually below the total cost specified for each agricultural task in the different case studies.

For example, for 1976, Guerrero (1977) estimated that passing the disk harrow required the use of a 81 HP tractor during 1.1 hours. This entailed the utilization of 13.4 liters of gas-oil at seven pesetas per liter, and the hiring of a tractor driver during 1.1 hours, at 71.9 pesetas per hour. The cost resulting from the utilization of these inputs, is below the cost that Guerrero assigned to the task of passing the disk harrow, which was 473 pesetas per hectare ,for 1976.

Consequently, a fourth category, that could be defined as "other sources of cost", has been included in this study to account for the difference between the total costs assigned to each of the mentioned agricultural tasks, and the cost that results from giving a market value to the input utilization data.

Thus, the category defined as "other sources of cost" could include costs such as repairs, amortization of machinery, maintenance, lubricants, and hiring machinery when relevant[1]. Besides, most of these agricultural tasks require the utilization of a tractor and an additional agricultural device. For example, passing the disk harrow in 1976, demanded the use of an 81 HP wheel tractor and of a disk harrow. The different case studies selected described the fuel requirements derived from the use of the tractor alone, but not the extra fuel utilization that the use of an additional agricultural device, such as a disk harrow, requires. Then, the cost of the extra fuel utilized is to be included also under the category "other sources of cost".

In the process of cost extrapolation, this study assumes that the category labeled as "other sources of cost" changes with the general level of inflation. Moreover, to extrapolate costs for the years in which no case study is available, this dissertation assumes that the input utilization data[2], that each case study describes for the different agricultural tasks, remains constant until the year of the next available case study.

To determine the annual cost of input utilization, the amounts of each input utilized in each of the agricultural tasks is multiplied by the annual price of the input. The result is added to the extrapolated, "other

[1]For example, in the harvest of sunflowerseed, it is very common for farmers to hire the harvesters from agricultural co-operatives, or even from the crushing industry.

[2]For example, liters of gas-oil or hours of tractor driver consumed per hectare.

sources of cost" category, in order to calculate the costs of the different agricultural tasks for the years in which no case studies are available.

MAPA publishes each year the prices that farmers pay for gas-oil fuel, and the costs of hiring tractor drivers and part time laborers. Farmers do not usually hire tractor drivers (Ballesteros, 1980). This job tends to be performed by the farm owner himself. Nonetheless, the hours that a farmer works as a tractor driver have opportunity costs, since, in principle, farmers could earn a salary performing this same work at another farm. Consequently, all the selected case studies regard the utilization of tractor drivers hours as an economic cost. On the other hand, the utilization of part-time non-specialized agricultural laborers usually takes place through the agricultural labor markets.

Furthermore, the different case studies show that the amount of agricultural labor utilized remains fairly constant over the 1976-1990 interval. The quantity of fuel utilized in each agricultural task has also remained relatively constant during the 1976-1990 period. However, the reform of the CAP in the oilseeds sector has induced a lower degree of utilization of machinery and, consequently, lower fuel and labor requirements after 1991.

In relation to the remaining sources of cost, that is seed, herbicide, and soil disinfection, the total costs that the case studies provide can be fully explained in terms of the costs of the raw materials used. That is, the per hectare seed cost is the result of multiplying the price of the seed by the amount of seed applied, the cost of the herbicide is equal to multiplying its price by the quantity used per hectare, and the cost of soil disinfection results from multiplying the amount of insecticide applied by its price.

In general, the amounts of seed, herbicides and insecticides applied remain fairly constant among case studies. Hence, in the process of cost extrapolation, the dissertation usually assumes that the application of seed, herbicide and insecticide that each case study describes remains

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constant until the year of the next available case study. However, in a few cases, there are relatively abrupt changes in the application of some inputs among consecutive case studies. In those cases the dissertation assumes a linear transition of application rates among case studies[3].

The type of herbicide and insecticide used also tends to change over time. Therefore, to make extrapolations this study assumes that the type of insecticide or herbicide used remains the same, until there is a change described in subsequent case studies.

To extrapolate the costs of these inputs, the applied quantities are multiplied by the annual estimated or available price of these inputs. MAPA publishes every year the prices of certified sunflowerseeds and certified hybrid sunflowerseeds. However, there are no published time series with the prices of most of the herbicides and insecticides used in the different case studies. Nonetheless, MAPA also publishes every year a price index for phytopathologic treatments. This dissertation has used that price index in order to extrapolate the prices of herbicides and insecticides for those years in which there were not any available case studies.

The application of seed per hectare was very high in the early years of sunflowerseed production in Spain. However, since 1982, it declined significantly. This is because the case studies assume that this was the year in which the use of high precision planters started to be generalized in Spain. Consequently, for the 1976-1982 period this dissertation assumes a linear transition of the seed application rate.

Moreover, although the quantity of seed applied has decreased significantly after 1976, the price of the seed has also increased importantly since then. This is because, from 1982 onwards, all the case studies assume that farmers utilize certified hybrid seeds.

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[3]The only exceptions are the declines in inputs application rates that have resulted after CAP reform. In this case, the changes in input application rates do not arise from technological changes, but from a radical change in the agricultural policy system; therefore, it seems plausible to assume that farmers respond abruptly to the important policy changes that CAP reform has entailed, as, in fact, the consulted key informants have indicated.

From 1982 to 1991, the application of seed per hectare remained at relatively constant levels. However, the application of seed per hectare has declined significantly again since the reform of CAP mechanisms regulating the oilseeds sector. Thus, the switch to a scheme of direct payments per hectare seems to have induced a lower application of seed per hectare. In this case, an abrupt decrease in the seed application rate seems to reflect well the reality; hence the linear transition assumption is not applied.

De la Rosa (1992), estimated that, in 1992, farmers applied only 2.5 kilograms of hybrid seed per hectare. This dissertation assumes that this is the amount of seed that farmers producing rain fed sunflowerseed have been applying since 1992 onwards. Furthermore, the application of seed in quantities below this dosage is not permitted by the reglaments regulating the conditions that are necessary to be eligible to obtain direct deficiency payments for planting rain fed sunflowerseed.

In the 1976 case study, Guerrero (1977) assumes that four tasks related to the preparation of soil were performed: plowing, passing the heavy cultivator, passing the disk harrow and four passes of the chisel plow. The other agricultural tasks performed in 1976 were: application of seed, thinning of the plants, harvesting, cleaning, and finally loading and transporting the harvest. Herbicides and insecticides were not used in 1976.

This dissertation assumes that this technology holds until the year 1981. A detailed specification of the costs associated with the different tasks is presented in Table 3.1. According to Guerrero, in 1976, farmers utilized a low precision cereal planter in the seeding process. This implied a relatively high application of seed per hectare, and required the thinning of plants before harvest.

The costs associated to the year 1982 are also detailed in Table 3.1. The soil preparation tasks that Guerrero (1983) identified that were applied in that year were the following ones: plowing, passing the heavy cultivator, two passes of disk harrow, three passes of the chisel plow, and, finally, reclaiming the sunflower stems and passing a roller after harvest.

Herbicide was used in 1982, and from this year onwards the use of herbicide is present in all the case studies. However, insecticides were still not used in 1982. The herbicide that Guerrero assumes that farmers use in his 1982 and 1986 case studies is *Treflan*. Therefore, this dissertation assumes that farmers use Treflan until 1989 when the Cámara Agraria de Sevilla (1990) identified *Trifluoralina 48%* as the herbicide that farmers were using then.

The shift from Treflan to Trifluoralina 48% supposed a significant increase in the number of herbicide liters that are applied per hectare. This is because Trifluoralina 48% is a much less concentrated herbicide than Treflan. In any case, the change of herbicide did not imply abrupt changes in the costs of applying herbicide. The projected costs of herbicide experienced a smoothly increasing trend from 1986 to 1989. Hence, assuming a linear transition of herbicide application rates does not seem necessary in this case.

The remaining agricultural tasks performed in 1982 were: seeding, harvesting, and loading and transporting the harvest. As noted elsewhere, since 1982, farmers have used high precision planters especially adapted to sunflowerseed production. This implies the use of a much lower amount of seed. Therefore, the density of plants per hectare declines significantly in 1982 and, consequently, the task of thinning becomes unnecessary. The dissertation assumes that the technology described in this case study holds until 1985.

According to the 1986 case study by Guerrero (1987), farmers performed the following agricultural tasks related to the preparation of soil: plowing, use of a heavy cultivator, passing the disk harrow, three passes of the chisel plow and reclaiming the stems and passing the roller after harvest.

Other tasks that were performed in the 1986 study were: applying herbicide, seeding, harvesting, loading and transporting the harvest, and for the first time, applying insecticide. The dissertation assumes that this technology holds until 1988.

The insecticide that Guerrero (1987) assumes that farmers used in 1986 is *Lindano 4%*. Consequently, this dissertation assumes that farmers utilized Lindano 4% until 1990, when Guerrero (1991) detected that farmers used *Lindano 2%*. The University of Córdoba (1994) study, also assumes that farmers used Lindano 2% in 1994. Therefore, in the process of cost extrapolation, the dissertation considers that farmers utilize Lindano 2% from 1990 onwards.

If compared with the 1986 case study, in the 1989 case study there is a significant decrease in the amount of Lindano 4% applied. Hence, this dissertation adopts a linear transition in the application rates of Lindano 4% during the 1986-1989 period.

The weakest point of the 1986 case study is that it assumed that the price of fuel, used to compute the cost of the agricultural tasks in which gas-oil was utilized, was above the average price of gas-oil paid by farmers published in MAPA's *Anuario de Estadística Agraria* (MAPA, 1986). Consequently, in this dissertation, the costs of several agricultural tasks were recomputed using a lower gas-oil price. As a result, the cost of those agricultural tasks in which gas-oil is utilized, is slightly below the cost that the original case study by Guerrero (1987) provided. The revised version of the costs for 1986 used in this dissertation is available in Table 3.2.

The 1989 study from the Cámara Agraria de Sevilla (1990) is focused on the Sevilla province, and provides information on costs of production for different farm sizes. This dissertation utilizes the information given for an average size farm of 100 hectares, which most key informants identify as the most representative. According to this study, farmers performed the following tasks in the soil preparation process: plowing, heavy cultivator, disk harrow, two passes of the chisel plow and reclaiming stems and passing the roller.

Table 3.1. Gross Margins in Rain Fed Sunflowerseed Production, in 1976 and 1982.

Estimated Costs and Returns in the Campiña de Córdoba

	1976 Case Study			1982 Case Study		
	Quantity	Pts/Unit	Pts/Ha	Quant.	Pts/Unit	Pts/Ha
I. VARIABLE COSTS						
Preparation of Soil						
fuel (ltrs)	122.7	7	858.9	140.1	32.4	4,539.2
tractor (hrs)	9.9	71.9	715.4	11.8	181.4	2,140.5
labor (hrs)	-	-	-	1.5	200	300
other	-	-	2,319.5	-	-	6,643.3
Herbicides (ltrs)	-	-	-	1.5	1,008.6	1,513
Seed (kg)	12	38	456	6.5	350	2,275
Seeding						
fuel (ltrs)	12.6	7	88.2	14.9	32.4	483.6
tractor (hrs)	1	71.9	71.9	1	181.4	181.4
labor (hrs)	1	74.6	74.6	1	200	200
other	-	-	235.2	-	-	540.8
Thinning						
labor (hrs)	40	74.6	2,987	-	-	-
other	-	-	13	-	-	-
Harvesting	-	-	1,400	-	-	2,650
Cleaning	-	-	150	-	-	-
Transport and Loading						
driver (hrs)	.75	71.9	53.9	.75	181.4	136
labor (hrs)	.75	74.6	56	.75	200	150
other	-	-	290	-	-	673.8
Interest on Operating Capital	-	-	439.6	-	-	1,233.9
Total Variable Cost	-	-	10,209.6	-	-	23,669.9
II. GROSS REVENUE						
Seed (Kg)	590.8	20.32	12,004.2	676.2	38.63	26,121
Total Gross Revenue			12,004.2			26,121
III. GROSS MARGIN			+1,794.6			+2,451.1

SOURCE: Andrés Guerrero García.

The cost of passing the heavy cultivator was much lower than the one specified in the Guerrero (1987) study for 1986. There was no apparent reason for this decline, hence, the information provided by the 1989 study about the cost of passing the heavy cultivator was not considered in this dissertation. Instead, the costs provided by the 1986 study were extrapolated for 1989. Since the information in the Guerrero (1991) study for 1990 about the costs of using the heavy cultivator was also inconsistent with previous studies, this extrapolation was carried out also for 1990.

Other agricultural costs specified, in the 1989 study by the Cámara Agraria de Sevilla (1991), were the following ones: herbicide, seeding, soil disinfection, thinning, harvest, and transport and loading.

Due to an increasing trend in yields, the thinning of the sunflower plants becomes again necessary in 1989, in order to reduce the density of plants per hectare before the harvest process. The cost of the different agricultural tasks for 1989 are detailed in Table 3.2.

For the year 1990, the dissertation uses the Guerrero (1991) study on costs of production. Most of the key informants noticed that this study is the weakest of all the studies that Guerrero has presented. Nonetheless, some useful insights can be gained from it.

In any case, the 1990 Guerrero study is only used to extrapolate costs for 1991. For 1992 and 1993, the dissertation uses the University of Córdoba 1994 study, the only one that is available after the reform of the CAP.

Again, one of the main inconvenients of the 1990 study is that it computes costs using a price for gas-oil that is too high if compared with the data published by MAPA (MAPA, 1991). Therefore, this dissertation has slightly readjusted the costs for those agricultural tasks in which Guerrero (1991) provides data on fuel application.

According to Guerrero (1991), the following agricultural tasks were performed in the process of soil preparation in 1990: plowing, heavy cultivator, two passes of chisel plow, reclaiming stems and two passes of roller.

Other tasks are: herbicide, seed, seeding, soil disinfection, thinning, harvesting, and transport and loading. Terbutrex is the herbicide that Guerrero (1991) assumes that farmers used in 1990. This is the same herbicide used in the 1994 University of Córdoba (1994) study. Therefore, this dissertation assumes that farmers use Terbutrex from 1990 onwards.

The costs of passing the chisel plow, of transport, and of reclaiming the stems, provided in the 1990 study, were inconsistent with the previous study. Consequently, they were extrapolated from the 1989 study. Nonetheless, the extrapolation process only affected the category labeled "other sources of cost". This is because the 1990 case study provides distinct and consistent data on the application of gas-oil, tractor driver hours and part-time laborer hours, as well as on their prices. The revised final costs for 1990 can be found in Table 3.3.

The University of Córdoba (1994) study on cost of production is perhaps the most important of all the available case studies. This is because it is the only reliable study that is available after the reform of the CAP in the oilseeds sector. Nonetheless, the study is not perfect and presents some inconsistencies that are corrected in this dissertation.

As noted elsewhere, since the reform of the CAP, the gross revenues of sunflowerseed producers have depended only marginally on yields, and have been mainly determined by the direct compensatory payments per hectare that EAGGF grants. When possible, farmers have decreased their input application per hectare after CAP reform. However, EAGGF requires farmers to perform their traditional cultural practices, as well as the application of a minimum of 2.5 kilograms of certified hybrid seed per hectare, in order to be able to receive deficiency payments for producing rain fed sunflowerseed.

The author consulted with several farmers in Spain, and all of them confirmed that they were just applying the minimum amount of seed. The

Table 3.2. Gross Margins in Rain Fed Sunflowerseed Production, in 1986 and 1989.

Estimated Costs and Returns in the Campiña de Córdoba and in the Province of Sevilla

	1986 Case Study			1989 Case Study		
	Quantity	Pts/Unit	Pts/Ha	Quant.	Pts/Unit	Pts/Ha
I. <u>VARIABLE COSTS</u>						
Preparation of Soil						
fuel (ltrs)	141.9	38.5	5,463.1	128.8	34.4	4,430.7
tractor (hrs)	10.7	243.5	2,605.4	9.7	310.3	3,013.7
labor (hrs)	1.5	277.3	415.9	1.5	333	499.5
other	-	-	9,462.5	-	-	9,871.2
Herbicides (ltrs)	1.5	1,577.3	2,366	2.5	1,200	3,000
Seed (kg)	5	721	3,605	5.5	990	5,445
Seeding						
fuel (ltrs)	13.6	38.5	523.6	13.6	34.43	468.2
tractor (hrs)	1	243.5	243.5	1.1	310.3	341.4
labor (hrs)	1	277.3	277.3	1.1	333	366.3
other	-	-	978.5	-	-	1,229.2
Insecticides	7	258	1,806	4.5	282	1,269
Thinning						
labor (hrs)	-	-	-	12	333	3,996
other	-	-	-	-	-	-
Harvesting	-	-	5,000	-	-	5,500
Transport and Loading						
driver (hrs)	.75	243.5	182.6	.75	310.3	232.7
labor (hrs)	.75	277.3	208	.75	333	249.7
other	-	-	909.3	-	-	1,254.3
Interest on Operating Capital	-	-	2,042.9	-	-	2,470.1
Total Variable Cost	-	-	<u>36,092.6</u>	-	-	<u>43,638.5</u>
II. <u>GROSS REVENUE</u>						
Seed (Kg)	795.2	69.26	55,081	758.5	59.88	45,422
Total Gross Revenue			<u>55,081</u>			<u>45,422</u>
III. <u>GROSS MARGIN</u>			<u>+18,988.4</u>			<u>+1,783.5</u>

SOURCES: Andrés Guerrero García
Cámara Agraria de Sevilla.

amount of seed that the University of Córdoba assumes that farmers apply was four kilograms. Therefore, the cost derived from seed application that the University of Córdoba (1994) presents was readjusted downwards. Hence, this dissertation assumes that farmers apply only 2.5 kilograms of seed per hectare from 1992 onwards.

Apart from that, the University of Córdoba (1994) study seems to reflect well the lower degree of input application that all the consulted farmers estimated that has arisen from the reform of the CAP. Therefore, the dissertation assumes that the technology described in the 1994 study holds since 1992, the year in which the reform of the CAP was introduced.

The author has only detected three possible additional problems in the University of Córdoba (1994) study. First, the University of Córdoba assumes three passes of the chisel plow. However, most consulted farmers consider that two is more than enough. Besides, passing twice the chisel plow was the traditional practice before the reform of the CAP. Therefore, it does not seem very plausible to assume more passes of chisel plow, especially after a reform that has decreased the importance of yields as a form of generating gross revenues. Consequently, this dissertation assumes only two passes of the chisel plow.

The second problem is that the insecticide and herbicide prices that the University of Córdoba uses are significantly different from the prices that could be deducted from previous studies, and from the information on phytopathological prices that MAPA provides in its official statistical publications. Accordingly, the costs of herbicide and insecticide applications have been readjusted to reflect the information of MAPA. In relation to the use of herbicides, farmers have not been able to reduce appreciably the use of these inputs, even after the reform of the CAP.

Finally, the third problem present in the 1994 study is that the cost of plowing is too low if compared with the previous case study. Hence, it had to be extrapolated from the 1990 case study.

Thus, the revised University of Córdoba (1994) study assumes the following soil preparation tasks: plowing, passing heavy cultivator, and two passes of chisel plow. As it can seen, the decline in the number of tasks focused on the preparation of soil is significant with respect to previous studies.

Other tasks performed are: herbicide, seeding, soil disinfection, harvesting, and transport and loading. Due to the low application of seeds per hectare, thinning is no longer necessary. The cost of these tasks is detailed in Table 3.3.

As was pointed out in Chapter II, the reform of the CAP requires the fulfillment of set-aside requirements by those oilseeds producers who are willing to participate in the compensatory payments program. Since the reform was introduced, farmers have mostly adopted the rotational set-aside scheme (ABC, 1994). As noted, during the 1992-1994 period, this rotational set-aside was set at 15% of the total arable land owned by each farmer.

Accordingly, this dissertation has adjusted the per hectare variable costs provided in the 1994 University of Córdoba study, and the costs projected from this study for the years 1992 and 1993. This adjustment is performed to reflect the fact that 15% of the land cannot be cultivated with any crop, and consists of multiplying the original variable costs per hectare by 0.85. For 1995, the original variable costs per hectare were multiplied by 0.88.

The final series on variable costs, gross revenues and gross margins per hectare, for the rain fed production of sunflowerseed is presented in Table 3.4. This table combines the information on costs of production provided by Cañas for the period 1964-1975, by Guerrero for the years 1976, 1982, 1986 and 1990, by the Cámara Agraria de Sevilla for the year 1989, and by the University of Córdoba for the year 1994, as well as the extrapolations made by the author for the years 1977-1981, 1983-85, 1987, 1988, and 1991-1993.

The variable costs of producing rain fed sunflowerseed increase during all the years of the 1964-1975 period, and then decrease in 1976. They increase again from 1976 to 1981. However, in 1982 the cost of producing sunflowerseed obtained from the Guerrero (1983) case study, is lower than the cost extrapolated for 1981 from the 1976 Guerrero (1977) case study. Finally, the variable costs continue to rise from 1982 to 1991 and do not experience a decrease until 1992, the year in which the reform of the CAP for the oilseeds sector was put into practice.

The decrease in 1976, can be explained by the switch from the information provided by Cañas to the 1976 Guerrero case study; the decline in 1982, by the switch from the costs projected from the 1976 Guerrero case study to the cost provided in the 1982 Guerrero case study. The theoretical explanation for these decreases could be that sunflowerseed producers have adopted, over time, more efficient technologies. Sunflowerseed is a relatively young crop in Spain. It was not introduced until 1964; hence, it seems relatively safe to assume that the Spanish farmers were not able to identify the least costly production techniques from the first moment in which the crop was introduced.

As a matter of fact, the agricultural tasks described in the different case studies have changed significantly over time, especially during the first years of the implantation of sunflowerseed in Spain. This does not occur for crops with more tradition in the Spanish agriculture. For example, the agricultural tasks described in the next section for rain fed wheat production are essentially the same in all the selected case studies[4]. This suggests that agricultural technology has been more stable during the recent decades for a traditional crop, such as wheat, than for a relatively new crop, such as sunflowerseed.

The decrease in rain fed sunflowerseed variable costs experienced in 1992 is not likely to be caused by technological change; instead, it seems much more plausible to explain it in terms of the reform of the CAP mechanisms regulating the EU oilseeds sector.

The reform has induced lower degrees of input application and, accordingly, lower costs per hectare in the production of both rain fed

[4]The case studies selected to construct variable cost series for rain fed wheat production cover years 1976, 1982, 1986 and 1990.

Table 3.3. Gross Margins in Rain Fed Sunflowerseed Production, in 1990 and 1994.

Estimated Costs and Returns in the Campiña de Córdoba and in the Andalusian Region

	1990 Case Study			1994 Case Study		
	Quantity	Pts/Unit	Pts/Ha	Quant.	Pts/Unit	Pts/Ha
I. VARIABLE COSTS						
Preparation of Soil						
fuel (ltrs)	113	38.9	4,395.7	105	56	5,880
tractor (hrs)	9	344	3,096	7.1	444.6	3,156.9
labor (hrs)	1.5	375.6	563.4	0	-	-
other	-	-	10,076.6	-	-	9,749.3
Herbicides (ltrs)	2.5	1,400	3,500	2.5	1,695.5	4,148.9
Seed (kg)	5.5	1,000	5,500	2.5	1,161	2,902.5
Seeding						
fuel (ltrs)	12.1	38.9	470.8	12.1	56	677.7
tractor (hrs)	1.1	344	378.4	1.1	444.6	489.1
labor (hrs)	1.1	375.6	413.2	1.1	527.5	580.2
other	-	-	1,194.4	-	-	703.9
Insecticides	15	101	1,515	8	119.72	957.7
Thinning						
labor (hrs)	12	375.6	4,507.5	-	-	-
other	-	-	76.5	-	-	-
Harvesting	-	-	5,900	-	-	5,824
Transport and Loading						
driver (hrs)	.75	344	258	.75	444.6	333.5
labor (hrs)	.75	375.6	281.7	.75	527.5	395.6
other	-	-	1,338.4	-	-	765.9
Interest on Operating Capital	-	-	2,607.9	-	-	1,828.3
Total Variable Cost	-	-	46,074.6	-	-	38,394.7
Adjusted Variable Cost (85% of TVC)	-	-	-	-	-	32,635.5
II. GROSS REVENUE						
Seed (Kg)	866.6	57.53	49,857.6	524	34.39	-
Total Gross Revenue			49,857.6			70,286.3
III. GROSS MARGIN			+3,783			+37,650.8

SOURCES: Andrés Guerrero García
Universidad de Córdoba. Cátedra de Fitotecnia II.

and irrigated sunflowerseed. This hypothesis seems to be confirmed also by the fact that, since 1992, sunflowerseed yields have decreased sharply. Besides, the assumption of multiplying the original variable costs by 0.85, for the 1992-1994 period, and by 0.88, for 1995, to reflect the existence of set-aside requirements, results in an even further decrease in costs for 1992.

The gross margins series are computed deducting variable costs per hectare from gross revenues per hectare. For the 1964-1991 period this dissertation assumes that the average gross revenue per hectare received by a rain fed sunflowerseed producer in Spain, is equal to the average price received by sunflowerseed farmers multiplied by the average yield for rain fed sunflowerseed in Spain.

Thus, for the 1964-1991 period, the actual gross margins in the production of rain fed sunflowerseed are computed as follows:

(3.1) $GMRFS = (SPR*RFSY) - RFSVC$

Where,

GMRFS = Gross margins in the production of rain fed sunflowerseed (pts/ha.)

SPR = Sunflowerseed prices received by farmers (pts/kg.)

RFSY = Rain fed sunflowerseed yield (kg/ha.)

RFSVC = Rain fed sunflowerseed variable costs (pts/ha.)

For the 1992-1995 period, the dissertation takes into account the reform of the CAP in the oilseeds sector and, therefore, the procedure to compute gross revenues changes significantly. Hence, the method utilized to compute the gross revenue per base hectare received by the average rain fed sunflowerseed producer, during the 1992-1995 period, distinguishes between the hectares that are planted with sunflowerseed and the hectares that are left idle in order to fulfill the set-aside requirements.

The gross revenue yielded by a hectare planted with rain fed sunflowerseed would be equal to the income obtained by selling the

Table 3.4. Variable Costs, Gross Revenues and Gross Margins in pesetas per hectare, in the Spanish Rain Fed Sunflowerseed Production (1964-1995).

Year	Variable Cost	Gross Revenues	Gross Margins
1964	4,293.32	8,020.03	3,726.71
1965	4,605.54	9,344.84	4,739.3
1966	4,777.97	8,553.04	3,775.07
1967	5,022.50	8,371.74	3,349.68
1968	5,324.74	8,071.61	2,746.86
1969	5,565.85	7,230.27	1,664.42
1970	6,427.37	10,883.79	4,456.42
1971	6,827.56	8,589.83	1,762.27
1972	7,389.01	8,690.16	1,301.15
1973	8,094.25	10,426.27	2,332.02
1974	10,092.31	10,734.62	642.3
1975	10,575.12	8,873.15	-1,701.97
1976	10,209.65	12,004.21	1,794.56
1977	12,671.13	17,013.01	4,341.88
1978	15,466.2	19,453.07	3,986.86
1979	18,486.14	20,165.59	1,679.45
1980	22,535.1	21,290.24	-1,244.86
1981	26,081.9	14,032.14	-12,049.8
1982	23,669.98	26,121.06	2,451.08
1983	26,711.82	26,303.47	-409.35
1984	30,231.9	39,794.09	9,562.19
1985	33,044.74	39,569.83	6,525.09
1986	36,092.68	55,080.98	18,988.3
1987	36,954.79	41,768.41	4,813.62
1988	38,233.77	68,941.23	30,707.46
1989	43,638.58	45,422.09	1,783.51
1990	46,074.54	49,857.61	3,783.07
1991	48,911.67	44,776.27	-4,135.4
1992	28,479.78	52,203.9 (42,899)	23,724.12
1993	29,879.3	58,405.9 (48,367)	28,526.6
1994	32,635.5	70,286.3 (54,969)	37,650.8
1995	36,014.6	79,043.2 (68,026)	43,028.6

SOURCES: Andrés Guerrero García
Cámara Agraria de Sevilla
Universidad de Córdoba. Cátedra de Fitotecnia II
Author's estimates.

produced sunflowerseed[5], plus the compensatory payment that EAGGF grants to a typical hectare planted with rain fed sunflowerseed.

As was pointed out in Chapter II, the compensatory payment per harvested hectare that a sunflowerseed farmer could receive, varies among the different agricultural districts. For any farmer, this compensatory payment is computed by multiplying the average rain fed cereal yield obtained in the 1989-1991 period in the agricultural district on which his plot of land is located, by a payment reference amount that EAGGF establishes each year.

Therefore, sunflowerseed producers whose land is situated on an agricultural district that, on average, obtained high rain fed cereal yields during the 1989-1991 period, would receive a higher compensatory payment, in any given year, than farmers that produce in an agricultural district characterized by low average rain fed cereal yields during the same reference period.

This dissertation assumes that the average compensatory payment that the typical hectare planted with rain fed sunflowerseed receives is computed by multiplying the average rain fed wheat[6] yield obtained during the 1989-1991 period in the four principal sunflowerseed producer provinces -that is, in Sevilla, Córdoba, Cádiz and Cuenca- by the payment reference amount that EAGGF has established every year since 1992.

The penalizations in which rain fed sunflowerseed producers incurred during the 1992-1994 period (which are described in Chapter II) are also taken into account, and deducted from the original payment, in order to compute the final compensatory payment that the average hectare planted with rain fed sunflowerseed receives. Therefore, this chapter utilizes an estimation the *actual received final compensatory payment*, instead of an

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[5]Again, this income would be equal to the average price received by sunflowerseed farmers, multiplied by the average yield for rain fed sunflowerseed in Spain.

[6]Wheat is the most common rain fed cereal in the main sunflowerseed producer provinces of Spain.

estimation of the average *initially announced compensatory payment*, in the computation of the gross revenues and gross margins series.

As noted elsewhere, EAGGF also grants a compensatory payment for each hectare left idle in order to fulfill the land set-aside requirements. Therefore, the gross revenue received by each idle hectare would be equal to that compensatory payment.

The compensatory payments to idle land also depend on the cereal yields of each agricultural district during the 1989-1991 period, and are computed following a very similar methodology[7] than in the case of the deficiency payments for cultivated land.

Therefore, this dissertation uses the same procedure that has been described for the land cultivated with sunflowerseed, to calculate the average compensatory payment received by idle hectare by the typical Spanish rain fed sunflowerseed producer.

Thus, this dissertation assumes that the average compensatory payment received per rain fed idle hectare is determined by multiplying the average irrigated wheat yield obtained during the 1989-1991 period in the four principal sunflowerseed producer provinces by the payment reference amount that EAGGF establishes per idle hectare of arable crops.

Finally, this study assumes that the gross revenue that the typical rain fed sunflowerseed producer obtained per base hectare, during the 1992-1994 period, is equal to 85% of the average gross revenue obtained per cultivated rain fed sunflowerseed hectare, plus 15% of the average gross revenue received by a hectare left idle to fulfill the land set-aside requirements.

This last assumption is consistent with the previous presumption of taking into account only 85% of the variable costs during the 1992-1994 period.

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[7]As noted in Chapter II, the only differences are: a lower reference amount for idle land than for cultivated land, and the fact that the compensatory payments for idle land are not subject to penalizations.

Thus, for the 1992-1994 period, the actual gross margins in the production of rain fed sunflowerseed are computed using the following formula:

(3.2) GMRFS = 0.85*(SPR*RFSY) + 0.85*RCPRFS + 0.15*CPIRFL
- 0.85*RFSVC

Where,

RCPRFS = Received compensatory payment for rain fed sunflowerseed (pts/ha.)

CPIRFL = Compensatory payment for idle rain fed land (pts/ha.)

In 1995, the European Commission reduced the set-aside requirements to 12%. Consequently, for 1995 gross margins are computed as follows:

(3.3) GMRFS = 0.88*(SPR*RFSY) + 0.88*RCPRFS + 0.12*CPIRFL
- 0.88*RFSVC

As it can be noted in Table 3.4, gross revenues and, consequently, gross margins, tend to fluctuate much more from year to year than variable costs per hectare. Moreover, due to the reform of the CAP in the oilseeds sector, the gross revenues received by the typical sunflowerseed farmer have increased since 1992. In Table 3.4, the portion of total gross revenues that, after 1992, is obtained by means of compensatory payments, is indicated in brackets.

Besides, gross revenues are more stable than before 1992. In the 1964-1991 period farmers were facing more uncertainty because their gross revenues were very dependent on variable sunflowerseed yields. Since the reform of the CAP, they still face some uncertainty due to the possible penalizations to which they are exposed. Nonetheless, their gross revenues and their gross margins have been subjected to much less variability.

The reform of the CAP in the oilseeds sector has also resulted in an important decrease in input application and variable costs per hectare that, to some extent, could also explain the detected significant increase in the gross margins per hectare for rain fed sunflowerseed. This could help to explicate the explosive increase in the area planted with sunflowerseed that Spain has experienced during the 1992-1995 period.

II. Wheat rain fed production.

There are over 90 varieties of wheat in Spain, mostly developed to adapt to the different microclimates of Spain (Kelch, 1982). Most wheat is planted during the months of November and December, and is usually harvested in August.

As in the case of sunflowerseed, the agricultural policies of MAPA have influenced dramatically the Spanish supply of wheat. This study is specially concerned with the agricultural policies affecting the wheat sector over the 1964-1995 period.

During the 1964-1985 period, SENPA was operating a monopoly over the buying and selling of all the Spanish wheat. SENPA closely controlled all wheat sales and purchases, although did not always physically handle them. SENPA announced every year, around the months of October and November, the guaranteed fixed price for the different wheat qualities that would be harvested in the following year.

The entire crop was purchased at that guaranteed prices. Thus, due to MAPA's monopoly in the wheat market, the average prices that wheat producers received during this period were equal to the prices guaranteed by SENPA. These guaranteed prices were designed to sustain farmers' incomes and to encourage the domestic production of wheat. Therefore, they were well above the levels dictated by the world market.

In 1986, Spain adopted the EC legal framework for the wheat sector. The monopoly of SENPA in the wheat market was abolished. However, the policy of guaranteed wheat prices was maintained by means of the public intervention of EAGGF, through SENPA, in the market. Thus, since 1986, EAGGF has established every year an intervention price. Farmers can sell wheat to SENPA at that price if they face low market prices.

Hence, since Spain's accession to the EC, not all the wheat that producers commercialize is sold to SENPA (Junta de Andalucía, 1988). The intervention price that EAGGF fixes every year still has a very strong influence on the final prices received by wheat producers. However, the final price received is not necessarily equal to the price that SENPA guarantees. Thus, the wheat market price can be, during some periods, below the intervention price that EAGGF establishes, and during others, above it. As a result, wheat farmers are facing higher price uncertainty after Spain's accession to the EC.

From 1986 to 1988, intervention prices for wheat experienced a slightly increasing trend. However, in the 1989-1992 period, the policy of EAGGF was to establish a moderate decrease over the years in the cereal intervention prices. Thus, in 1989, EAGGF was paying 174.06 ECU for each ton of wheat sold in intervention, while in 1992, EAGGF paid only 163.55 ECU per ton of wheat. In any case, the final prices received by farmers tended to remain above the intervention levels during this period.

Since 1993 onwards, EAGGF has undertaken a much more radical reform of the regulatory mechanisms governing the cereal sector in the EU. This reform is, in many aspects, similar to the one that was put into practice in 1992 for the oilseeds sector. The main difference with the oilseeds reform is that public intervention in the cereal markets is still maintained. However, the intervention prices for all cereals have decreased substantially since 1993. Thus, in 1993 EAGGF only paid 117 ECU per metric ton of soft wheat. This intervention price was reduced to 108 ECU in 1994, and is supposed to be at 100 ECU from 1995 onwards.

Fortunately for Spanish farmers, the decrease of the intervention price in pesetas has not been so sharp. This is because of the strong devaluation that the peseta experienced during the 1993 monetary unrest. Thus, while the green ECU for the cereals sector was valued at 151.7 pesetas in 1992, the agricultural conversion rate of the ECU increased to 182.7 in 1993.

Therefore, even with a sharp decrease in the intervention prices paid in ECU, the intervention price for Spanish wheat paid in pesetas only decreased from 24.8 to 21.3 pesetas per kilogram in 1993, and from 21.3 to

19.7 pesetas per kilogram in 1994. Moreover, due to relatively bad harvests and to an easiest access of the Spanish wheat to external markets during the 1992-1994 period, the actual prices received by farmers have remained at relatively constant levels: 26.8 pesetas per kilogram of soft wheat in 1992, 26.9 in 1993, and 26.14 en 1994 (MAPA, 1994).

In any case, in order to compensate farmers for the decrease in the cereal intervention prices, EAGGF has established a scheme of direct payments per hectare. The structure of this system of deficiency payments is very similar to the one established for oilseeds.

However, since price intervention is still maintained in the cereal markets, the level of payments per hectare was initially established at significantly lower levels for cereals than for oilseeds; although compensatory levels are growing at faster rates in the cereal sector than in the oilseeds sector. The compensatory payments are also determined on a regional basis, depending on the average cereal regional yields obtained over the 1989-1991 period.

As in the case of oilseeds, the final compensatory payment per harvested hectare, that any given wheat producer could receive each year, is determined by multiplying a payment *reference amount,* by the average yield for rain fed cereals obtained during the 1989-1991 period, in the *comarca* ,or district, in which his/her farm is located.

For rain fed cereals, and therefore for rain fed wheat, the reference amounts have been 25 and 35 ECU/MT during 1993 and 1994. For 1995, this reference amount was 45 ECU/MT.

Moreover, wheat farmers must also fulfill the same set-aside requirements as sunflowerseed farmers. In 1993 and 1994, wheat farmers could choose between a 15% rotational set-aside, and a 20% non-rotational set-aside. In 1995, EAGGF has required only the fulfillment of 12% rotational set-aside, or a 17% non-rotational set-aside. The compensatory payments that EAGGF grants for the land left idle in fulfillment of the land set-aside requirements, are exactly the same as for oilseeds.

Furthermore, rain fed wheat producers are globally subjected to the same limitations and penalizations, in terms of arable crops, that were described in Chapter II for rain fed sunflowerseed producers. As noted elsewhere, in Andalucía, the main sunflowerseed producer region, the area planted with arable crops has never exceeded, so far, the regional maximum guaranteed area. Therefore, rain fed wheat farmers in the most traditional sunflowerseed producer provinces have never been penalized.

As in the case of sunflowerseed production, there is not any official publication providing time series data about costs per hectare in the production of rain fed wheat. Therefore, the data on variable costs of production for rain fed wheat supply must be extrapolated also from available case studies.

This dissertation is primarily focused on the study of the Spanish sunflowerseed sector. Due to budgetary and time constraints, most of the author's time and effort during his two trips to Spain had to be concentrated on locating possible case studies that could be used to develop variable costs of production series for the Spanish sunflowerseed sector. Consequently, this dissertation has been able to identify more case studies on the production of rain fed and irrigated sunflowerseed than on the production of rain fed wheat. Thus, this dissertation uses six different case studies in the analysis of rain fed sunflowerseed supply, and only four case studies in the analysis of the rain fed wheat supply.

The case studies that this dissertation utilizes to make extrapolations of the variable costs of producing rain fed wheat are also provided by Guerrero (1977; 1983; 1987; 1991) in the different editions of *Cultivos Herbáceos Extensivos*.

The use of these case studies has several advantages. First, they cover the same years as Guerrero's case studies on sunflowerseed, that is, 1976, 1982, 1986 and 1990. Second, both sets of case studies were focused on the *Campiña de Córdoba*, a typically representative sunflowerseed producer region in Spain. Finally, the wheat case studies are also designed to represent an average size farm of around 100 hectares.

The main handicap in the development of gross margins series for rain fed wheat in Spain comes from the fact that there is no available case study after 1993, the year in which the reform of the CAP affecting cereals and other arable crops was implemented.

Nonetheless, the author consulted several farmers in Southern Spain, and they confirmed that production practices have not experienced significant changes after the reform of the CAP, as it has been the case with sunflowerseed. Perhaps this could be explained because, thanks to the peseta devaluation and to the other factors already mentioned, the average wheat prices received by farmers in Spain have remained at relatively constant levels.

Besides, the gross revenues of rain fed wheat producers still depend strongly on yields. Thus, in 1993 in the Andalusian region, around 81% of the gross income earned by rain fed wheat producers was generated by selling wheat, and only around 19% of that income was granted by EAGGF by means of direct deficiency payments (Campo Andaluz, 1994).

Therefore, it seems reasonably safe to extrapolate costs for the 1993-1995 period, from the 1990 Guerrero case study on the costs of producing rain fed wheat, as it is done in this dissertation.

The case studies on wheat also dissagregate the data on costs of production according to the different agricultural tasks that are necessary to produce rain fed wheat. The methodology utilized to make variable costs projections from the wheat case studies is essentially the same as the one used to make variable costs projections from the sunflowerseed case studies.

Unfortunately, the author was unable to locate any scientific study on the costs of producing rain fed wheat during the 1964-1975 period. Accordingly, for the 1964-1975 period the variable costs of producing rain fed wheat had to be extrapolated backwards from the 1976 Guerrero case study.

As noted elsewhere, agricultural practices are much more constant over time for wheat than for sunflowerseed. In fact, practically the same agricultural tasks are performed in the different case studies on rain fed wheat. This facilitates the process of cost extrapolation.

A significant methodological difference with the analysis of rain fed sunflowerseed variable costs comes from the fact that rain fed wheat is usually fertilized in Spain while rain fed sunflowerseed production is not. Therefore this section has extrapolated the costs of fertilizing sunflowerseed for these years in which no case studies were available. This was done utilizing the time series on the prices of different fertilizers that MAPA publishes every year.

The first case study utilized is the 1976 Guerrero case study (Guerrero, 1977). In this case study Guerrero assumed that the preparation of soil for the production of rain fed wheat was accomplished by passing the disk harrow three times. The preparation of soil is performed in exactly the same way in the remaining case studies (Guerrero 1983; 1987; 1991).

Other agricultural tasks that take place in the 1976 Guerrero case study are: base and top dressing fertilizing, seeding, application of herbicides and insecticides, cleaning, harvesting, and transporting and loading the harvest. The same agricultural tasks are also carried out in the other Guerrero case studies. Other sources of variable cost that are present in all the case studies are fire insurance and interest on operating capital. All these costs are described in detail in Table 3.5 and Table 3.6.

In his different case studies Guerrero reports the units of the fertilizing elements N_2, P_2O_5 and K_2O that are applied in rain fed wheat production. He assumes that N_2, P_2O_5 and K_2O are applied in 1976 and 1982, and that only N_2, P_2O_5 are utilized in 1986 and 1990. The application of the quantities of the different fertilizing elements also tends to vary among the different case studies.

Guerrero also provides an approximate price per unit for each of the fertilizing elements. However, MAPA does not publish price series on the unitary price of fertilizing elements; instead it publishes the actual

Table 3.5. Gross Margins in Rain Fed Wheat Production, in 1976 and 1982.

Estimated Costs and Returns in the Campiña de Córdoba

	1976 Case Study			1982 Case Study		
	Quantity	Pts/Unit	Pts/Ha	Quantity	Pts/Unit	Pts/Ha
I. VARIABLE COSTS						
Preparation of Soil						
fuel (ltrs)	40.2	7	281.4	82.2	32.4	2,668.2
tractor (hrs)	3.3	71.9	237.3	3.3	181.4	598.7
labor (hrs)	0	-	-	0	-	-
other	-	-	900.3	-	-	924.1
Fertilizer						
base: N_2 (kg)	260.9	11	2,872	86.9	32.2	2,803.6
P_2O_5 (kg)	222.2	10.9	2,428.9	177.7	23.41	4,161.6
K_2O (kg)	160	4.9	787.2	80	9.4	756
top dressing N_2 (kg)	130.4	11	1,436	260.9	32.2	8,410.4
Fertilizing						
fuel (ltrs)	19	7	133	20.4	32.4	663.5
tractor (hrs)	1.5	71.9	107.8	1.5	181.4	272.1
labor (hrs)	1.5	74.7	112	1.5	200	300
other	-	-	275.1	-	-	754.3
Herbicides	-	-	1,085.5	-	-	2,369.1
Seed (kg)	200	11.9	2,378	200	26.8	5,368
Seeding						
fuel (ltrs)	10	7	70.6	11.9	32.4	386.9
tractor (hrs)	.8	71.9	57.5	0.8	181.4	145.1
labor (hrs)	.8	74.7	59.7	0.8	200	160
other	-	-	170.1	-	-	406.9
Insecticides (ltrs)	2	220	440	2	465	930
Spraying	-	-	912.6	-	-	1,471.6
Harvesting	-	-	1,500	-	-	3,560
Cleaning	-	-	270	-	-	1,216
Transport and Loading	-	-	900	-	-	2,280
Fire insurance	-	-	263	-	-	957
Interest on Operating Capital	-	-	795.5	-	-	2,286
Total Variable Cost			18,473.8			43,849.4
II. GROSS REVENUE						
Seed (Kg)	1,985.8	10.38	20,612.6	2,429.6	20.27	49,248.4
Total Gross Revenue			20,612.6			49,248
III. GROSS MARGIN			+2,138.8			+5,398.6

SOURCE: Andrés Guerrero García.

price per kilogram of different commercial fertilizers. The author consulted with several farmers about the most commonly used fertilizers in the production of rain fed wheat, and arrived at the conclusion that it could be reasonably safe to assume that the N_2 requirements are accomplished with the utilization of *Urea 46%*; the P_2O_5 requirements with *Superfosfato Triple 45%*; and the K_2O requirements with *Cloruro Potásico 50%*.

It is possible to deduct a price per unit of fertilizing element from the prices per kilogram of the mentioned fertilizers. However, the prices per unit of fertilizing element deducted from the information provided by MAPA, are slightly different from the prices per unit of fertilizing element that Guerrero assumes in his different case studies. Consequently, the cost of using fertilizers that Guerrero calculated are readjusted in this dissertation to reflect the prices published by MAPA.

In the 1982 case study, the base N_2, P_2O_5 and K_2O requirements decrease if compared with the 1976 case study. On the other hand, the application of top dressing N_2 increases in relation to the 1976 case study. Therefore, this dissertation assumes a linear transition in the application rates of these fertilizers during the 1976-1982 period. Moreover, in the 1986 case study the application of base N_2, P_2O_5 and K_2O was lower relative to the 1982 case study. Hence, a linear transition in the application rates of these fertilizers is also assumed for the 1982-1986 period.

The application of insecticides and herbicides also has experienced some changes over the years. The 1976 case study assumes that the herbicides that wheat farmers use are *Sales Aminas* and *Suffix*; the 1982 and 1986 case studies assume the use of *MCPA* and *Iloxán*; finally the 1990 case study assumes the utilization of *Granstar* and *Puma*. The application of herbicides remains at relatively similar rates in all the case studies.

In relation to insecticides, the 1976, 1982 and 1986 studies describe the application of *Rogor*. However, the 1990 case study assumes the application of *Decis UVL*. The application rate of insecticides is also

Table 3.6. Gross Margins in Rain Fed Wheat Production, in 1986 and 1990.

Estimated Costs and Returns in the Campiña de Córdoba

	1986 Case Study			1990 Case Study		
	Quantity	Pts/Unit	Pts/Ha	Quantity	Pts/Unit	Pts/Ha
I. VARIABLE COSTS						
Preparation of Soil						
fuel (ltrs)	51.5	38.5	1,981.9	59.4	38.9	2,311.1
tractor (hrs)	3.3	243.5	803.5	3.3	344	1,135.2
labor (hrs)	0	-	-	0	-	-
other	-	-	3,117.6	-	-	4,144.8
Fertilizer						
base: N_2 (kg)	130.4	41.9	5,467.8	130.4	25.7	3,361.3
P_2O_5 (kg)	133.3	38.4	5,125.3	133.3	37.1	4,953.9
top dressing N_2 (kg)	260.9	41.9	10,935.6	260.9	25.7	6,722.6
Fertilizing						
fuel (ltrs)	20.4	38.5	785.4	11	38.9	428
tractor (hrs)	1.5	243.5	365.2	1	344	344
labor (hrs)	1.5	277.4	416	1	375.6	375.6
other	-	-	1,236.3	-	-	2,818.1
Herbicides	-	-	3,853.3	-	-	5,301.3
Seed (kg)	200	37.5	7,496	200	40	8,000
Seeding						
fuel (ltrs)	10	38.5	418.8	8.8	38.9	342.4
tractor (hrs)	.8	243.5	194.8	0.8	344	275.2
labor (hrs)	.8	277.4	221.9	0.8	375.6	300.5
other	-	-	791	-	-	768.9
Insecticides (ltrs)	2	806	1,612	2	840	1,680
Spraying	-	-	2,214.7	-	-	2,209.3
Harvesting	-	-	6,400	-	-	7,405
Cleaning	-	-	1,716	-	-	1,827
Transport and Loading	-	-	5,000	-	-	6,335.8
Fire insurance	-	-	1,198	-	-	957
Interest on Operating Capital	-	-	3,681.1	-	-	2,286
Total Variable Cost			65,032.6			66,067.9
II. GROSS REVENUE						
Seed (Kg)	2,379.5	28.61	68,077.8	2,599.7	25.72	66,856.6
Total Gross Revenue			68,077.8			66,856.6
III. GROSS MARGIN			+3,041.2			+797.7

SOURCE: Andrés Guerrero García.

almost constant in all the case studies. Moreover, all the case studies assume that wheat producers use certified habilitated wheat seeds.

This dissertation has applied some additional modifications to the costs of producing rain fed wheat that Guerrero describes in his case studies. As in the case of rain fed sunflowerseed, the fuel price was too high for 1986 and 1990, and the costs had to be readjusted to reflect the true cost of fuel for these years. Besides, for 1990, the cost of transporting and loading the harvest was too low if compared with the previous case study. Therefore, it had to be projected from the 1986 case study.

The final series on variable costs, gross revenues and gross margins per hectare for the rain fed production of wheat is presented in Table 3.7. This table combines the information on costs of production for rain fed wheat provided by Guerrero for the years 1976, 1982, 1986 and 1990, with the extrapolations made by the author for the years 1964-1975, 1977-1981, 1983-1985, 1987-1989 and 1991-1994.

The variable costs of producing rain fed wheat increased during all the years of the 1964-1987 period. In 1988, they decreased due to a decline in the prices of the fertilizers used in rain fed wheat production. These costs increased again from 1989 to 1992, and suffered a new reduction in 1993.

This last decrease was due to the fact that, for 1993 and 1994, this dissertation has readjusted downwards the projected variable costs of producing rain fed wheat multiplying them by 0.85. For 1995, only 88% of the variable costs were considered. As in the case of rain fed sunflowerseed, this readjustment was carried out to reflect the existence of rotational set-aside requirements.

The gross revenues and gross margins series for rain fed wheat are computed following essentially the same methodology as for rain fed sunflowerseed. Again, in Table 3.7, the portion of total rain fed wheat gross revenues that, after 1993, is obtained by means of compensatory payments, is indicated in brackets.

For the 1964-1992 period this dissertation assumes that the average gross revenue per hectare received by rain fed wheat producers in Spain is equal to the average price received by wheat farmers, multiplied by the average yield for rain fed wheat in the four main sunflowerseed producer provinces of Spain.

Thus, for the 1964-1992 period, the actual gross margins in the production of rain fed wheat are computed as follows:

(3.4) GMRFW = (WPR*RFWY) - RFWVC

Where,

GMRFW = Gross margins in the production of rain fed wheat (pts/ha.)

WPR = Wheat prices received by farmers (pts/kg.)

RFWY = Rain fed wheat yield (kg/ha.)

RFWVC = Rain fed wheat variable costs (pts/ha.)

From 1993 onwards, this dissertation assumes that the gross revenue yielded by a hectare planted with rain fed wheat would be equal to the income obtained by selling the produced wheat[8], plus the compensatory payment that EAGGF grants per hectare planted with rain fed cereals.

The procedure that this dissertation utilizes to determine the average compensatory payment received per hectare planted with rain fed wheat in the main sunflowerseed zones of Spain, is exactly the same as the procedure used in the previous section to determine the average compensatory payment received per hectare planted with rain fed sunflowerseed in Spain.

Hence, this dissertation assumes that the average compensatory payment received for a hectare planted with rain fed wheat is computed by multiplying the average rain fed wheat yield obtained during the 1989-1991 period in the four principal sunflowerseed producer provinces, by the payment reference amount that EAGGF has established for cereals every year

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[8]Again, this income would be equal to the average price received by wheat farmers, multiplied by the average yield for rain fed wheat in the four main sunflowerseed producer provinces of Spain.

Table 3.7. Variable Costs, Gross Revenues and Gross Margins in pesetas per hectare, in the Spanish Rain Fed Wheat Production (1964-1995).

Year	Variable Costs	Gross Revenues		Gross Margins
1964	8,061.39	6,476.15		-1,585.24
1965	8,433.84	8,984.6		550.75
1966	8,642.64	8,529.75		-112.89
1967	8,807.98	10,535.75		1,727.77
1968	8,982.79	13,148.75		4,165.95
1969	9,088.47	11,645.47		2,557
1970	9,315.23	10,837.25		1,522.02
1971	9,697.92	14,150.4		4,452.48
1972	10,051	12,874.4		2,823.4
1973	10,928.42	11,998.37		1,069.95
1974	13,793.37	14,844.53		1,051.16
1975	15,431.84	18,600.14		3,168.29
1976	18,473.85	20,612.6		2,138.75
1977	20,768.18	21,494.47		726.28
1978	24,068.23	26,520.9		2,452.67
1979	27,867.78	32,139.1		4,271.32
1980	32,901.87	46,431		13,529.13
1981	39,218.75	18,438.03		-20,780.7
1982	43,849.44	49,247.99		5,398.55
1983	48,788.38	30,252.2		-18,536.2
1984	54,223.89	80,056.8		25,832.91
1985	58,264.46	71,498.16		13,233.7
1986	65,032.6	68,077.78		3,041.18
1987	65,282.94	78,001.34		12,718.4
1988	63,565	74,970.69		11,405.68
1989	63,598.02	70,053.84		6,455.82
1990	66,067.92	66,865.57		797.65
1991	69,620.48	80,334.28		10,713.8
1992	70,893.64	72,094.63		5,809.18
1993	61,818.86	73,032.04	(13,959)	11,213.18
1994	66,285.45	71,645.1	(19,421)	5,359.65
1995	72,746.65	35,438.6	(23,297)	-37,308.05

SOURCES: Andrés Guerrero García
Author's estimates.

since 1993. Compensatory payments for rain fed wheat can also be subjected to the penalization set in terms of rain fed arable crops that were described in Chapter II; however, so far rain fed arable crops producers in the main sunflowerseed regions have not incurred in these penalizations.

As in the case of rain fed sunflowerseed, the final assumption is that the gross revenue that the typical wheat producer in the main sunflowerseed provinces, obtains per base hectare of rain fed wheat, for 1993 and 1994, is equal to 85% of the average gross revenue obtained per cultivated rain fed wheat hectare, plus 15% of the average gross revenue received by a hectare left idle to fulfill the land set-aside requirements.

As noted elsewhere, the payments per idle hectare are exactly the same for rain fed sunflowerseed and for rain fed wheat. Thus, for the 1993-1994 period the actual gross margins in the production of rain fed wheat are computed using the following formula:

(3.5) GMRFW = 0.85*(WPR*RFWY) + 0.85*RCPRFW + 0.15*CPIRFL - 0.85*RFWVC

Where,

RCPRFW = Received compensatory payment for rain fed wheat (pts/ha.)

Again, for 1995, the formula changes to:

(3.6) GMRFW = 0.88*(WPR*RFWY) + 0.88*RCPRFW + 0.12*CPIRFL - 0.88*RFWVC

For rain fed wheat, gross revenues and, consequently, gross margins also fluctuate more than the variable costs per hectare. Although there are less years with negative gross margins than in the case of rain fed sunflowerseed, the magnitude of the negative gross margins is usually higher for rain fed wheat than for rain fed sunflowerseed.

Furthermore, historically, it has been very difficult for farmers to determine, a priori, which of the two crops could be more profitable in any given year. In some years gross margins for rain fed wheat exceeded rain fed sunflowerseed gross margins while in other years, gross margins for rain fed sunflowerseed were higher than for rain fed wheat.

Nonetheless, since the reform of the CAP, gross margins in the production of rain fed sunflowerseed have been above gross margins in the production of rain fed wheat. Besides, since 1992, sunflowerseed gross margins have also been subjected to less variability than wheat gross margins. In any case, farmers could not limit themselves to plant only rain fed sunflowerseed due to both, the legal limitations over planting sunflowerseed specified in Chapter II and the potential destructive effects that monocultive practices could have over time on soil.

III. Sunflowerseed irrigated production.

The same case studies that were utilized for developing gross margins series for the rain fed production of sunflowerseed provide information on the variable costs of producing irrigated sunflowerseed (Guerrero, 1977; 1983; 1987; 1991; Cámara Agraria de Sevilla, 1990; University of Córdoba, 1994). This dissertation also employs most of these case studies for developing variable costs and gross margins series for irrigated sunflowerseed.

The only case study that is not employed for developing variable costs of production series for irrigated sunflowerseed is the 1989 Cámara Agraria de Sevilla study. This study is not utilized in the dissertation because it presents serious inconsistencies with the data provided for irrigated sunflowerseed production in the other case studies.

The selected case studies were also employed in the two previous sections and, although they can be regarded as fairly representative, they present exactly the same inconsistencies as the cases used in the study of rain fed sunflowerseed and rain fed wheat.

Accordingly, the inconsistencies that were present in the case studies for irrigated sunflowerseed were corrected in precisely the same way as the inconsistencies detected in the case studies for rain fed sunflowerseed and rain fed wheat. The methodology utilized to carry out the extrapolation of costs is also essentially the same as for rain fed sunflowerseed. Unfortunately, for irrigated sunflowerseed there were no studies covering the 1964-1975 period[9]. Hence, the variable costs for that period had to be extrapolated backwards from the Guerrero 1976 case study.

Some of the selected case studies provide distinct information about the costs of producing irrigated sunflowerseed as a first crop, and about the costs of producing irrigated sunflowerseed as a second crop after harvesting irrigated cereal. However, although MAPA's official publications present information about the proportion of the Spanish sunflowerseed acreage and production that is irrigated or rain fed, MAPA does not specify what proportion of the irrigated production and area represents a first crop and what proportion represents a second crop.

Therefore, the assumption that this dissertation adopts is that all the irrigated production of sunflowerseed takes place as a first crop. Most key informants consulted consider that this is a reasonably safe assumption, even if the production of irrigated sunflowerseed as a second crop also has importance in Spain. Besides the average yields for irrigated sunflowerseed in Spain, during the 1964-1995 period, have tended to be well above the levels that could be considered normal for irrigated sunflowerseed as a second crop.

The irrigated production of sunflowerseed usually takes place on smaller farms than the rain fed production of sunflowerseed. Consequently, the selected case studies are supposed to represent an irrigated sunflowerseed farm of an average size smaller than in the case of rain fed sunflowerseed production. Most of the authors consulted have identified that the most representative size for a farm producing irrigated sunflowerseed could be around 40 hectares.

The irrigated production of sunflowerseed is more costly than the rain fed production of sunflowerseed but also leads to higher yields. Contrary to rain fed sunflowerseed, irrigated sunflowerseed responds well

[9]The Cañas (1977) study focused exclusively on rain fed sunflowerseed production.

to fertilization. Hence, the application of fertilizer to irrigated sunflowerseed is a common practice in Spain.

As in the case of rain fed wheat, most of the consulted farmers agree with the fact that Urea 46%, Superfosfato Triple 45% and Cloruro Potásico 50% could be regarded as commonly used fertilizers in the production of Spanish irrigated sunflowerseed. Hence, the costs of fertilization for irrigated sunflowerseed are adjusted in exactly the same form that was utilized in the previous section for rain fed wheat.

Apart from the costs of fertilizing, an important source of variable costs in the production of irrigated sunflowerseed comes from the costs of irrigating water, and from the costs of irrigation preparation and maintenance. Besides, the irrigated production of sunflowerseed requires a more intensive preparation of soil than the rain fed production of sunflowerseed.

In the 1976 case study, Guerrero (1977) assumes that five tasks related to the preparation of soil category were performed: plowing, passing the heavy cultivator, two passes of the disk harrow, four passes of the chisel plow, and, finally, the preparation of soil for irrigation. This last task is the most labor intensive and also the most expensive one. Other agricultural tasks that were performed in 1976 were: the application of fertilizer, seeding, thinning, harvesting, cleaning and transport and loading.

Guerrero (1977) assumes that the crop was irrigated two times in 1976. Other two additional sources of costs, that are present also in the other case studies, are irrigation maintenance and the interest on operating capital. All the costs for 1976 are specified in Table 3.8.

The costs associated to the year 1982 are also detailed in Table 3.8. In this case, the soil preparation tasks were: plowing, passing the heavy cultivator, two passes of disk harrow, three passes of the chisel plow, preparing the land for irrigation, and finally reclaiming the sunflower stems and passing a roller after harvest.

As for rain fed production, the herbicide Treflan is used in this case study, as well as in the 1986 case study. The remaining agricultural tasks performed in 1982 were: seeding, fertilizing, irrigating three times, harvesting, and transport and loading. There is a decrease in the application of base N_2, P_2O_5 and K_2O and, consequently, the dissertation assumes a linear transition in the application rates of these fertilizers from 1976 to 1982.

The thinning of the plants was still necessary in 1982 for irrigated sunflowerseed. However, due to the utilization of high precision planters, the cost of thinning decreased in relation to 1976. For the same reason, in 1982 there was a decrease in the kilograms of seed applied per hectare. Thus, this study adopts a linear transition in the application rates of seed from 1976 to 1982.

According to the 1986 case study, farmers performed the following agricultural tasks related to the preparation of soil: plowing, heavy cultivator, passing the disk harrow, three passes of the chisel plow, preparation of soil for irrigation, and reclaiming stems and passing the roller after harvest. Other agricultural tasks that were performed in 1986 were: applying herbicide, seeding, fertilizing, thinning the plants, irrigating three times, harvesting, and loading and transporting the harvest. There was a significant decrease in the amount of seed planted per hectare and, consequently, the linear transition assumption is applied also to the seed application rates of the period 1982-1986.

The 1990 study is the last study available before the reform of the CAP in the oilseeds sector. Again, this dissertation utilizes it to extrapolate costs only for 1991. In 1990, the tasks performed in the process of soil preparation were: plowing, heavy cultivator, disk harrow, three passes of chisel plow, preparation for irrigation, and reclaiming stems and two passes of roller. Other tasks were: herbicide application, seeding, soil disinfection (for the first time), fertilizing, thinning, irrigating three times, harvesting, and transport and loading.

Table 3.8. Gross Margins in Irrigated Sunflowerseed Production, in 1976 and 1982.

Estimated Costs and Returns in the Campiña de Córdoba

	1976 Case Study			1982 Case Study		
	Quantity	Pts/Unit	Pts/Ha	Quant.	Pts/Unit	Pts/Ha
I. VARIABLE COSTS						
Preparation of Soil						
fuel (ltrs)	136.1	7	952.7	136.4	32.4	4,426.7
tractor (hrs)	11	71.9	794.5	11.5	181.4	2,095.3
labor (hrs)	24	74.7	1,792.8	9.5	200	1,900.6
other	-	-	2,627.6	-	-	6,627.4
Fertilizer						
base: N_2 (kg)	130.4	11	1,436	108.7	32.2	3,504
P_2O_5 (kg)	133.3	10.9	1,457.3	111.1	23.4	2,601.1
K_2O (kg)	120	4.9	590.4	100	9.4	945
Fertilizing						
fuel (ltrs)	9.5	7	66.5	10.2	32.4	331.7
tractor (hrs)	.7	71.9	53.9	.7	181.4	136.1
labor (hrs)	.7	74.7	56	.7	200	150
other	-	-	137.6	-	-	377.1
Herbicides (ltrs)	0	-	-	1.5	1,008.6	1,513
Seed (kg)	12	38	456	8	350	2,800
Seeding						
fuel (ltrs)	12.6	7	88.2	14.9	32.4	483.6
tractor (hrs)	1	71.9	71.9	1	181.4	181.4
labor (hrs)	1	74.7	74.7	1	200	200
other	-	-	235.2	-	-	540.9
Thinning						
labor (hrs)	64	74.7	4,779.2	12	200	2,400
other	-	-	20.8	-	-	127.2
Irrigation maintenance	-	-	2,000	-	-	5,797
Irrigating	-	-	2,950	-	-	12,264
Harvesting	-	-	1,500	-	-	2,800
Cleaning	-	-	150	-	-	-
Transport and Loading						
driver (hrs)	.75	71.9	53.9	.75	181.4	136
labor (hrs)	.75	74.6	56	.75	200	150
other	-	-	790.1	-	-	1,603.9
Interest on Operating Capital	-	-	1,043.6	-	-	2,975.1
Total Variable Cost	-	-	24,234.4	-	-	57,068.6
II. GROSS REVENUE						
Seed (Kg)	1,565.9	20.32	31,820.7	1,781	38.63	68,800
Total Gross Revenue			31,820.7			68,800
III. GROSS MARGIN			+7,586.3			+11,731.4

SOURCE: Andrés Guerrero García.

As for rain fed production, Guerrero (1991) assumes that the herbicide that farmers used in 1990 was Terbutrex, and that the insecticide that farmers utilized was Lindano 2%. Terbutrex is less concentrated than Treflan and, consequently, the application rate of herbicide increased in 1990. In any case, there is a smooth transition in the costs of herbicides from 1986 to 1990 and, therefore, there is no need for the assumption of a linear transition in the herbicide application rates. Moreover, Lindano 2% is the same insecticide that is used in the 1994 University of Córdoba study.

The University of Córdoba (1994) study is the only available study reflecting the changes in the utilization of inputs that have occurred in the irrigated production of sunflowerseed after the reform of the CAP in the oilseeds sector. It is used to extrapolate costs from 1992 onwards. This study confirms that, when possible, farmers have decreased their input application per hectare after the reform of the CAP.

The University of Córdoba (1994) study assumes that farmers perform the following soil preparation tasks: plowing, heavy cultivating, passing the chisel plow three times, and reclaiming stems and passing the roller only one time. Thus, the reform of the CAP has resulted in a lower application of machinery in the irrigated production of sunflowerseed. Other agricultural tasks are: fertilizing, seeding, application of herbicide, thinning, irrigating, harvesting, application of insecticide, and transport and loading.

The herbicide that farmers apply in this study is *Alacloro*, and, with respect to the Guerrero (1991) study, there is a decline in the herbicide application rates that can be also attributed to the effects of CAP reform.

In addition, the University of Córdoba (1994) shows that the application of fertilizer has also declined significantly after CAP reform. Top dressing fertilizer is applied instead of base fertilizer. Besides, P_2O_5 and K_2O are not applied any more, with N_2 as the only fertilizing element that farmers use after the reform of the CAP. As a

Table 3.9. Gross Margins in Irrigated Sunflowerseed Production, in 1986 and 1990.

Estimated Costs and Returns in the Campiña de Córdoba

	1986 Case Study			1990 Case Study		
	Quantity	Pts/Unit	Pts/Ha	Quant.	Pts/Unit	Pts/Ha
I. VARIABLE COSTS						
Preparation of Soil						
fuel (ltrs)	138.6	38.5	5,336.1	136.4	32.4	5,488
tractor (hrs)	10.4	243.5	2,544.6	11.5	181.4	3,732.4
labor (hrs)	9.5	277.4	2,635.1	9.5	200	3,568.4
other	-	-	9,461.2	-	-	12,249.2
Fertilizer						
base: N_2 (kg)	108.7	41.9	4,556.5	108.7	25.8	2,801
P_2O_5 (kg)	111.1	38.4	4,271.1	111.1	37.1	4,128.3
K_2O (kg)	100	15.4	1,536	100	16	1,600.2
Fertilizing						
fuel (ltrs)	10.2	38.5	392.7	5.5	38.9	214
tractor (hrs)	.7	243.5	182.6	.5	344	172
labor (hrs)	.7	277.4	208	.5	375.6	187.8
other	-	-	618.1	-	-	1,409
Herbicides (ltrs)	1.5	1,577.3	2,366	2.5	1,400	3,500
Seed (kg)	5	721	3,605	6.5	1,000	6,500
Seeding						
fuel (ltrs)	13.6	38.5	523.6	12.1	38.9	470.8
tractor (hrs)	1	243.5	243.5	1.1	344	378.4
labor (hrs)	1	277.4	277.4	1.1	375.6	413.2
other	-	_	978.5	-	-	1,194.4
Thinning						
labor (hrs)	12	277.4	3,328.5	12	375.6	4,507.5
other	-	-	187.5	-	-	76.5
Irrigation maintenance	-	-	6,338	-	-	14,472
Irrigating	-	-	15,201	-	-	19,500
Harvesting	-	-	5,000	-	-	5,900
Insecticides (ltrs)	-	-	-	15	101	1,515
Transport and Loading						
driver (hrs)	.7	243.5	182.6	.7	344	258
labor (hrs)	.7	277.4	208	.7	375.6	281.7
other	-	-	2,984.3	-	-	2,160.3
Interest on Operating Capital	-	-	4,389.9	-	-	5,800.7
Total Variable Cost	-	-	77,554.4	-	-	102,479
II. GROSS REVENUE						
Seed (Kg)	2,037	69.26	141,082.6	2,471	57.53	142,156.6
Total Gross Revenue			141,082.6			142,156.6
III. GROSS MARGIN			+63,528.2			+39,677.6

SOURCE: Andrés Guerrero García.

consequence of the switch from base to top dressing fertilizing, passing the disk harrow became unnecessary in 1994.

The author detected some inconsistences in the University of Córdoba (1994) study that have been corrected in this dissertation. For example, the University of Córdoba (1994) study assumes that farmers were only applying four kilograms of seed per hectare in 1994. However this was inconsistent with MAPA's regulations for irrigated sunflowerseed; therefore, this dissertation assumes that farmers applied 4.5 kilogram of seed per hectare, which is the minimum amount demanded to fulfill the requirements that are necessary to be eligible to receive compensatory payments.

Moreover, the cost of transport and loading presented by the University of Córdoba (1994) was inconsistent with the information provided in the previous case studies. Hence, this dissertation projects that cost from the 1990 case study.

In any case, perhaps the weakest point of the University of Córdoba (1994) study is that it did not take into account the costs of preparing the land for irrigation and of irrigation maintenance. These two tasks must be performed before the irrigation process and were omitted in the study. Therefore, this dissertation has also projected these two costs from the 1990 case study.

Furthermore, the 1994 case study assumes that irrigated sunflowerseed is irrigated three times. However, most farmers consulted by the author consider that, since 1992, irrigating the crop once or twice is the most common practice. Besides, the severe drought that affected Spain during the first half of the 1990s limited seriously the availability of irrigation water and forced a less intensive irrigation for most crops. Accordingly, this dissertation assumes that sunflowerseed is irrigated only twice.

The final series on variable costs, gross revenues and gross margins for the irrigated production of sunflowerseed is presented in Table 3.11. The table combines the information provided by Guerrero for the years

Table 3.10. Gross Margins in Irrigated Sunflowerseed Production, in 1994.

Estimated Costs and Returns in the Campiña de Córdoba

	1990 Case Study		
	Quantity	Pts/Unit	Pts/Ha
I. VARIABLE COSTS			
Preparation of Soil			
fuel (ltrs)	117.2	56	6,567.2
tractor (hrs)	10.1	444.6	4,490.9
labor (hrs)	9.5	527.5	5,011
other	-	-	8,959.9
Fertilizer			
top dressing: N_2 (kg)	163	26.9	4,389.6
Fertilizing			
fuel (ltrs)	5.5	56	308
tractor (hrs)	.5	444.6	222.3
labor (hrs)	.5	527.5	263.7
other	-	-	22.9
Herbicides (ltrs)	4	1,007	4,028
Seed (kg)	4.5	1,161	5,224.5
Seeding			
fuel (ltrs)	12.1	56	677.7
tractor (hrs)	1.1	444.6	489.1
labor (hrs)	1.1	527.5	580.2
other	-	-	703.9
Thinning	-	-	3,900
Irrigation maintenance	-	-	17,526
Irrigating	-	-	14,000
Harvesting	-	-	5,875
Insecticides (ltrs)	9	119.7	1,077.5
Transport and Loading			
driver (hrs)	.7	444.6	333.5
labor (hrs)	.7	527.5	395.6
other	-	-	2,616.2
Interest on Operating Capital	-	-	4,383.1
Total Variable Cost	-	-	92,045.77
Adjusted Variable Cost (85% of TVC)			78,238.9
II. GROSS REVENUE			
Seed (Kg)	1,379	35.38	
Total Gross Revenue			120,159.5
III. GROSS MARGIN			+41,920.6

SOURCE: Universidad de Córdoba. Cátedra de Fitotecnia II.

1976, 1982, 1986 and 1990, and by the University of Córdoba for the year 1994, with the extrapolations made by the author for the periods 1964-1975, 1977-1981, 1983-1985, 1987-1989 and 1991-1993.

The variable costs of producing irrigated sunflowerseed increase during all the years of the period 1964-1981; then they decrease slightly in 1982. As in the case of rain fed sunflowerseed, this decrease could be explained by means of the adoption of more efficient agricultural practices over time. The variable costs series continues to increase during the 1983-1991 period.

There was a very significant decrease in variable costs in 1992. This decrease was due to the lower rates of input utilization that have resulted after the reform of the CAP in the oilseeds sector. Furthermore, to reflect the existence of set-aside requirements, this dissertation takes into account only 85% of the variable costs for the 1992-1994 period, and 88% of the variable costs for 1995. This last assumption magnifies the decrease in the variable costs after 1992.

The gross revenues and gross margins series for irrigated sunflowerseed are computed following the same procedure as for rain fed sunflowerseed. In Table 3.11, the portion of total irrigated sunflowerseed gross revenues that, after 1992, is obtained by means of compensatory payments is indicated in brackets.

For the 1964-1991 period, this dissertation assumes that the average gross revenue per hectare received by irrigated sunflowerseed producers in Spain, is equal to the average price received by sunflowerseed farmers multiplied by the average yield for irrigated sunflowerseed in Spain.

Thus,

(3.7) GMIS = (SPR*ISY) - ISVC

Where,

GMIS = Gross margins in the production of irrigated sunflowerseed (pts/ha.)

SPR = Sunflowerseed prices received by farmers (pts/kg.)

ISY = Irrigated sunflowerseed yield (kg/ha.)

ISVC = Irrigated sunflowerseed variable costs (pts/ha.)

From 1992 onwards, this dissertation assumes that the gross revenue yielded by a hectare planted with irrigated sunflowerseed is equal to the income obtained by selling the produced sunflowerseed[10], plus the compensatory payment that EAGGF grants per hectare planted with irrigated sunflowerseed.

The method that this dissertation uses to compute the average compensatory payment received by the typical irrigated sunflowerseed producer in Spain is the same as the procedure utilized to determine the average compensatory payment received by a farmer producing rain fed sunflowerseed in Spain.

Although the production of irrigated sunflowerseed is more costly than the production of rain fed sunflowerseed, the reform of the CAP in the oilseeds sector also grants higher levels of compensatory payments to the area planted with irrigated sunflowerseed.

This dissertation assumes that the average compensatory payment received per hectare planted with irrigated sunflowerseed is computed by multiplying the average irrigated wheat yield obtained during the 1989-1991 period in the four principal sunflowerseed producer provinces, by the payment reference amount in pesetas that EAGGF has established per cultivated hectare of sunflowerseed every year since 1992.

The penalizations in which irrigated sunflowerseed producers incurred during the 1992-1994 period[11] are also taken into account and deducted from the original payment, to compute the final compensatory payment that the average hectare planted with irrigated sunflowerseed receives.

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[10]This income would again be equal to the average price received by sunflowerseed producers, multiplied by the average yield for irrigated sunflowerseed in Spain.

[11]These penalizations are described in Chapter II.

Table 3.11. Variable Costs, Gross Revenues and Gross Margins in pesetas per hectare, in the Spanish Irrigated Sunflowerseed Production (1964-1995).

Year	Variable Costs	Gross Revenues	Gross Margins
1964	7,324.74	14,973.17	7,648.42
1965	7,952.6	23,283.16	15,330.56
1966	8,486.79	16,327.81	7,841.02
1967	8,950.53	12,343.33	3,392.8
1968	9,346.45	9,084.44	-262
1969	9,716.44	12,038.15	2,321.71
1970	10,435.58	20,219.48	9,783.89
1971	11,213.65	29,806.31	18,592.66
1972	12,116.93	12,720.14	603.21
1973	13,626.13	20,455.65	6,829.52
1974	17,170.14	26,601.26	9,431.12
1975	19,641.1	27,125.57	7,484.47
1976	24,234.41	31,820.73	7,586.32
1977	29,444.1	43,330	13,885.9
1978	35,747.1	47,350.44	11,603.34
1979	43,190.36	44,939.1	1,748.74
1980	50,074.21	50,298.22	224.01
1981	57,961.5	62,914	4,952.5
1982	57,068.6	68,800.03	11,731.43
1983	63,517.16	99,219.33	35,702.17
1984	71,090.98	116,845.5	45,754.52
1985	77,138.46	97,446.5	20,308.04
1986	77,554.4	141,082.6	63,528.22
1987	80,103.5	106,915.9	26,812.4
1988	82,023.86	139,448.1	57,424.21
1989	86,753.05	132,574.3	45,821.27
1990	102,479	142,156.6	39,677.63
1991	109,043.7	140,732.5	31,688.82
1992	70,001.08	98,154.26 (69,468)	28,153.18
1993	73,185.92	104,344.9 (71,763)	31,159.02
1994	78,238.9	120,159.5 (79,849)	41,920.6
1995	86,048.95	150,235.9 (111,763)	64,920.6

SOURCES: **Andrés Guerrero García**
Universidad de Córdoba. Cátedra de Fitotecnia II
Author's estimates.

As in the case of rain fed sunflowerseed, the final assumption is that the gross revenue obtained by irrigated sunflowerseed producers per base hectare, during the 1992-1994 period, is equal to 85% of the average gross revenue obtained per cultivated irrigated sunflowerseed hectare, plus 15% of the average gross revenue received by an irrigated hectare left idle to fulfill the land set-aside requirements.

For any given farmer, the payments per idle irrigated hectare are determined by multiplying the payment reference amount per idle hectare that EAGGF establishes every year, by the average irrigated cereals yield obtained in his agricultural district during the 1989-1991 period.

The payment reference amounts, and hence the final compensatory payments, are significantly lower per idle hectare than per cultivated hectare of irrigated sunflowerseed. However, since irrigated yields are higher than rain fed yields, normally the payment reference amounts per idle hectare of irrigated arable crops are higher than per idle hectare of rain fed arable crops.

Again, this dissertation assumes that the average compensatory payment received per each irrigated hectare left idle, is determined by multiplying the average irrigated wheat yield obtained during the 1989-1991 period in the four principal sunflowerseed producer provinces, by the payment reference amount that EAGGF establishes per idle hectare of arable crops.

As for rain fed arable crops, the deficiency payments for irrigated idle land are not subjected to penalizations; therefore, in this case, the initially announced compensatory payments for idle land would be equal to the finally received compensatory payments for idle land.

Consequently,

(3.8) $GMIS = 0.85*(SPR*ISY) + 0.85*RCPIS + 0.15*CPIIL - 0.85*ISVC$

Where,

RCPIS = Received compensatory payment for irrigated sunflowerseed (pts/ha.)

CPIIL = Compensatory payment idle irrigated land (pts/ha.)

As for rain fed sunflowerseed, for 1995 gross margins are computed differently, due to the change it the set-aside requirements:

(3.9) GMIS = 0.88*(SPR*ISY) + 0.88*RCPIS + 0.12*CPIIL - 0.88*ISVC

The gross revenues and gross margins series reveal that, historically, irrigated sunflowerseed has tended to be more profitable than rain fed sunflowerseed. Irrigation results in higher yields and, consequently, in larger gross revenues and positive gross margins. Negative gross margins are very rare in irrigated sunflowerseed production. Besides, irrigation has also resulted in relatively stable yields and gross margins.

On the other hand, the reform of the CAP has not resulted in a very significant increase in irrigated sunflowerseed gross revenues and gross margins. Since 1992, due to the decrease in sunflowerseed prices, gross margins are much less dependent on yields, and are determined mainly by the deficiency payments granted by EAGGF.

CHAPTER IV

ECONOMETRIC ANALYSIS OF SUPPLY

Few studies have tried to model the supply of sunflowerseed in Spain. Most of them focused on the development of the sector in the 1970s, and were based in very simple models in which the total area planted with sunflowerseed is the dependent variable.

Cañas (1980) did not find a significant relationship between the sunflowerseed real price and the area planted with sunflowerseed in Spain during the 1970s. However, Cañas only developed fairly simplistic models regressing, under different model specifications, the annual acreage planted with sunflowerseed in Spain on the average deflated price received in the same year by sunflowerseed producers. The Cañas study was not very refined in terms of the formation of farmers expectations; it relied on simplistic assumptions about the degree of certainty that farmers had about prices.

A very similar study was developed by Nieto and Contreras (1980). Their analysis has the same weak points as the study developed by Cañas, and they also concluded that the dramatic growth in the area planted with sunflowerseed that Spain had experienced during the 1970s, could not be explained by the trend in sunflowerseed real prices.

Nieto and Contreras concluded that the main factor explaining the growth in the area planted with sunflowerseed, was the increase in the real wages of agricultural workers: higher agricultural wages were accompanied by a larger sunflowerseed acreage. This could be a plausible explanation, considering that sunflowerseed production is highly mechanized. However, this cause-effect relationship does not prove so appealing after taking into account that cereal production, the main alternative to sunflowerseed production, is also highly mechanized; and after considering that sunflowerseed production only took off in Spain once MAPA started to guarantee relatively high prices.

In this dissertation, the study of supply is carried out by means of an econometric analysis that simulates the evolution of the area planted with sunflowerseed in Spain, as well as the Spanish production of sunflowerseed, sunflowerseed oil and sunflowerseed meal. Thus, the present chapter carries out an analysis of supply with the use of econometric models that account from the stage of sunflowerseed agricultural production, to the industrial processing of sunflowerseed oil and sunflowerseed meal.

The study uses a partial equilibrium framework because the primary interest of the research is the Spanish sunflowerseed sector. Such an approach permits the inclusion of specific factors influencing the sunflowerseed supply. Consideration of the entire agricultural sector would reduce the precision of the analysis for the study of the sunflowerseed sector.

The most elaborate models are constructed at a strictly agricultural level, and are focused on the simulation of the evolution of the annual area planted with sunflowerseed. An innovation with respect to previous studies about the sector is that expected gross margins per hectare, in the production of sunflowerseed and alternative crops, are included as independent variables. Moreover, this chapter incorporates the *actual gross margins* and *actual variable costs* series that were constructed in Chapter III, into the different models assessing the formation of sunflowerseed producers' *expected gross margins*.

Furthermore, this dissertation generates distinct models for the rain fed and the irrigated agricultural supply of sunflowerseed. Thus, the separation of irrigated and dryland areas and yields allows greater insights into the analysis of supply.

The study develops less refined models for the production and distribution of sunflowerseed oil and sunflowerseed meal. The development of these models was limited by the lack of available secondary data sources on prices, costs and inputs applications, at those higher levels of the food chain.

One of the presumptions on which this dissertation is based is that the future evolution of the levels of compensatory payments, granted by the EU to sunflowerseed producers, can affect very significantly the Spanish sunflowerseed acreage and, consequently, the domestic production of sunflowerseed, sunflowerseed oil and sunflowerseed meal. Hence, the models developed in this chapter are intended to be able to quantify such effects.

Since, for the reasons specified in Chapter I, sunflowerseed prices and deficiency payments are taken as exogenously determined, then both the actual and the expected sunflowerseed gross margins can also be regarded as exogenous variables. Therefore, the analysis of supply constructed in the present chapter is unrelated to the analysis of demand that is developed in Chapter V.

I. Agricultural Supply of Sunflowerseed.

Two different sets of econometric models are developed in this section. The first set establishes the *rain fed* sunflowerseed area and yield as endogenous variables; the endogenous variables of the second set are the *irrigated* sunflowerseed area and yield.

The remaining variables used in this section are predetermined (lagged endogenous or exogenous). Finally, the production of rain fed and irrigated sunflowerseed is deduced by means of identities that relate rain fed and irrigated yields to rain fed and irrigated areas. Multiplying dryland and irrigated area by the appropriate yields and summing these products gives total production.

The estimation of the area and yield equations is carried out with the use of single equation techniques. If the disturbances in both equations were correlated joint estimation techniques would provide more efficient estimates (Greene, 1990). However, the different models that are developed here do not entail any theoretical correlation of disturbances among the area and yield equations and, consequently, each equation was estimated separately.

The supply of a commodity is influenced by numerous factors. In this section, real expected gross margins in the production of sunflowerseed, and in the production of its alternatives when relevant, are used as one of the possible predetermined variables influencing the area planted with sunflowerseed in Spain. Thus, the use of gross margins is a valid form to present concentrated information about different variables influencing the agricultural supply of sunflowerseed -such as prices, input prices, input application rates, variable costs, deficiency payments and gross revenues- and permits an efficient utilization of degrees of freedom.

As noted elsewhere, the utilization of real gross margins proves to be especially useful in this case; this is because it permits an analysis of how the sunflowerseed supply could be affected by the possible future evolution of the levels of the compensatory payments granted to farmers by the EU, without disregarding the historical data on the sector previous to the reform of the CAP. Thus, gross margins could be regarded as effective instruments of analysis to handle the transition in market regimes that the reform of the CAP in the oilseeds sector has entailed.

The main issue in this section is to introduce different models accounting for the formation of farmers' expectations about gross margins. In fact, two general alternative hypotheses are tested to explain the formation of farmers expectations about gross margins.

The first hypothesis is based on the presumption that farmers' expectations are formed rationally. The rational expectations hypothesis assumes that, when facing their planting decisions, sunflowerseed producers take into account all the relevant information available at the present moment.

In this case, it is assumed that farmers perceive the information that MAPA announces about prices (from 1964 to 1991) and about deficiency payments(from 1992 onwards) as an accurate basis to predict the final gross revenues and gross margins that they will receive in the production of sunflowerseed and of its alternatives. Consequently, it is presumed that they base their planting decisions on that information.

The second hypothesis supposes that farmers do not form their expectations according to the rational expectations presumption. Hence, under this hypothesis, sunflowerseed producers would not regard official prices and compensatory payments as reliable sources on which to develop their expectations about the gross margins that they will receive in the current period.

Accordingly, their expectations would be based only on the past evolution of real gross margins in the production of sunflowerseed, and of potential alternative crops. A number of different expectation mechanisms are used to specify this second hypothesis: naive, polynomial lags and double exponentially smoothed trends.

Finally, the relevancy of the different specifications is examined performing statistical tests on the estimated parameters and assessing the accuracy of the forecasts.

I.a. Rain Fed Supply.

I.a.1. *Rain Fed Area.*

This section analyses how the evolution of the rain fed sunflowerseed area could be related to potential independent variables. In principle, six variables were identified as factors that could be influencing, at least theoretically, the Spanish rain fed sunflowerseed harvested area: rain fed sunflowerseed harvested area lagged one year, real expected gross margins in the production of rain fed sunflowerseed, real expected gross margins in the production of rain fed wheat, a dummy variable for year 1975, a dummy variable for those years in which MAPA has imposed restrictions to the production of sunflowerseed[1], and, finally weather. The area harvested is used instead of the area planted, because MAPA does not publish any data on area planted.

[1] 1994 and 1995.

The inclusion of the lagged harvested area as an independent variable is supposed to capture the increasing trend that the production of sunflowerseed has had in Spain during the 1964-1995 period. This variable, should reflect the growing acceptance of the crop among Spanish producers, as well as the gradual adaptation of Spanish farmers to the production of sunflowerseed. Accordingly, the coefficient of this variable is expected to have a positive sign.

Theoretically, high expected real gross margins in the production of sunflowerseed should mean an incentive for the production of sunflowerseed; therefore, they should be positively correlated with the sunflowerseed rain fed area.

On the other hand, the expectations about real gross margins in the production of wheat, possibly the main alternative to sunflowerseed production at the national level, are supposed to be negatively correlated to the sunflowerseed area. Accordingly, a decrease in the gross margins obtained in rain fed wheat production should lead to an increase in the area planted to rain fed sunflowerseed.

A dummy variable was included for year 1975. This is because of the atypical increase in the area planted with rain fed sunflowerseed that occurred in that year. Such an increase cannot be explained in terms of prices or gross margins in the production of sunflowerseed or of alternative products. The existing agricultural reports do not mention either the specific causes of this unexpected rise, not even in terms of possible adverse effects of the climatology on alternative crops. Consequently, this study has considered the observation for 1975 as an outlier that probably could be explained by means of a failure in the statistical service of MAPA. The dummy variable for 1975 is expected to have a positive sign.

Beginning in 1994, MAPA imposed very severe restrictions on an individual basis for those farmers willing to plant sunflowerseed. These restrictions -which have already been described in Chapter II- were designed to avoid the large penalties which the Spanish sunflowerseed sector could incur if the total acreage planted with sunflowerseed surpassed the limits established by the EU.

These restrictions were in practice for 1994 and 1995, and proved very effective in reducing the area planted with rain fed sunflowerseed in Spain, even with an increase in the real value of the gross margins received by the Spanish rain fed sunflowerseed producers.

Thus, in the econometric modelling of the sunflowerseed rain fed area, a dummy variable has been included to distinguish between those years in which no limits were imposed, and those other years in which legal restrictions to the production of sunflowerseed were put into practice, that is 1994 and 1995. Such a variable is expected to have a negative sign.

Finally, due to the relatively high resistance of sunflowers to dry weather, some key informants suggested the introduction of weather as an independent variable that could be influencing the evolution of the sunflowerseed rain fed area. The variable that this dissertation used to capture the effects of weather, in any year t, was a weighted average of the rainfall, from October of year t-1 to February of year t, in the four main producer provinces of Spain. The presumption was that in low rainfall periods farmers would choose to plant sunflowerseed instead of cereal.

However, such a variable proved to be non significant in the different model specifications that were attempted in this study. Thus, although dry weather is known to have been an incentive for planting sunflowerseed during periods of severe droughts, apparently it does not prove to be a very significant factor explaining the evolution of the area planted with rain fed sunflowerseed over the medium to long term. Consequently, the econometric analysis of the evolution of the rain fed sunflowerseed area was reduced to the use of the first five independent variables described, plus a constant term.

The original sample size that this study intended to use included all the years of the 1964-1995 interval. As noted elsewhere, oil varieties of sunflowerseed were introduced for the first time in Spain in 1964.

However, the early years of the original sample did not prove to be very representative of the present evolution of rain fed sunflowerseed production in Spain.

It was not until the 1970s when the production of rain fed sunflowerseed began to be relatively generalized in Spain. In the 1964-1969 period, the area planted with sunflowerseed in Spain was still very small; besides, the real gross margins obtained were excessively high if compared with later years.

It could be deduced that during the 1960s, sunflowerseed production was a new and profitable enterprise that was undertaken only by a few innovative farmers. This picture is dramatically different from the situation that has prevailed during the 1970s, 1980s and 1990s: the production of rain fed sunflowerseed has been generalized but profitability rates have declined somehow. As a result, the estimation results improved significantly when the early observations where dropped from the sample. Accordingly, this dissertation limits the econometric analysis of supply to the 1970-1995 period.

Five different models are tested to assess the formation of farmers' expectations about real gross margins in the production of rain fed sunflowerseed, as well as of rain fed wheat as its main production alternative.

Model 1 and Model 2 are constructed under the rational expectations hypothesis. Consequently, in both models farmers form their expectations about gross margins at time t taking all the information that is available at the moment of the planting decision. More formally,

(4.1) $E_t(x_t) = E(x_t/\Omega_{t-1})$

where,

Ω_{t-1} = All relevant information available at time t-1.

The rational expectations defined in Model 1 are based mainly on practical considerations; on the other hand, Model 2 is based on a formal theoretical model. Both models presume that farmers have a high degree of certainty about the potential gross margins that could be obtained, in any year t, in the production of rain fed sunflowerseed and of rain fed wheat, when making their planting decisions for the year t.

That is, in any given year sunflowerseed producers, before reaching any planting decision, consider that, thanks to the available official information, they have a good degree of knowledge about what could be the real value of the rain fed sunflowerseed and rain fed wheat gross margins that they could receive in the current period.

Models 3, Model 4 and Model 5 are developed under the assumption that farmers have a high degree of uncertainty about what could be the levels of gross margins in the current period. Under such an assumption, farmers would base their expectations about current gross margins only on the information that they have about actual gross margins in the past.

There are a priori arguments to defend both the rational expectations and the uncertainty hypotheses. Hence, the assumption that producers have a high degree of certainty about current gross margins in the production of rain fed sunflowerseed and alternative crops, before facing their planting decisions -and accordingly form their expectations rationally- could be based on several facts.

First, up to 1991, there has been, initially, a minimum contractual price, and then, an intervention price that MAPA guaranteed to farmers. Thus, farmers had reasons to have a good degree of knowledge about the levels of the final sunflowerseed price that they could receive. A similar argument can be utilized for wheat prices.

Second, since 1992 sunflowerseed prices have fluctuated freely in the market but MAPA has announced well in advance the compensatory payments per hectare that farmers could receive, and these compensatory payments have been the main determinants of gross revenues after the reform of the CAP. In addition, although sunflowerseed prices are determined now by the international market, the oil industry publishes periodically reports and prospects regarding present and future short term price levels in the international market.

Third, although, historically, gross revenues, and hence gross margins, have depended significantly on highly variable yields, farmers could have had a good degree of knowledge about what the historical trend in yields was; therefore farmers could have formed plausible rational expectations about the average yields that they could obtain for different crops in any given period.

Finally, production costs are subjected to little variability from year to year and, therefore, should be easy to predict for any given year before planting sunflowerseed. Relatively similar arguments could be developed for rain fed wheat.

On the other hand there are also a priori reasons to defend the hypothesis of uncertainty about current gross margins, on which Models 3, 4 and 5 are based. First, yields, both in the production of sunflowerseed and of rain fed wheat, are subjected to uncertain variability from year to year and farmers are subjected to risk when taking their planting decisions. Second, it could even be plausible to assume that sunflowerseed prices have historically been subjected to an important degree of uncertainty in the typical producer's mind. This last assumption could be adopted, even taking into account that producer price formation has historically been an administrative process, due to the importance that price controls and intervention prices have had in this sector. As noted, up to 1985, excess capacity in the crushing industry kept the prices received by sunflowerseed farmers above the levels fixed by the government. In some years the difference between the final price received by farmers and the minimum contractual price was not very large, but in others was truly significant. In the 1986-1991 period, that tendency was reverted and the final sunflowerseed prices received by farmers tended to be below the intervention prices that the EC established. In relation to wheat market prices, they have tended to differ also from wheat intervention prices, during the 1986-1995 period.

Third, even if a researcher assumed that the minimum contractual or intervention prices were equal to the final sunflowerseed prices received by farmers, he would have to assume also that sunflowerseed producers knew the minimum contractual price with some anticipation to their planting decisions. In practice this would mean that, each year, farmers would have had to know the minimum contractual price for sunflowerseed before November, when they have to face the alternative of planting cereal, or waiting until March and planting sunflowerseed. Existing reports (MAPA 1975, 1976, 1979) show that there has been some exceptions to that norm.

Fourth, the switch to a free market system could have reinforced the price uncertainty hypothesis since 1992 for sunflowerseed prices.

Fifth, although it is possible to argue that there is less gross revenue and gross margin uncertainty after CAP reform -because producers incomes depend mainly on the compensatory payments that EAGGF grants-, these compensatory payments are also uncertain because they could be subjected to potential penalizations. Consequently, producers do not necessarily know the exact level of the compensatory payments that they are going to receive at the end of the year.

And sixth, although information about official prices and compensatory payments has generally been available to the public, this does not necessarily mean that most farmers are aware of that information and that use it when making their planting decisions. It could be plausible to assume that they give more importance to the historical evolution of past real gross margins.

Model 1 assumes that the expectations of farmers about gross margins in the production of rain fed sunflowerseed and rain fed wheat, in any given year t, are determined by subtracting the actual variable cost series, as constructed in Chapter III and valued at year t, from their expectations about current gross revenues for year t in the production of these two crops.

Such an approach supposes that farmers have an a priori knowledge of their production costs when making their planting decisions for year t. This could be a plausible assumption, especially taking into account that technology does not change abruptly from year to year, and that sunflowerseed producers could have a good degree of information about the prices of the inputs utilized in the different production processes before reaching their planting decisions; besides input prices are not likely to be subjected to sharp interanual variations either.

Obviously, the hypothesis of rational expectations about gross margins is also based on the assumption of farmers' rational expectations about gross revenues. To reflect this presumption Model 1 assumes that, for the 1970-1991 period, the expected gross revenues in the production of rain fed sunflowerseed are computed by multiplying a trend of past yields by the institutional price set by MAPA (which would be the minimum contractual price for the 1970-1985 period, and the intervention price for the 1986-1991 period). Consequently, the *expected gross revenues and gross margins* for rain fed sunflowerseed defined in Model 1 are different from the *actual gross revenues and gross margins* that were calculated in Chapter III.

The trend in past rain fed sunflowerseed yields is determined by means of the use of double exponential smoothing (Pindyck and Rubinfeld, 1991) on the actual yield series in the production of rain fed sunflowerseed for the 1964-1995 period. Double exponential smoothing (DES) takes into account all past sunflowerseed yields. However, more recent data is given a greater weight than the earlier data. This technique is utilized to assess farmers' perceptions about potential present yields, taking into account all the information available about past yields in any given period.

The double exponential smoothing technique can be regarded as a two step procedure. The first step consists of developing a single exponential smoothing process. The formula for single exponential smoothing is:

(4.2) $F_t = \alpha A_{t-1} + (1-\alpha)F_{t-1}$

Where F_t refers to the forecasted value for any given period, while A_t refers to the actual observed value for any period t. The term α, or damping parameter, is estimated by minimizing the sum of squared errors within the sample.

However, single exponential smoothing is only appropriate to generate forecasts for a series that moves randomly above and below a constant mean (Pindyck and Rubinfeld, 1991). In the second step, the single smoothed data are smoothed again:

(4.3) $F'_t = \alpha F_{t-1} + (1-\alpha)F'_{t-1}$

Where F'_t is the doubly smoothed forecast. Again, α is estimated by finding the value that minimizes the sum of squared errors within the sample. DES is more suitable for series that have a trend, as are the different yield series considered in this chapter.

The idea behind applying DES techniques to the series on rain fed sunflowerseed yields, is to get a relatively smooth yield trend that is not subjected to abrupt variabilities over time. However, in this case, the doubly exponentially smoothed yield series was still subjected to relatively abrupt variations for some years.

Consequently, different moving averages of the double exponentially smoothed yield series were constructed in an attempt to achieve a higher degree of smoothness. The main disadvantages of such an approach are the lost of degrees of freedom that it entails, as well as the differences that could arise among the original and predicted values. After examining different moving averages, this study selected a *three step moving average of the double exponentially smoothed series* as the most acceptable representation of a smoothed trend in past sunflowerseed yields.

The formula for the three step moving average of the doubly smoothed series is the following one:

(4.4) $F''_t = (F'_t + F'_{t-1} + F'_{t-2})/3$

Where F''_t refers to a three step moving average of the doubly smoothed series.

To sum up, for the 1970-1991 period, Model 1 assumes that the expected gross margins in the production of rain fed sunflowerseed in any given period t are computed as follows:

(4.5) $EGMRFS_t = (RFSYS_t{*}SIP_t) - RFSVC_t$

Where,

$EGMRFS_t$ = Expected gross margins in rain fed sunflowerseed production at period t (pts/ha.)

$RFSYS_t$ = Three step moving average of the double exponentially smoothed series of the actual yields in the production of rain fed sunflowerseed at period t (kg/ha.)

SIP_t = Institutional price for sunflowerseed at period t (pts/kg.)

$RFSVC_t$ = Variable costs in the production of rain fed sunflowerseed at period t (pts/ha.)

From 1992 onwards, the compensatory payments that EAGGF grants per hectare planted with rain fed sunflowerseed, and per hectare left idle to fulfill the set-aside requirements, are incorporated into the expected gross revenue computation.

The average announced compensatory payments are computed as described in Chapter III. However, in this case the penalizations which farmers have incurred since the reform of the CAP are not subtracted from the announced compensatory payment for rain fed sunflowerseed. This is because farmers do not know if they would be penalized at all after the end of the marketing year, almost a year after the planting process; and because the specification of the rational expectations hypothesis upon which Model 1 is based, assumes that farmers take the compensatory payments announced by MAPA as valid predictions of the compensatory payments that they will finally receive.

Gross revenues and variable costs are weighted according to the land retirement requirements that EAGGF has established since the introduction of the compensatory payment scheme. Consequently, for the 1992-1994 period Model 1 assumes that the expected gross margins in the production of rain fed sunflowerseed are computed as follows:

$$(4.6)\quad EGMRFS_t = 0.85*(RFSYS_t*SPR_t) + 0.85*ACPRFS_t + 0.15*CPIRFL_t - 0.85*RFSVC_t$$

Where,

$ACPRFS_t$ = Announced compensatory payment[2] for rain fed sunflowerseed (pts/ha.)

SPR_t = Sunflowerseed prices received by farmers (pts/kg.)

$CPIRFL_t$ = Compensatory payment[3] per idle rain fed land (pts/ha.)

As noted elsewhere, the reform of CAP entailed the abolition of institutional prices in the sunflowerseed sector. Therefore, Model 1 uses the actual market price at period t as the one that is perceived by farmers when making their planting decisions.

Such an approach assumes that, since 1992, farmers, when planting sunflowerseed, have a very good degree of certainty about what could be the market levels of the sunflowerseed price at harvest. This presumption could be regarded as plausible, especially taking into account that since the reform of the CAP in the oilseeds sector, Spanish sunflowerseed prices have fluctuated around world market levels, and that relatively reliable information about international prices is easily available to the different agents involved in the Spanish sunflowerseed sector. Besides sunflowerseed world market prices are not usually subjected to large fluctuations along the year.

In 1995, EAGGF has reduced the rotational set-aside requirements to 12%. Accordingly, the formula to compute expected gross margins in Model 1 is changed to:

$$(4.7)\ EGMRFS_t = 0.88*(RFSYS_t*SPR_t) + 0.88*(ACPRFS_t) + 0.12*CPIRFL_t - 0.88*RFSVC_t$$

[2]The average announced compensatory payment for rain fed sunflowerseed is computed by multiplying the average rain fed wheat yield series during the 1989-1991 period in the four principal sunflowerseed provinces, by the announced reference amount (in pesetas) for rain fed sunflowerseed; the *announced compensatory payment* would be different from the *final received compensatory payment*, in those years in which sunflowerseed producers are penalized.

[3]The compensatory payment for idle rain fed land is not subject to penalizations; hence, the average compensatory payment for idle land is computed exactly as described in Chapter III.

In the case of rain fed wheat gross margins, Model 1 assumes that, for the 1970-1992 period, the expected gross revenues in the production of rain fed wheat are constructed by multiplying a trend of past yields by the institutional price set by MAPA. Again, the current expected gross margins for rain fed wheat in Model 1 would be different from the actual gross margins that were computed in Chapter III. From 1970 to 1985, the institutional wheat price would be the guaranteed price prevailing before accession to the EC, while from 1986 to 1995 it would be the intervention price established by EAGGF.

For rain fed wheat, the trend in past rain fed wheat yields is also determined by means of the use of double exponential smoothing on the actual yield series in the production of wheat from 1964 to 1995. In this case, the application of DES to the series on rain fed wheat yields results in a fairly smooth and approximately linear trend.

Consequently, the study did not construct moving averages of the double exponentially smoothed rain fed wheat yield series, as it was done in the case of rain fed sunflowerseed.

Thus, for the 1964-1992 period, Model 1 assumes that the expected gross margins in the production of rain fed wheat in any given period t are computed as follows:

(4.8) $EGMRFW_t = (RFWYS_t * WIP_t) - RFWVC_t$

Where,

$EGMRFW_t$ = Expected gross margins in rain fed wheat production (pts/ha.)

$RFWYS_t$ = Double exponentially smoothed series of the actual yields in the production of rain fed wheat at period t (kg/ha.)

WIP_t = Institutional price for wheat (pts/kg.)

$RFWVC_t$ = Variable costs in the production of rain fed wheat at period t (pts/ha.)

From 1993 onwards, the compensatory payments that EAGGF grants per hectare are also incorporated into the computation of rain fed wheat gross revenues. Again, gross revenues and variable costs are weighted according to the land retirement requirements that EAGGF has established since the introduction of the compensatory payment scheme.

Consequently, for 1993 and 1994, Model 1 assumes that the expected gross margins in the production of rain fed wheat are computed as follows:

$$(4.9)\quad EGMRFW_t = 0.85*(RFWYS_t*WIP_t) + 0.85*(ACPRFW_t) + 0.15*CPIRFL_t - 0.85*RFWVC_t$$

Where,

$ACPRFW_t$ = Announced compensatory payment[4] for rain fed wheat (pts/ha.)

As noted elsewhere, the reform of CAP did not imply the abolition of institutional prices in the wheat sector. In fact, wheat intervention prices strongly influence the final wheat prices received by farmers, which, in Spain, are still above the levels prevailing in the international wheat market. Accordingly, for the 1993-1995 period, Model 1 still uses the institutional wheat price announced by EAGGF at period t as the one that is perceived by farmers when making their planting decisions.

Since in 1995 EAGGF reduced the rotational set-aside requirements to 12%, the formula to compute expected gross margins in Model 1, for that year, was changed to:

$$(4.10)\quad EGMRFW_t = 0.88*(RFWYS_t*WIP_t) + 0.88*(ACPRFW_t) + 0.12*CPIRFL_t - 0.88*RFWVC_t$$

Hence, the econometric specification of Model 1 is as follows:

$$(4.11)\quad SARF_t = a + b*SARF_{t-1} + c*DV75_t + d*DVR_t + e*EGMRFSD_t + f*EGMRFWD_t + \epsilon_t$$

Where,

SARF = Area planted with rain fed sunflowerseed (Has.)

[4]The average announced compensatory payment for rain fed wheat is computed by multiplying the average rain fed wheat yield series during the 1989-1991 period in the four principal sunflowerseed provinces, by the announced reference amount (in pesetas) for rain fed wheat; compensatory payments for wheat can be subject to the penalizations set in term of arable crops: therefore, the *announced compensatory payment* for rain fed wheat is conceptually different from the *final received compensatory payment* for rain fed wheat.

DV75 = Dummy variable for 1975

DVR = Dummy variable for years in which MAPA limits the production of rain fed sunflowerseed (1994 and 1995)

EGMRFSD = Expected gross margins in the rain fed production of sunflowerseed -as specified in 4.4, 4.5 and 4.6- expressed in real terms

EGMRFWD = Expected gross margins in the rain fed production of wheat -as specified in 4.7, 4.8 and 4.9- expressed in real terms.

ϵ = Disturbance term

The expected gross margins variables are expressed in real terms. Moreover, all real values in this model, and in later models, are expressed in 1983 pesetas by using the consumer price index (1983=1.00) to transform the expected gross margins series.

The information to estimate this model, as well as subsequent models, is taken from several sources. Annual data are used in the estimation process, covering the period 1970-1995 which includes 26 observations. The data are obtained from the Anuario de Estadística Agraria, the Boletín Mensual de Estadística Agraria, and the Avances Estadísticos published by MAPA, as well as from the variable costs series constructed in Chapter III of this dissertation.

Model 1, as well as the other models, includes the lagged sunflowerseed rain fed area as one of the independent variables explaining the evolution of the current rain fed sunflowerseed acreage. The presence of a lagged dependent variable on the right hand side implies that the equation can be estimated by ordinary least squares (OLS) only provided that the disturbance term ϵ_t is not autocorrelated (Greene, 1990). Otherwise, a problem of stochastic regressors would be present and the use of OLS would lead to inconsistent estimators. An additional condition for the consistent use of OLS is a relatively large sample frame that, apparently, is fulfilled in this case. The presence of serial correlation would require alternative estimation procedures because the random term and the lagged dependent variable would be correlated. One possible option would be maximum likelihood estimation (MLE). Another alternative is to use a residual adjusted estimation procedure (Hatanaka, 1974), in which the autocorrelation coefficient is estimated through the use of instrumental variables (IV) residuals.

An additional problem is that the potential presence of serial correlation along with a lagged dependent variable invalidates the "usual" tests for autocorrelation[5]. To solve for this problem, a testing procedure proposed by Godfrey (1978) is used to test for autocorrelation in the different models developed in this chapter. Such a test is asymptotically valid and, in the case of AR(1) autocorrelation, consists of regressing the current OLS residuals on the lagged OLS residuals and in all the other explanatory variables. The presence of AR(1) autocorrelated disturbances is then tested by doing a t-test on the significance of the coefficient of the lagged residuals. This is a Lagrange multiplier (LM) test, in which a significant coefficient for the lagged residuals implies that the disturbances follow an AR(1) process, and in which a non significant coefficient for the lagged residuals entails non autocorrelated disturbances. In the specific case of Model 1, the Godfrey (1978) test resulted in not autocorrelated disturbances even at the 10% significance level. Accordingly, an asymptotically valid OLS estimation procedure was carried out for Model 1.

Thus, the estimation results for Model 1 are the following ones:

$$(4.12)\quad SARF_t = \underset{(2.39^{**})}{290{,}887.5} + \underset{(4.81^{***})}{.683}*SARF_{t-1} + \underset{(2.58^{**})}{320{,}782.6}*DV75_t$$

$$- \underset{(-4.37^{***})}{495{,}812}*DVR_t + \underset{(2.96^{***})}{10.85}*EGMRFSD_t$$

$$- \underset{(-1.88^{*})}{17.47}*EGMRFWD_t$$

$$\bar{R}^2 = .849 \qquad d.f = 20$$

*= significant at 10% level **= significant at 5% level ***=significant at 1% level

[5]For example, the Durbin-Watson (DW) test.

In Model 1, as well as in the other models, the significance of the coefficients is asserted by means of two tailed t-tests. In these significance tests the null hypotheses tested is that the coefficients are equal to zero; the alternative hypothesis is that the coefficient are different from zero. The t-values are presented in parentheses.

One star implies significance at the 10% confidence level, two stars significance at the 5% confidence level, and three stars significance at the 1% confidence level. The lack of a star implies that the coefficient is not significant even at the 10% level.

In the case of Model 1, all the coefficients have the theoretically right sign and are significant at least at the 10% confidence level. In fact, even the constant term is significant in this case.

The "goodness of the fit" is measured with the use of the adjusted R^2; this permits making comparisons with alternative models that involve a different use of degrees of freedom.

Model 2 is based on a theoretical rational expectations model developed by McCallum (1976). In such a model, the actual ex-post observation at time t -which is in fact unobserved at the moment of reaching the planting decision- can be used as an approximation to the rational expectations predictor. Such a model requires an IV estimation procedure.

More formally, the true model is:

(4.13) $y_t = \alpha E(x_t/\Omega_{t-1}) + \beta z_t + \epsilon_t$

Where z_t is an exogenous variable.

Then, the following assumption about the rationally formed expectations is adopted:

(4.14) $x_t = E(x_t/\Omega_{t-1}) + \eta_t$

Where ϵ_t and η_t are assumed to be white noise. Thus, equation 4.13 can be redefined as:

(4.15) $y_t = \alpha x_t + \beta z_t + u_t$

Where,

(4.16) $u_t = \epsilon_t - \alpha\eta_t$

As a consequence u_t and x_t are correlated and the use of instrumental variables is needed in the estimation process. Consequently, Model 2 can be specified as:

(4.17) $SARF_t = a + b*SARF_{t-1} + c*DV75_t + d*DVR_t$

$+ e*GMRFSD_t + f*GMRFWD_t + \epsilon_t$

Where $GMRFSD_t$ and $GMRFWD_t$ are the actual rain fed sunflowerseed and rain fed wheat ex-post gross margins, as were constructed in Chapter III of this dissertation. The ex-post gross margins are not observable at the moment of taking the planting decision at t.

Assuming that the expectations are formed rationally as defined by McCallum (1976), then:

(4.18) $GMRFSD_t = EGMRFSD_t + \eta_t$

and,

(4.19) $GMRFWD_t = EGMRFWD_t + \gamma_t$

Where ϵ_t, η_t and γ_t are assumed to be white noise and

(4.20) $u_t = \epsilon_t - e*\eta_t - f*\gamma_t$

In this case two natural instruments in the IV estimation process would be the lagged gross margins in rain fed sunflowerseed and rain fed wheat. More specifically, the instruments that would form the instrument matrix in the IV estimation process are the following ones: the intercept, $SARF_{t-1}$, $DV75_t$, DVR_t, $GMRFSD_{t-1}$ and $GMRFWD_{t-1}$.

Thus, the IV estimation results for Model 2 are:

(4.21) $SARF_t = \underset{(.174)}{278,310} + \underset{(1.166)}{.904}*SARF_{t-1} - \underset{(-.121)}{421,190}*DV75_t$

$+ \underset{(.124)}{549,160}*DVR_t - \underset{(-.194)}{44.31}*GMRFSD_t$

$+ \underset{(.317)}{24.84}*GMRFWD_t$

$\bar{R}^2 = -.01623$

As can be noted, the estimation results of Model 2 are very poor in comparison to Model 1. In Model 2, none of the coefficients are significant and all have the theoretically wrong signs, except the lagged sunflowerseed rain fed area. In any case, the presence of a lagged dependent variable in the regression could invalidate the estimation results if u_t were serially correlated.

Thus, the Godfrey (1978) test was computed from the instrumental variable residuals. From the results of the Godfrey test it could be concluded that the disturbances were not autocorrelated even at the 10% significance level. Therefore, the IV estimation results that were presented above could be taken as valid.

In Model 3, 4 and 5 alternative theoretical designs are tested to account for the formation of farmers' expectations about gross margins under uncertainty.

These models are of standard use in marketing analysis, and were initially developed in contexts that tried to assess the influence of expected real prices over supply. Moreover, it is also possible to find studies on the Spanish agricultural sector that have applied such models to analyze the influence of real prices on agricultural supply (Caldentey and Titos, 1979; Albiac, 1991).

The innovation of the present study is that it utilizes these models to determine the influences of real gross margins, instead of real prices, on the area planted with rain fed sunflowerseed.

In this context, Model 3, Model 4 and Model 5 assume that farmers base their expectations about present gross margins on the information that they have on past actual gross margins; therefore, these models utilize the actual gross margins series that were constructed in Chapter III.

Model 3 is based on naive expectations about gross margins. Thus, Model 3 assumes that the producers' expected real gross margin at time t is the actual deflated gross margin at time t-1. In fact, this model is conceptually very similar to a cobweb model in which expectations about current prices are based on past prices (Tomek and Robinson, 1990).

Thus,

(4.22) $EGMRFS_t = GMRFS_{t-1}$

Where,

GMRFS = Actual gross margins in the rain fed production of sunflowerseed, as constructed in Chapter III (pts/ha.)

Consequently, in Model 3 the current area planted with rain fed sunflowerseed depends on lagged real gross margins in the production of rain fed sunflowerseed and rain fed wheat. The lag captures the assumption that farmers expect in the future the real gross margin prevailing in the current period.

Accordingly, the econometric specification of Model 3 is as follows:

$$(4.23)\quad SARF_t = a + b*SARF_{t-1} + c*DV75_t + d*DVR_t + e*GMRFSD_{t-1} + f*GMRFWD_{t-1} + \epsilon_t$$

Where,

GMRFSD = Actual gross margins in the rain fed production of sunflowerseed -as constructed in Chapter III- expressed in real terms (pts/ha).

GMRFWD = Actual gross margins in the rain fed production of wheat -as constructed in Chapter III- expressed in real terms (pts/ha).

The inclusion of the lagged rain fed area in the equation makes Model 3 conceptually very similar to a geometric lag model. The Godfrey (1978) test for AR(1) autocorrelation is also applied to Model 3. This test denoted a lack of autocorrelated disturbances even at a the 10% significance level. Accordingly, OLS can be applied consistently to estimate Model 3. Thus, for the 1970-1995 period the estimation results for Model 3 are:

$$(4.24)\quad SARF_t = \underset{(1.03)}{88,050} + \underset{(9.07***)}{.945}*SARF_{t-1} + \underset{(2.12**)}{291,380}*DV75_t - \underset{(-3.39***)}{428,060}*DVR_t + \underset{(1.23)}{4.20}*GMRFSD_{t-1} - \underset{(-1.79*)}{4.59}*GMRFWD_{t-1}$$

$\bar{R}^2 = .810 \qquad d.f = 20$

In the case of Model 3, that is the "naive model", all the coefficients have the theoretically correct signs. However, the a priori most relevant variable, that is the expected real gross margins in the production of rain fed sunflowerseed, is not significant even at the 10% confidence level.

Model 4, assumes that the expected real gross margins for any given period in the production of rain fed sunflowerseed and rain fed wheat are influenced by a trend including all past real gross margins, instead of just by the actual deflated gross margin in the previous period.

In this model, the trend in past rain fed sunflowerseed real gross margins for any given period, is determined by means of the use of DES on the actual series of deflated gross margins in the production of rain fed sunflowerseed for the 1964-1995 period; the expectations about gross margins in the production of rain fed wheat in any given period would be equal to the value resulting of applying double exponential smoothing to the actual real rain fed wheat gross margins for that same period.

Again, the concept behind applying DES techniques to the deflated gross margin series, is to get a relatively smooth real gross margins trend that is not subjected to abrupt variabilities over time. The assumption is that producers would regard the value of that trend in any given period as the potential real gross margin that could be obtained in the production of rain fed sunflowerseed or rain fed wheat for that period.

However, in the particular case of rain fed sunflowerseed, the doubly exponentially smoothed real gross margins series was still subjected to relatively abrupt variations for some years.

Accordingly, different moving averages, of the double exponentially smoothed real sunflowerseed gross margins series, were constructed in an attempt to achieve a higher degree of smoothness. After considering different moving averages, a *two step moving average of the double exponentially smoothed series* was selected as the most acceptable representation of a smoothed trend in past rain fed sunflowerseed real gross margins.

The formula for the two step moving average of the doubly smoothed sunflowerseed gross margin series is the following one:

(4.25) $F''_t = (F'_t + F'_{t-1})/2$

Where F''_t refers to the two step moving average of the doubly smoothed series and F' to the original DES series.

For rain fed wheat the application of DES to the series on real gross margins results in a fairly smooth and approximately linear trend. Therefore, it is not necessary to construct moving averages of the DES series, as it was done for rain fed sunflowerseed.

To sum up, Model 4 assumes that the real expected gross margins in the production of rain fed sunflowerseed in any given period t are as follows:

(4.26) $EGMRFSD_t = GMRFSD2SA2_t$

Where,

$GMRFSD2SA2_t$ = Two step moving average of the DES actual rain fed sunflowerseed deflated gross margins series (pts/ha.)

For rain fed wheat, Model 4 assumes that the real expected gross margins in any given period t are perceived by farmers according to the following expression:

(4.27) $EGMRFWD_t = GMRFWD2S_t$

Where,

$GMRFWD2S_t$ = Double exponentially smoothed actual rain fed wheat deflated gross margins series (pts/ha.)

That being so, the econometric specification of Model 3 is as follows:

$$(4.28)\ SARF_t = a + b*SARF_{t-1} + c*DV75_t + d*DVR_t + e*GMRFSD2SA2_t + f*GMRFWD2S_t + \epsilon_t$$

As in previous models, the sample frame in the estimation of Model 4 was limited to the 1970-1995 period.

The Godfrey (1978) test for autocorrelation lead to the conclusion that the null hypothesis of serial correlation could be rejected at the 10% significance level. The OLS estimates are, thus, retained.

The estimation results for Model 4 are the following ones:

$$(4.29)\quad SARF_t = \underset{(2.63^{**})}{498{,}930} + \underset{(5.56^{***})}{.752{*}SARF_{t-1}} + \underset{(2.77^{**})}{349{,}510{*}DV75_t}$$

$$- \underset{(-3.75^{***})}{439{,}510{*}DVR_t} + \underset{(.83)}{3.39{*}GMRFSD2SA2_t}$$

$$- \underset{(-2.72^{**})}{37.47{*}GMRFWD2S_t}$$

$$\bar{R}^2 = .841 \qquad d.f = 20$$

In Model 4, that is the "smoothed model", all the coefficients have the theoretically correct signs. However, just as in the case of Model 3, the coefficient for the expected real rain fed sunflowerseed gross margin is not significant, even at the 10% confidence level.

Model 5 is also based on the assumption of farmers' uncertainty about gross margins. In this case, the presumption is that producers form their expectations about gross margins according to a polynomial distributed lag (Almon, 1965).

This expectation formation mechanism is similar to the naive formulation, although in the polynomial distributed model weights are spreading over several periods.

The original formulation of the polynomial distributed lag was developed in a framework in which expectations about current values are formed as a function of weighted past and present values.

In particular, supply is specified according to the following mathematical expression:

$$(4.30)\quad y_t = \alpha + \beta_0 x_t + \beta_1 x_{t-1} + \ldots + \beta_m x_{t-m} + \epsilon_t$$

or,

$$(4.31)\quad y_t = \alpha + \Sigma_{i=0,m} \beta_i x_{t-i} + \epsilon_t$$

The polynomial lag model is based on the assumption that the true distribution of lag coefficients can be well approximated by a polynomial of fairly low order:

(4.32) $\beta_i = \omega_0 + \omega_1 i + \ldots + \omega_q i^q + \epsilon_i, \quad i=0\ldots q<m$

Usually the polynomial lag model is used to assess the formation of producers' expectations about real prices; however, in this particular case it is utilized to analyze the formation of farmers' expectations about real gross margins in the production of rain fed sunflowerseed and rain fed wheat.

Moreover, since Model 5 is based upon the assumption of uncertainty about present gross margins, the expectation formation mechanism is based only on past real gross margins, and not on current real gross margins. Accordingly, supply is specified again as,

(4.33) $y_t = \alpha + \beta_0 x_{t-1} + \beta_1 x_{t-2} + \ldots + \beta_{m-1} x_{t-m} + \epsilon_t$

or,

(4.34) $y_t = \alpha + \Sigma_{i=1,m} \beta_{i-1} x_{t-i} + \epsilon_t$

and,

(4.35) $\beta_i = \omega_0 + \omega_1 i + \ldots + \omega_q i^q + \epsilon_i, \quad i=0\ldots q<m-1$

Several specifications of the polynomial lag were considered in the analysis. Various forms of the degree of the polynomial and the length of the lag were examined.

Thus, the final specification of the polynomial supply is the result of some experimentation with the degree of the polynomial and the lag structure.

The polynomial specification was applied to both real gross margins in the production of rain fed sunflowerseed and in the production of rain fed wheat, which along with the inclusion of the other variables that were utilized in previous models resulted in a high use of degrees of freedom.

Therefore, the maximum lag length that was examined was t-5. The minimum lag examined was t-3. The t-2 lag was limited to the restriction of equality of the lag coefficients, which was regarded as too strong.

Hence, all the possible polynomial degrees for the t-5, t-4 and t-3 lag structures were examined. The rationale to select among alternative polynomial structures was based on the degree of significance of the coefficients and on the correctness of their signs. The specification that led to the most acceptable results was a t-4 lag and a polynomial of degree 1. Thus, the formation of expectations about real gross margins in the production of rain fed sunflowerseed can be defined as follows:

$$(4.36)\ EGMRFSD_t = e_0*GMRFSD_{t-1} + e_1*GMRFSD_{t-2} + e_2*GMRFSD_{t-3} + e_3*GMRFSD_{t-4}$$

With weights e_i following a first degree polynomial,

$$(4.37)\ e_i = \omega_0 + \omega_1 i \qquad (i=0,1,2,3)$$

Also, in the production of rain fed wheat, expected real gross margins could be defined as,

$$(4.38)\ EGMRFWD_t = f_0*GMRFWD_{t-1} + f_1*GMRFWD_{t-2} + f_2*GMRFWD_{t-3} + f_3*GMRFWD_{t-4}$$

With weights f_i following a first degree polynomial,

$$(4.39)\ f_i = \theta_0 + \theta_1 i \qquad (i=0,1,2,3)$$

That being so, the econometric specification of Model 5 is as follows:

$$(4.40)\ SARF_t = a + b*SARF_{t-1} + c*DV75_t + d*DVR_t + e_0*GMRFSD_{t-1} + e_1*GMRFSD_{t-2} + e_2*GMRFSD_{t-3} + e_3*GMRFSD_{t-4} + f_0*GMRFWD_{t-1} + f_1*GMRFWD_{t-2} + f_2*GMRFWD_{t-3} + f_3*GMRFWD_{t-4} + \epsilon_t$$

Subjected to the restrictions:

$e_0 = \omega_0$ $\qquad f_0 = \theta_0$

$e_1 = \omega_0 + \omega_1$ $\qquad f_1 = \theta_0 + \theta_1$

$e_2 = \omega_0 + 2\omega_1$ $\qquad f_2 = \theta_0 + 2\theta_1$

$e_3 = \omega_0 + 3\omega_1$ $\qquad f_3 = \theta_0 + 3\theta_1$

Such an equation is estimated by restricted least squares estimation as the polynomial structures of the lag weights are introduced as constraints to the initial models. Again, the sample frame was limited to the 1970-1995 period.

The Godfrey (1978) test for autocorrelation was computed from the restricted errors and led to the conclusion that the hypothesis of serial correlation could be rejected at the 10% significance level.

Accordingly, the problem of stochastic regressors is not present in the estimation of Model 5. Thus, the estimation results for the restriction, or polynomial, coefficients are the following ones:

$$\underset{(1.56)}{\omega_0 = 4.49} \qquad \underset{(-2.67^{**})}{\theta_0 = -8.8}$$

$$\underset{(.41)}{\omega_1 = .62} \qquad \underset{(1.17)}{\theta_1 = 1.38}$$

Applying the appropriate transformations leads to the estimation results for the original specification of the model; hence, the estimation results obtained after applying restricted least squares to equation 4.40 are as follows:

$$(4.41)\quad SARF_t = \underset{(1.31)}{156{,}690} + \underset{(7.05^{***})}{.891*SARF_{t-1}} + \underset{(2.48^{**})}{347{,}800*DV75_t}$$

$$- \underset{(-4.02^{***})}{540{,}650*DVR_t} + \underset{(1.57)}{4.49*GMRFSD_{t-1}}$$

$$+ \underset{(2.37^{**})}{5.12*GMRFSD_{t-2}} + \underset{(2.41^{**})}{5.74*GMRFSD_{t-3}}$$

$$+ \underset{(1.89^{*})}{6.36*GMRFSD_{t-4}} - \underset{(-2.67^{**})}{8.8*GMRFWD_{t-1}}$$

$$- \underset{(-2.79^{**})}{7.42*GMRFWD_{t-2}} - \underset{(-2.45^{**})}{6.04*GMRFSD_{t-3}}$$

$$- \underset{(-1.66)}{4.65*GMRFWD_{t-4}}$$

$\bar{R}^2 = .826$ $\qquad$ d.f = 18

In Model 5, that is the "polynomial model", all the coefficients have the theoretically correct signs. However, in the case of the rain fed sunflowerseed gross margins, the coefficient for the most recent lag is not significant, even at the 10% confidence level; for the rain fed wheat gross margins, the fourth lag is not significant either.

The selection of the expectation formation mechanisms that could explain best the behavior of the Spanish rain fed sunflowerseed producers is a key issue in this chapter. Therefore, it is necessary to choose among the five models that have already been estimated, relative to appropriate performance measures.

Different discrimination criteria are taken into account to determine the model that results in a best simulation of the historical data on rain fed sunflowerseed area. The different models are ranked according to these procedures and compared to select a final specification. The ranking method is summarized in Table 4.1.

The selection process to choose an expectation mechanism that represents best the behavior of farmers planting rain fed sunflowerseed is performed by steps. First, the signs of the different estimated coefficients are examined. In this case, four of the models that were estimated result in coefficients that have the theoretically correct signs for every variable: in fact, only the estimation of Model 2 resulted in incorrect signs for the equation coefficients.

Second, the usual statistical tests for the significance of the coefficients are performed. The only model in which all the estimated coefficients are significant ,at least at the 10% level, is Model 1. In Model 2 most coefficients are not significant. In Model 3 and Model 4 the estimated coefficient for the expected real gross margins in the production of rain fed sunflowerseed is not significant. For that reason these last three models are largely discounted.

Moreover, the lack of significance of the coefficient for the first lag in real rain fed sunflowerseed gross margins, and of the coefficient for the fourth lag in real rain fed wheat gross margins, make the use of the polynomial distributed lags model questionable. In that sense Model 1 also performs better than Model 5.

The third discrimination criterion that is used to select the most appropriate supply specification is the adjusted R^2. The fact that Model 5 makes a higher use of degrees of freedom than Models 1, 2, 3 and 4 was determinant in selecting the adjusted R^2, instead of the unadjusted R^2, as a measure of the goodness of the fit provided by the different models. In relation to this criterion Model 1 performed also better than the others models, in the sense that it provided a higher value for the adjusted R^2.

The fourth discrimination criterion is given by the values of Theil's (1965) U statistics. Theil's statistics constitute one measure of the accuracy of the forecasts. In this case the U statistics are computed for an ex-post simulation of the sample which compares the predicted values from the different models, with the actual values for the sample period 1970-1995. Let P_t represent the predicted value at time t, and A_t the actual value. Then,

$$(4.42)\quad p_t = P_t - A_{t-1}$$

and,

$$(4.43)\quad a_t = A_t - A_{t-1}$$

The U statistics are then defined as,

$$(4.44)\quad U_1 = \frac{[(\Sigma_t(p_t - a_t)^2)/N]^{.5}}{[(\Sigma_t(p_t)^2)/N]^{.5} + [(\Sigma_t(a_t)^2)/N]^{.5}}$$

$$(4.45)\quad U_2 = \frac{[(\Sigma_t(p_t - a_t)^2)/N]^{.5}}{[(\Sigma_t(a_t)^2)/N]^{.5}}$$

The formulae for U_1 and U_2 involve actual values for the time period t-1. This means that in the original Theil's formulation the first observation had to be dropped in order to accommodate the lagged actual value (Leuthold, 1975). However, in this case, data previous to the year 1970 were available and, consequently, it was not necessary to drop the first observation.

Both statistics are equal to zero in the case of a perfect forecast. However, U_1 is limited to values between zero and one, while the value for U_2 ranges from zero to infinity. Specifically, if the value of U_2 falls between zero and one, the forecast is better than the one obtained from a naive model in which the lagged rain fed sunflowerseed area is set as the valid prediction for the current period; if $U_2 = 1$, the forecast would be equivalent to the one obtained in such a naive model; finally if U_2 is greater than one, then the forecasting equation is performing worse than the naive model (Tomek and Robinson, 1990).

Model 1 has the lowest value for the U_1 statistic. Thus, according to that performance measure Model 1 presents the best simulation of the actual data within the sample. In relation to the U_2 statistic, Model 1 has also the lowest value; that indicates also its better performance according to this criterion. Moreover, all the models, except Model 2, have U_2 below one and, therefore, provide better forecasts than a naive model based on the lagged rain fed sunflowerseed acreage only.

The U_1 and U_2 statistics designed by Theil are more appropriate for period to period simulations than for long term forecasts. Ferris (1995) has proposed a modified, U_3, statistic that is best designed for relatively long-term projection orientations. The U_3 statistic would be equivalent to Theil's U_2 statistic, although now p_t would be computed using the lagged predictions, instead of the lagged actual values. Specifically, p_t would be calculated as follows:

(4.46) $p_t = P_t - P_{t-1}$

In this case, and since the estimation procedure was limited to the 1970-1995 period, the first observation had to be dropped in order to accommodate the lagged predicted value. Accordingly, the formula for U_3 is the following one:

$$(4.47)\quad U_3 = \frac{[(\Sigma_t(p_t - a_t)^2)/N-1]^{.5}}{[(\Sigma_t(a_t)^2)/N-1]^{.5}}$$

Again, Model 1 has the lowest value for the U_3 statistic. Therefore it also presents the best simulation of the data in relation to this discrimination criterion.

To sum up, as it is shown in Table 4.1, Model 1 functions better than the other models according to all the utilized performance criteria. Consequently, the hypothesis that farmers' expectations are formed taking into account the current institutional prices and subsidies announced by MAPA is confirmed in the rain fed production of sunflowerseed.

Farmers take MAPA announcements as valid and form their expectations in relation to these announcements, instead of basing their expectations in past patterns of real gross margins. Therefore, rain fed sunflowerseed producers form their expectations according to the rational expectations hypothesis defined in Model 1.

As noted elsewhere, the signs and magnitudes of all the coefficients in Model 1 correspond to what should be expected according to economic theory. Hence, the sunflowerseed rain fed area harvested in period t is positively correlated with the rain fed sunflowerseed acreage harvested in the previous year.

As expected, the rain fed sunflowerseed acreage is also positively correlated with the expectations about gross margins in the production of rain fed sunflowerseed. Thus, it could be deduced that, after CAP reform, the compensatory payments that EAGGF announces do, in fact, influence significantly the Spanish rain fed sunflowerseed acreage.

Moreover, the negative and significant coefficient for $EGMRFWD_t$ confirms that rain fed wheat is an alternative to the production of rain fed sunflowerseed. Consequently, the compensatory payments levels granted in the production of rain fed wheat have also a very important influence on the Spanish rain fed sunflowerseed area.

This result is confirmed by the evolution of the Spanish sunflowerseed acreage during the 1992-1995 period: compensatory payments and gross margins have been significantly higher for rain fed sunflowerseed than for rain fed wheat. Therefore, the Spanish sunflowerseed area has increased significantly at the expense of the cereal area: as noted in Chapter II, after CAP reform sunflowerseed has been massively planted even in zones of Spain where, traditionally, sunflowerseed had never been an alternative to cereal production.

Furthermore, the significant and negative coefficient for DVR_t, confirms that the set of restrictions that MAPA has imposed in 1994 and 1995 on the production of sunflowerseed, have proven as very effective policy instruments in containing the tremendous growth in the rain fed

Table 4.1. Evaluation of the Different Rain Fed Supply Models.

Measures of Performance	Model 1	Model 2	Model 3	Model 4	Model 5
Correctness of All Coefficients..	Yes	No	Yes	Yes	Yes
Significance of All Coefficients..	Yes	No	No	No	No
Adjusted R^2..	0.849	-.0162	0.810	0.841	0.826
U_1...........	0.3113	0.5679	0.3590	0.3209	0.3175
U_2...........	0.5677	2.0138	0.6361	0.5820	0.5769
U_3...........	0.8277	2.7154	0.9641	0.9069	0.9163

sunflowerseed acreage that has arisen since the reform of the CAP in the oilseeds sector. Thus, the average rain fed sunflowerseed area tends to be around 496,000 hectares lower for those years in which legal restrictions to the production of sunflowerseed are put into practice.

Hence, the data on rain fed sunflowerseed area for the 1970-1995 period was simulated on the basis of Model 1. The results are presented in Table 4.2. In general, the estimated values are close to the actual values, with most of the estimates deviating from the actual values by less than ten percent.

I.a.2. *Rain Fed Yield.*

In this section the evolution of the rain fed sunflowerseed yields is related to potential independent variables. Three variables were identified as factors that, a priori, could be influencing the Spanish rain fed sunflowerseed yields: weather, real institutional prices for sunflowerseed, and a trend variable reflecting technology improvements.

The variable selected to reflect the influence of weather on rain fed sunflowerseed yields, in any given year t, was a weighted average of the rainfall, from October of year t-1 to June of year t, in the four main sunflowerseed producing provinces of Spain. Hence, low rainfall years are supposed to result in low rain fed sunflowerseed yields while high rainfall should have a positive influence on yields. Accordingly, the coefficient for this variable is expected to have a positive sign.

Clearly, the relatively high sunflowerseed prices prevailing before the reform of the CAP provided an incentive for obtaining high yields in the production of sunflowerseed. The high sunflowerseed market prices were caused by the high institutional prices that MAPA offered for the Spanish sunflowerseed. Therefore, the institutional prices[6] for sunflowerseed are

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[6]Since 1992 there has been no institutional prices for sunflowerseed. However, sunflowerseed market prices in Spain have been very close to world market levels. Accordingly, from 1992 onwards, the institutional price variable employed in the yield equation takes the value of the actual price received by sunflowerseed farmers.

Table 4.2. Rain Fed Sunflowerseed Area in Spain (1970-1995).

Year	Actual	Estimate	% Error
	<u>Hectares</u>		
1970	164,946	234,133	41.94
1971	295,380	305,687	3.48
1972	338,795	319,018	-5.83
1973	410,251	369,324	-9.97
1974	430,669	501,029	16.33
1975	778,004	778,004	0
1976	492,890	767,490	55.71
1977	532,892	484,802	-9.02
1978	556,880	470,241	-15.55
1979	595,751	528,025	-11.36
1980	633,212	611,422	-3.44
1981	679,499	702,993	3.45
1982	766,914	718,648	-6.29
1983	785,749	753,326	-4.13
1984	874,605	732,643	-16.23
1985	884,124	810,970	-8.27
1986	838,451	965,803	15.18
1987	871,176	936,002	7.44
1988	865,113	903,428	4.42
1989	851,566	932,343	9.48
1990	1,031,110	970,025	-5.92
1991	900,699	1,105,380	22.72
1992	1,194,081	1,092,335	-8.52
1993	1,565,182	1,344,865	-14.07
1994	1,040,706	1,107,376	6.40
1995	844,427	777,758	-7.89

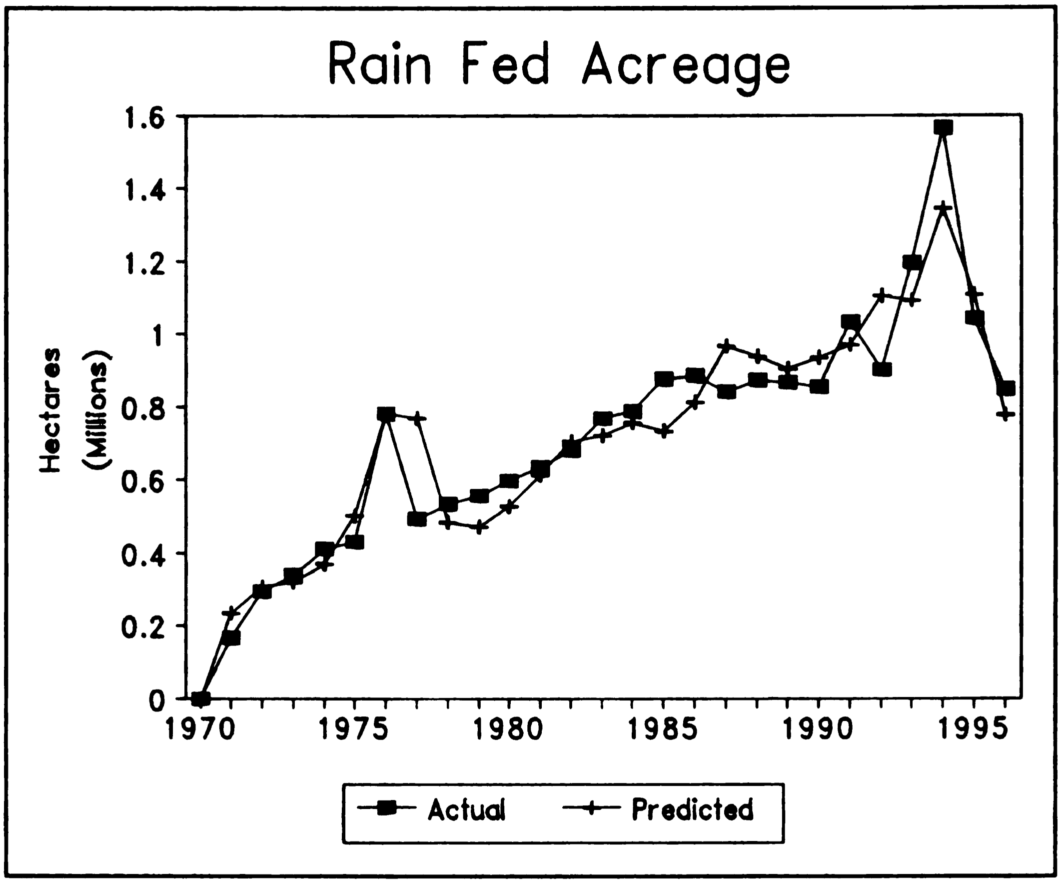

Figure 4.1. Actual and Predicted Rain Fed Sunflowerseed Area in Spain, (1970-1995).

included in the yield equation as a variable that should have a positive effect on rain fed sunflowerseed yields.

As noted elsewhere, the reform of the CAP has resulted in a very significant decrease in the real prices received by sunflowerseed farmers. Such a decline has been accompanied by a decrease in input application rates and, consequently, in variable costs and yields in the production of rain fed and irrigated sunflowerseed, which reinforces the hypothesis that sunflowerseed prices and yields should be positively correlated.

Technological change has also had a very important positive impact on the yields obtained in the production of sunflowerseed since the crop was introduced in Spain. The development of seed varieties suited to the Spanish conditions and the utilization of modern and efficient machinery has resulted in generally increasing yields over time. Consequently, a time variable that takes the value of the current year is included in the yield equation to take into account the effects of technological change. Such a variable is expected to have a positive sign. To be consistent with the analysis of the rain fed sunflowerseed area, the sample size was also limited to the 1970-1995 period in the estimation of the rain fed yield equation. The econometric specification of the yield equation for rain fed sunflowerseed is as follows:

(4.48) $RFSY_t = a + b*SIPD_t + c*WEA_t + d*YEAR_t + \epsilon_t$

Where,

RFSY = Actual yields in the production of rain fed sunflowerseed at period t (kg/ha.)

SIPD = Institutional price for sunflowerseed, deflated (pts/kg.) It would be equal to the minimum contractual prices, for the 1970-1985 period; to the intervention price, for the 1986-1991 period; and to the actual market price for the 1992-1995 period

YEAR = Time variable

WEA = Rainfall, from October of year t-1 to June of year t, in the main sunflowerseed producer provinces (liters/m^2)

Ordinary least squares were applied to the specification defined in equation 4.48, in order to obtain the estimation results; hence, the estimation results for the rain fed sunflowerseed yield equation were the following ones:

$$(4.49)\quad RFSY_t = \underset{(-1.78^{*})}{-21{,}142} + \underset{(1.79^{*})}{6.482{*}SIPD_t} + \underset{(4.57^{***})}{1.0726{*}WEA_t} + \underset{(1.78^{*})}{10.621{*}YEAR_t}$$

$$R^2 = .615 \qquad d.f = 22 \qquad dw = 1.683$$

In this case, the Durbin-Watson test is inconclusive at the 5% significance level. Therefore, an alternative testing procedure is developed to test for the possible presence of AR(1) serial correlation. Specifically, the Breusch (1978) -Godfrey (1978) test was applied to the yield equation.

Such a test is developed under the null hypothesis of "no autocorrelation". Operationally, the test is carried out by regressing the current OLS residuals on the lagged residuals (filling in the missing value with a zero) and the rest of the regressors employed in the yield equation. Then, TR^2 -where T is the sample size- is referred to the tabled critical value for the chi-squared distribution with one degree of freedom.

Thus, the computed Breusch-Godfrey statistic was 0.364, below the 1% and 5% critical values for a chi-squared distribution with one degree of freedom. Accordingly, the null hypothesis of no autocorrelation could not be rejected, even at the 5% significance level.

Therefore, the OLS results are taken as valid, not requiring further transformations of the data. All the coefficients have the theoretically right signs and all of them, even the constant term, are significant at least at the 10% confidence level. The "goodness of the fit" is measured with the use of the coefficient of determination R^2 and has an acceptable value for a yield equation.

As for other equations, the values of Theil's U statistics were also computed for the rain fed sunflowerseed yield equation. Such statistics are shown in Table 4.5, and according to them the rain fed yield equation performs reasonably well in simulating the historical data on rain fed sunflowerseed yields.

To confirm the hypothesis that the disturbances were uncorrelated in the rain fed area and yield equations, the errors obtained from Model 1 in the area equation were regressed on the errors obtained from the rain fed sunflowerseed yield equation, including an intercept in the regression. Then a two tailed t-test was performed on the significance of the coefficient for the rain fed yield equation error. The t-test denoted that both sets of errors were uncorrelated even at the 10% significance level. Accordingly, the single equation estimation procedure employed for the rain fed area and yield equations can be regarded as efficient.

I.b. Irrigated Supply.

I.b.1. *Irrigated Area.*

The present section studies how the evolution of the irrigated sunflowerseed area could be related to possible independent variables.

Historically, the irrigated area planted with sunflowerseed has had a minor importance if compared with the rain fed sunflowerseed acreage. Nevertheless, the relative importance of irrigated sunflowerseed production has increased over time. During the 1970s, only around 3% of the total sunflowerseed area was under irrigation. In the 1980s, this percentage raised to over 10%. Finally, from 1990 to 1995, the percentage of the Spanish sunflowerseed acreage planted with irrigated sunflowerseed has been close to 20% on average.

In the case of the sunflowerseed irrigated acreage, five variables - apart from a constant term- were identified as factors that could be influencing the harvested area: irrigated sunflowerseed harvested area lagged one year, real expected gross margins in the production of irrigated sunflowerseed, a dummy variable for the years in which MAPA has imposed restrictions to the production of sunflowerseed, a dummy variable for the period 1992-1995 (during this period Spain experienced an extremely severe drought), and finally a dummy variable for the year 1988. To be consistent with the study of the rain fed acreage, the econometric analysis of the irrigated sunflowerseed area was also limited to the 1970-1995 period.

As for rain fed sunflowerseed, the inclusion of the lagged harvested area as an independent variable is supposed to capture the increasing trend that the production of irrigated sunflowerseed has had in Spain during the 1970-1995 period. This variable is expected to have a positive sign. The coefficient for the expected real gross margins in the production of irrigated sunflowerseed is also expected to have a positive sign.

In the case of irrigated sunflowerseed a variable reflecting expectations in the production of alternative crops is not included in the econometric specification of supply. The main reason for omitting such a variable is that it is not possible to identify one or two crops that could be regarded as clear alternatives to planting irrigated sunflowerseed at the national level, as it was done in the analysis of rain fed sunflowerseed.

As noted elsewhere, irrigated sunflowerseed can compete with a wide number of irrigated crops, and the development of a variable costs and gross margins analysis for such a large number of crops is beyond the scope of this dissertation. Besides, the inclusion of a large number of crops in the econometric analysis of the irrigated sunflowerseed acreage would impose an important use of scarce degrees of freedom and is not likely to lead to improved estimation results.

In the year 1975 there was not any atypical increase in the area planted with irrigated sunflowerseed, as occurred for the rain fed sunflowerseed acreage. Therefore, it was not necessary to include a dummy variable for that year. On the other hand, for 1988 there was an atypical decrease in the area planted with irrigated sunflowerseed in Spain; this decrease could not be explained in terms of a decrease in real irrigated sunflowerseed gross margins. Thus, a dummy variable was included for year

1988 in all the irrigated acreage models, which is equivalent to dropping year 1988 from the sample.

A dummy variable was also included for the 1992-1995 period. During that period Spain has experienced an explosive increase in the area planted with irrigated sunflowerseed. Such a rise cannot be fully explained by the not so important increase in irrigated sunflowerseed gross margins that has resulted from the reform of the CAP. Most consulted key informants indicated that this increment in the irrigated sunflowerseed acreage could be mostly caused by the severe drought that Spain, and especially Southern Spain, experienced during the 1992-1995 interval.

In fact, during that period, the average rainfall in Spain was only around 60% of the average rainfall for the 1964-1991 period. Such a situation could be regarded as very atypical. As a result, during the 1992-1995 interval, there were very strict limitations in the availability of irrigation water. Many crops that require large amounts of irrigation water could not be cultivated, and irrigated sunflowerseed was planted instead.

In 1994 and 1995, MAPA imposed the same set of restrictions on those farmers willing to plant irrigated sunflowerseed as on those planting rain fed sunflowerseed. Accordingly, in the econometric modelling of the irrigated sunflowerseed acreage, a dummy variable has also been included to distinguish between those years in which no limits were imposed, and those other years in which legal restrictions to sunflowerseed production were put into practice. Again, such a variable is expected to have a negative sign.

The five models that were utilized in the analysis of the rain fed sunflowerseed area are also tested to assess the formation of farmers' expectations about real gross margins in the production of irrigated sunflowerseed. The econometric specification of these models is basically the same as in the study of the rain fed sunflowerseed area.

As it was done for rain fed sunflowerseed, Model 1 and Model 2 are constructed under the rational expectations hypothesis, while Model 3, Model 4 and Model 5 are developed under the assumption that farmers base their expectations about current gross margins only on the information that they have about actual gross margins in the past.

Model 1 assumes again that the farmers expectations about gross margins in the production of irrigated sunflowerseed are determined by subtracting the actual variable cost series, that were constructed in Chapter III, from their expectations about current gross revenues for irrigated sunflowerseed

Again, for the 1970-1991 period, the expected gross revenues in the production of irrigated sunflowerseed are computed by multiplying a trend of past yields by the institutional price set by MAPA.

The trend in past irrigated sunflowerseed yields is still determined by the use of double exponential smoothing on the actual yield series in the irrigated production of sunflowerseed for the 1964-1995 period. In this case, the doubly exponentially smoothed yields series was also subjected yet to relatively abrupt variations for some years.

Accordingly, different moving averages of the double exponentially smoothed yield series were constructed in an effort to achieve a higher degree of smoothness.

After considering different moving averages, a *two step moving average of the doubly exponentially smoothed series* was selected as the most acceptable representation of a smoothed trend in past irrigated sunflowerseed yields. The formula for the two step moving average of the doubly smoothed series is defined in equation 4.25.

To sum up, for the 1970-1991 period, Model 1 assumes that the expected gross margins in the production of irrigated sunflowerseed in any given period t are computed as follows:

(4.50) $EGMIS_t = (ISYS_t * SIP_t) - ISVC_t$

Where,

$EGMIS_t$ = Expected gross margins in irrigated sunflowerseed production at period t (pts/ha.)

$ISYS_t$ = Two step moving average of the double exponentially smoothed series of the actual yields in the production of irrigated sunflowerseed at period t (kg/ha.)

SIP_t = Institutional price for sunflowerseed at period t (pts/kg.)

$ISVC_t$ = Variable costs in the production of irrigated sunflowerseed at period t (pts/ha.)

From 1992 onwards, the compensatory payments that EAGGF grants per hectare planted with irrigated sunflowerseed, and per hectare left idle to fulfill the set-aside requirements, are incorporated into the expected gross revenue computation.

Again, the penalizations which farmers have incurred since the reform of the CAP are not subtracted from the announced compensatory payment for irrigated sunflowerseed.

Consequently, for the 1992-1994 period, Model 1 assumes that the expected gross margins in the production of irrigated sunflowerseed are computed as follows:

$$(4.51)\ EGMIS_t = 0.85*(ISYS_t*SPR_t) + 0.85*ACPIS_t + 0.15*CPIIL_t - 0.85*ISVC_t$$

Where,

$ACPIS_t$ = Announced compensatory payment[7] for irrigated sunflowerseed (pts/ha.)

SPR_t = Sunflowerseed prices received by farmers (pts/kg.)

$CPIIL_t$ = Compensatory payment per idle irrigated land (pts/ha.)

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[7]The average announced compensatory payment for irrigated sunflowerseed is computed by multiplying the average irrigated wheat yield series during the 1989-1991 period in the four principal sunflowerseed provinces, by the announced reference amount (in pesetas) for irrigated sunflowerseed; the *announced compensatory payment* would be different from the *final received compensatory payment*, in those years in which irrigated sunflowerseed producers are penalized.

In 1995, EAGGF has reduced the rotational set-aside requirements to 12%; therefore, the formula to compute expected gross margins in Model 1 is changed to:

$$(4.52)\quad EGMIS_t = 0.88*(ISYS_t*SPR_t) + 0.88*(ACPIS_t) + 0.12*CPIIL_t - 0.88*ISVC_t$$

Thus, for irrigated sunflowerseed the econometric specification of Model 1 is as follows:

$$(4.53)\quad SAI_t = a + b*SAI_{t-1} + c*D88_t + d*DVD_t + e*DVR_t + f*EGMISD_t + \epsilon_t$$

Where,

SAI = Area planted with irrigated sunflowerseed (Has)

D88 = Dummy variable for year 1988.

DVD = Dummy variable for the drought period 1992-1995.

DVR = Dummy variable for years in which MAPA limits the production of rain fed sunflowerseed (1994 and 1995)

EGMISD = Expected gross margins in the irrigated production of sunflowerseed -as specified in 4.50, 4.51 and 4.52- expressed in real terms (pts/ha.)

ϵ = Disturbance term

Thus, the estimation results obtained after applying OLS to Model 1 are the following ones:

$$(4.54)\quad SAI_t = \underset{(.011)}{195.1} + \underset{(4.36^{***})}{.7452}*SAI_{t-1} - \underset{(-1.39)}{74,991}*D88_t + \underset{(4.89^{***})}{214,756}*DVD_t - \underset{(-5.11^{***})}{318,700}*DVR_t + \underset{(1.625^{*})}{1.424}*EGMISD_t$$

The Godfrey (1978) test resulted in autocorrelated disturbances even at the 1% significance level. Accordingly, estimation by OLS does not provide consistent estimates of the coefficients. Hence, the model was re-estimated using a residual adjusted estimation procedure (Hatanaka, 1974).

As a first step, the model was estimated using the IV technique, in which the instrument matrix was formed by: the intercept, $D88_t$, DVD_t, DVR_t, $EGMISD_t$ and $EGMISD_{t-1}$. Thus, the natural instrument for the lagged sunflowerseed irrigated area would be the lagged expected gross margin for irrigated sunflowerseed as constructed in Model 1. Then, the autocorrelation coefficient was estimated from the residuals of the IV estimation; the result obtained was $\rho = -0.01778$.

Finally, the Cochrane-Orcutt transformations were applied to the original model. The model was estimated again, although this time including in the regression the lagged IV residuals obtained in the previous step. This procedure gives consistent estimates of the coefficients of Model 1; the results are:

$$(4.55)\quad SAI_t = \underset{(.168)}{3,166.5} + \underset{(4.17^{***})}{.7445*SAI_{t-1}} - \underset{(-1.32)}{73,951*D88_t}$$

$$+ \underset{(4.42^{***})}{207,550*DVD_t} - \underset{(-4.97^{***})}{317,220*DVR_t}$$

$$+ \underset{(1.456)}{1.317*EGMISD_t}$$

$$\bar{R}^2 = 0.845 \qquad d.f = 18^8$$

All the estimated coefficients have the theoretically correct signs. Moreover, except for the coefficient for the expected gross margins for irrigated sunflowerseed, all the relevant coefficients are significant at least at the 10% confidence level. The coefficient for the expected gross margins in irrigated sunflowerseed is not significant at the 10% significance level, although it would be significant for a two tailed test based on a 16% confidence level[9]. The "goodness of the fit" is measured with the use of the adjusted R^2. The predicted values utilized to compute the adjusted R^2 are calculated multiplying the estimated parameters by the independent variables defined in the original specification of the model,

[8]The inclusion of the lagged IV residuals in the regression, reduces by two the degrees of freedom because the first observation must be dropped from the regression.

[9]The coefficient would also be significant at the 10% level for a one tailed t-test. Such a test would make sense in this context because it would discount all negative values for the coefficient.

and adding up the total. This procedure to compute the adjusted R^2 is also employed in the other models.

Model 2 assumes that the actual ex-post observation at time t -which is in fact unobserved at the moment of reaching the planting decision- can be used as an approximation to the rational expectations predictor (McCallum, 1976). For the irrigated sunflowerseed acreage Model 2 can be specified as:

$$(4.56)\quad SAI_t = a + b*SAI_{t-1} + c*D88_t + d*DVD_t + e*DVR_t + f*GMISD_t + \epsilon_t$$

Where $GMISD_t$ is the actual irrigated sunflowerseed ex-post gross margin, as constructed in Chapter III. Again, the ex-post gross margins are not observable at the moment of taking the planting decision at t. As noted in the previous section, the specification of this model implies that $GMISD_t$ is correlated with ϵ_t. Therefore, estimation by OLS does not lead to consistent results and the use of IV becomes necessary.

In this case the natural instrument in the IV estimation process would be the lagged gross margins for irrigated sunflowerseed. More specifically, the elements of the instrument matrix in the IV estimation process are the following ones: the intercept, $D88_t$, DVD_t, DVR_t, SAI_{t-1} and $GMISD_{t-1}$. The results obtained after applying the IV estimation thus defined to Model 2 are the following ones:

$$(4.57)\quad SAI_t = \underset{(.347)}{50{,}539} + \underset{(2.83^{***})}{.8016*SAI_{t-1}} - \underset{(-.38)}{32{,}963*D88_t} + \underset{(4.22^{***})}{211{,}250*DVD_t} - \underset{(-2.59^{***})}{309{,}260*DVR_t} - \underset{(-.223)}{1.034*GMISD_t}$$

The Godfrey (1978) test was computed from the IV residuals and resulted in autocorrelated disturbances even at the 1% significance level. The presence of AR(1) autocorrelated disturbances implies that SAI_{t-1} and, possibly, $GMISD_{t-1}$ are correlated with ϵ_t. The result is that estimation by the IV procedure defined above does not provide consistent estimates of the coefficients. Hence, the model was re-estimated using a residual adjusted estimation procedure (Hatanaka, 1974) that was especially adapted to this case.

As a first step, the model was estimated again using the IV technique to obtain a consistent estimate of the autocorrelation coefficient. In this second IV procedure the instrument matrix was formed by: the intercept, $D88_t$, DVD_t, DVR_t, $GMISD_{t-2}$ and $GMISD_{t-3}$. In this case, $GMISD_{t-2}$ is not likely to be correlated with ϵ_t, and should be correlated with SAI_{t-1}, through SAI_{t-2}, if the expectations are formed rationally as defined by McCallum. Furthermore, $GMISD_{t-3}$ should not be correlated with ϵ_t either, but it could likely be correlated with $GMISD_t$. Hence, the instrument for the lagged sunflowerseed irrigated area would be $GMISD_{t-2}$, while the instrument for the actual ex-post gross margin would be $GMISD_{t-3}$. The autocorrelation coefficient was estimated from the residuals of this second IV estimation; the result obtained was $\rho = -0.33082$.

Finally, the Cochrane-Orcutt transformations were applied to the original model. The model was estimated again by IV, although this time including in the regression the lagged IV residuals obtained in the previous step. In this last step the transformed actual ex-post irrigated sunflowerseed gross margins are still theoretically correlated with the disturbances and, therefore, the transformed lagged irrigated sunflowerseed gross margins are used as an instrument.

This procedure gives consistent estimates of the coefficients of Model 2; the results from this last IV estimation are:

$$(4.58)\quad SAI_t = \underset{(1.252)}{70{,}150} + \underset{(5.59^{***})}{.999{*}SAI_{t-1}} - \underset{(-.14)}{9{,}189{*}D88_t}$$

$$+ \underset{(1.97^{**})}{129{,}150{*}DVD_t} - \underset{(-4.28^{***})}{298{,}700{*}DVR_t}$$

$$- \underset{(-1.119)}{2.221{*}GMISD_t}$$

$$\bar{R}^2 = 0.6157 \qquad d.f = 18$$

The estimation results suggest that Model 2 should not be seriously considered as a reliable predictor of the sunflowerseed irrigated acreage in Spain. The estimated coefficient for the ex-post irrigated sunflowerseed is clearly not significant and besides it has the theoretically wrong sign. Furthermore, the lagged irrigated sunflowerseed area has an unitary coefficient. This presumption is very difficult to accept, and largely discounts the use of Model 2 as a predictor, because it indicates that the effect of lagged irrigated sunflowerseed acreages persist over time.

Model 3 is a naive model in which the producers' expected real gross margin at time t is the actual deflated gross margin at time t-1. The econometric specification of Model 3 is as follows:

$$(4.59)\quad SAI_t = a + b*SAI_{t-1} + c*D88_t + d*DVD_t + e*DVR_t + f*GMISD_{t-1} + \epsilon_t$$

Where,

GMISD = Actual gross margins in the irrigated production of sunflowerseed -as constructed in Chapter III- expressed in real terms (pts/ha.)

The estimation results obtained after applying OLS to Model 3 during the 1970-1995 period are the following ones:

$$(4.60)\quad SAI_t = \underset{(1.025)}{21{,}555} + \underset{(5.08^{***})}{.8514}*SAI_{t-1} - \underset{(-.90)}{49{,}268}*D88_t + \underset{(4.59^{***})}{215{,}110}*DVD_t - \underset{(-5.09^{***})}{331{,}160}*DVR_t - \underset{(-.215)}{1.074}*GMISD_{t-1}$$

The Godfrey (1978) test for AR(1) autocorrelation was also applied to Model 3. This test resulted in autocorrelated disturbances even at the 1% significance level. Accordingly, estimation by OLS does not provide consistent estimates of the coefficients and the model had to be re-estimated using residual adjusted estimation (Hatanaka, 1974).

Thus, the model was estimated using IV to compute the autocorrelation coefficient. In this case the instrument matrix is formed by: the intercept, $D88_t$, DVD_t, DVR_t, $GMISD_{t-1}$ and $GMISD_{t-2}$. Hence, the instrument used for the lagged sunflowerseed irrigated area would be $GMISD_{t-2}$, which in theory must not be correlated with ϵ_t but should be correlated with SAI_{t-1} if the specification defined in Model 3 is correct. The autocorrelation coefficient was estimated from the residuals of the IV estimation; the result obtained was $\rho = 0.048072$.

Then, the Cochrane-Orcutt transformations were applied to the original model. The model was estimated again, this time including in the regression the lagged IV residuals obtained in the previous step; the results of this procedure are:

$$(4.61)\ SAI_t = \underset{(1.087)}{26,317} + \underset{(4.41^{***})}{.8173*SAI_{t-1}} - \underset{(-.95)}{56,487*D88_t} + \underset{(4.02^{***})}{212,800*DVD_t} - \underset{(-4.59^{***})}{328,880*DVR_t} - \underset{(-.229)}{.1247*GMISD_{t-1}}$$

$\bar{R}^2 = 0.824$ d.f = 18

In the case of Model 3, the a priori most relevant variable -that is the expected real gross margins in the production of irrigated sunflowerseed- is not significant and has the theoretically wrong sign. This seriously questions the use of Model 3 as a predictor. Again, the "goodness of the fit" is measured with the use of the adjusted R^2.

Model 4 assumes that the expectations about gross margins in the production of irrigated sunflowerseed in any given period would be equal to the value, for that same period, resulting from applying double exponential smoothing to the actual real irrigated sunflowerseed gross margins.

In this case the application of DES to the series on real irrigated sunflowerseed gross margins results in a fairly smooth and approximately linear trend and no further transformation of the data is needed, as it was for rain fed sunflowerseed.

To sum up, Model 4 assumes that the real expected gross margins in the production of irrigated sunflowerseed, in any given period t, depend only in past actual gross margins, and are defined according to the specification stated in the following equation:

$$(4.62)\ EGMISD_t = GMISD2S_t$$

Where,

$GMISD2S_t$ = Doubly exponentially smoothed and deflated actual irrigated sunflowerseed gross margins series (pts/ha.)

That being so, the econometric specification of Model 3 is defined as:

$$(4.63)\quad SAI_t = a + b{*}SAI_{t-1} + c{*}D88_t + d{*}DVD_t + e{*}DVR_t + f{*}GMISD2S_t + \epsilon_t$$

The estimation results obtained after applying OLS to Model 4 are:

$$(4.64)\quad SAI_t = \underset{(1.413)}{39{,}514} + \underset{(4.61^{***})}{.8026}{*}SAI_{t-1} - \underset{(-.86)}{46{,}269}{*}D88_t + \underset{(4.79^{***})}{224{,}200}{*}DVD_t - \underset{(-4.98^{***})}{322{,}550}{*}DVR_t - \underset{(-.882)}{.981}{*}GMISD2S_t$$

The Godfrey (1978) test for AR(1) autocorrelation resulted in autocorrelated disturbances at the 1% significance level. Thus, the model had to be re-estimated using residual adjusted estimation (Hatanaka, 1974).

First, the model was estimated using IV to compute the autocorrelation coefficient. The instrument matrix was formed by: the intercept, $D88_t$, DVD_t, DVR_t, $GMISD2S_t$ and $GMISD2S_{t-1}$.

Hence, the instrument used for the lagged sunflowerseed irrigated area would be the lagged doubly exponentially smoothed gross margins for irrigated sunflowerseed, which in theory must not be correlated with ϵ_t but should be correlated with SAI_{t-1}, if the specification defined in Model 4 is correct.

The autocorrelation coefficient was estimated from the residuals obtained in the IV estimation; the result was $\rho = -0.53876$.

Then, the Cochrane-Orcutt transformations were applied to the original model. The model was estimated again, this time including in the regression the lagged IV residuals obtained in the previous step; the results of the Hatanaka procedure are:

$$(4.65)\ SAI_t = \underset{(4.27^{***})}{98,853} + \underset{(1.86^{*})}{.8483*SAI_{t-1}} + \underset{(1.11)}{75,787*D88_t}$$

$$+ \underset{(3.25^{***})}{264,030*DVD_t} - \underset{(-.206)}{18,625*DVR_t}$$

$$- \underset{(-2.181^{**})}{2.3204*GMISD2S_t}$$

$$\bar{R}^2 = -0.348 \qquad d.f = 18$$

In the case of Model 4, the coefficient for the expected real gross margins in the production of irrigated sunflowerseed is significant but has a negative sign, which is contrary to what should be expected according to the postulates of economic theory.

Furthermore, the coefficient for the dummy variable accounting for the years, in which limits to the production of sunflowerseed are established, is not significant; that coefficient is significant in all the other irrigated and rain fed models. These facts question the validity of Model 4.

As in the other models, the "goodness of the fit" is measured with the use of the adjusted R^2.

Model 5 is based on the assumption that producers form their expectations about gross margins according to a polynomial distributed lag (Almon, 1965).

Again, various forms of the degree of the polynomial and the length of the lag were examined in the analysis in order to select the most appropriate specification.

As for rain fed sunflowerseed, the rationale to select among alternative polynomial structures was based on the degree of significance of the coefficients and on the correctness of their signs.

After examining alternative models, the specification that led to the most acceptable results was also in this case a t-4 lag and a polynomial of degree 1.

That being so, the econometric specification of Model 5 for irrigated sunflowerseed is as follows:

$$(4.66)\ SAI_t = a + b*SAI_{t-1} + c*D88_t + d*DVD_t + e*DVR_t + f_0*GMISD_{t-1} + f_1*GMISD_{t-2} + f_2*GMISD_{t-3} + f_3*GMISD_{t-4} + \epsilon_t$$

Subjected to the restrictions:

$f_0 = \omega_0$

$f_1 = \omega_0 + \omega_1$

$f_2 = \omega_0 + 2\omega_1$

$f_3 = \omega_0 + 3\omega_1$

The equation was estimated by restricted least squares. Thus, the estimation results for the polynomial coefficients are the following ones:

$$\omega_0 = \underset{(-.50)}{-.19}$$
$$\omega_1 = \underset{(-.12)}{-.02}$$

Applying the appropriate transformations leads to the estimation results for the original specification of the model:

$$(4.67)\ SAI_t = \underset{(1.36)}{45{,}525} + \underset{(4.70^{***})}{.816}*SAI_{t-1} - \underset{(-.76)}{42{,}019}*D88_t + \underset{(4.59^{***})}{220{,}150}*DVD_t - \underset{(-5.05^{***})}{329{,}920}*DVR_t - \underset{(-.50)}{.19}*GMISD_{t-1} - \underset{(-.80)}{.21}*GMISD_{t-2} - \underset{(-.89)}{.24}*GMISD_{t-3} - \underset{(-.68)}{.26}*GMISD_{t-4}$$

The Godfrey (1978) test for AR(1) autocorrelation was computed and, in this case, also resulted in autocorrelated disturbances at the 1% significance level.

Thus, the model was re-estimated using IV to compute the autocorrelation coefficient; in this step the polynomial restrictions were still applied, both to the original regression matrixes and to the instrument matrix.

The instrument used for the lagged sunflowerseed irrigated area was the gross margins for irrigated sunflowerseed lagged twice. Such a variable must not be correlated with ϵ_t, but should be correlated with SAI_{t-1} assuming that the specification defined in Model 5 is correct. The autocorrelation coefficient was estimated from the residuals obtained in the IV estimation; the result was $\rho = 0.22968$.

Then, the Cochrane-Orcutt transformations were applied to the original model. The model was estimated subjected again to the polynomial restrictions, and this time including in the regression the lagged IV residuals obtained in the previous step. Hence, the results of the Hatanaka procedure for the polynomial coefficients are:

$$\omega_0 = \underset{(-.63)}{-.31}$$
$$\omega_1 = \underset{(-.13)}{-.03}$$

Again, applying the appropriate transformations leads to the estimation results for the original specification of the model:

$$(4.68)\quad SAI_t = \underset{(1.05)}{47{,}191} + \underset{(4.04^{***})}{.847^{*}SAI_{t-1}} - \underset{(-.58)}{34{,}174^{*}D88_t}$$

$$+ \underset{(4.35^{***})}{228{,}430^{*}DVD_t} - \underset{(-4.18^{***})}{325{,}240^{*}DVR_t}$$

$$- \underset{(-.63)}{.30^{*}GMISD_{t-1}} - \underset{(-.78)}{.27^{*}GMISD_{t-2}}$$

$$- \underset{(-.72)}{.24^{*}GMISD_{t-3}} - \underset{(-.46)}{.21^{*}GMISD_{t-4}}$$

$$\bar{R}^2 = 0.815 \qquad d.f = 17$$

In the case of Model 5, all the polynomial coefficients for the real gross margins in the production of irrigated sunflowerseed have negative signs, which is contrary to the postulates of economic theory. Furthermore, all the polynomial coefficients are also not significant. The polynomial model makes also a higher use of degrees of freedom than previous models.

The selection process to choose an expectation mechanism that explains best the behavior of farmers planting irrigated sunflowerseed is the same as for rain fed sunflowerseed production. The results of applying the different discrimination criteria are summarized in Table 4.3. First, the signs of the different estimated coefficients are examined. In this case, only Model 1 had the theoretically correct signs for every variable.

Second, the usual statistical tests for the significance of the coefficients were performed. There were no models in which all the relevant estimated coefficients were significant at the 10% significance level. However, in Model 1 this condition would be fulfilled if the coefficient for the expected gross margins in the production of irrigated sunflowerseed is accepted as significant at the 16% level. In that sense Model 1 also performs better than the other models.

The third discrimination criterion is the adjusted R^2. With respect to this criterion Model 1 performed also better than the others models, in the sense that it provided a higher value for the adjusted R^2.

Finally, the fourth discrimination criterion is again given by the values of Theil's (1965) U statistics. Again, Model 1 has the lowest value for the U_1 statistic. Hence, according to that performance measure Model 1 presents the best simulation of the actual data within the sample.

In relation to the U_2 statistic, Model 1 has also the lowest value; that indicates also its better performance according to this criterion. Moreover, all the models, except Model 4, have U_2 below one and, therefore, provide better forecasts than a naive model based on the lagged irrigated sunflowerseed area only. Furthermore, Model 1 has the lowest value for the U_3 statistic.

To sum up, Model 1 functions better than the other irrigated sunflowerseed models according to all the utilized performance criteria. Accordingly, the hypothesis that farmers' expectations are formed taking into account the current institutional prices and subsidies announced by MAPA is confirmed in the irrigated production of sunflowerseed as it was done for the rain fed area. Thus, irrigated and sunflowerseed producers follow the same criteria when forming their expectations about gross margins.

Table 4.3. Evaluation of the Different Irrigated Supply Models.

Measures of Performance	Model 1	Model 2	Model 3	Model 4	Model 5
Correctness of All Coefficients..	Yes	No	No	No	No
Significance of All Coefficients..	No	No	No	No	No
Adjusted R^2..	0.845	0.6157	0.824	-.348	0.815
U_1...........	0.2656	0.4081	0.2822	0.6382	0.2848
U_2...........	0.4953	0.7802	0.5275	1.4617	0.5257
U_3...........	0.7875	1.2258	0.8744	1.5428	0.9113

As expected, the selected irrigated acreage equation indicates that the sunflowerseed irrigated area harvested in period t is positively correlated with the irrigated sunflowerseed acreage harvested in the previous year.

In addition, the irrigated sunflowerseed acreage is also positively correlated with the expectations about gross margins in the production of irrigated sunflowerseed, as presumed according to the postulates of economic theory.

The positive and significant sign for DVD_t indicates that the lack of irrigating water has been a meaningful factor in explaining the increase in the irrigated sunflowerseed acreage that Spain has experienced during the first half of the 1990s.

Moreover, the significant and negative coefficient for DVR_t in the irrigated sunflowerseed area equation, corroborates that the set of restrictions that MAPA has imposed, in 1994 and 1995, on the production of sunflowerseed has also proven as very effective in restricting further increases in the irrigated sunflowerseed acreage.

Thus, the average irrigated sunflowerseed area tends to be around 319,000 hectares lower for those years in which legal restrictions to the production of sunflowerseed are put into practice.

Hence, the data on irrigated sunflowerseed area for the 1970-1995 period was simulated on the basis of Model 1. The results are presented in Table 4.4. The simulation leads to a clear overprediction for the early years of the sample. However, the accuracy of the results improve significantly for later observations; thus, the estimates deviate, on average, by less than 20 percent from the actual values for the 1985-1995 period.

I.b.2. *Irrigated Yield.*

This section relates the evolution of the irrigated sunflowerseed yields to potential independent variables. The variables that proved to be relevant in explaining the evolution of the Spanish irrigated sunflowerseed yields were the same as for rain fed sunflowerseed yields:

Table 4.4. Irrigated Sunflowerseed Area in Spain (1970-1995).

Year	Actual	Estimate	% Error
	Hectares		
1970	991	15,722	1,486
1971	4,620	18,966	310
1972	5,562	40,195	623
1973	5,732	37,325	551
1974	9,053	29,501	226
1975	13,761	36,350	164
1976	13,216	28,877	118
1977	12,656	22,352	76.6
1978	27,265	21,914	-19.6
1979	41,807	32,022	-23.4
1980	35,120	38,669	10.1
1981	46,045	26,808	-41.7
1982	75,988	43,864	-42.3
1983	140,702	64,602	-54.1
1984	132,862	116,375	-12.4
1985	104,451	126,768	21.3
1986	100,758	127,821	26.8
1987	123,127	130,071	5.6
1988	75,013	74,574	-.6
1989	126,827	112,157	-11.5
1990	169,457	141,686	-16.4
1991	169,001	170,692	1
1992	225,023	360,068	41.2
1993	575,674	455,502	-20.8
1994	314,461	373,879	18.8
1995	250,346	176,624	-29.4

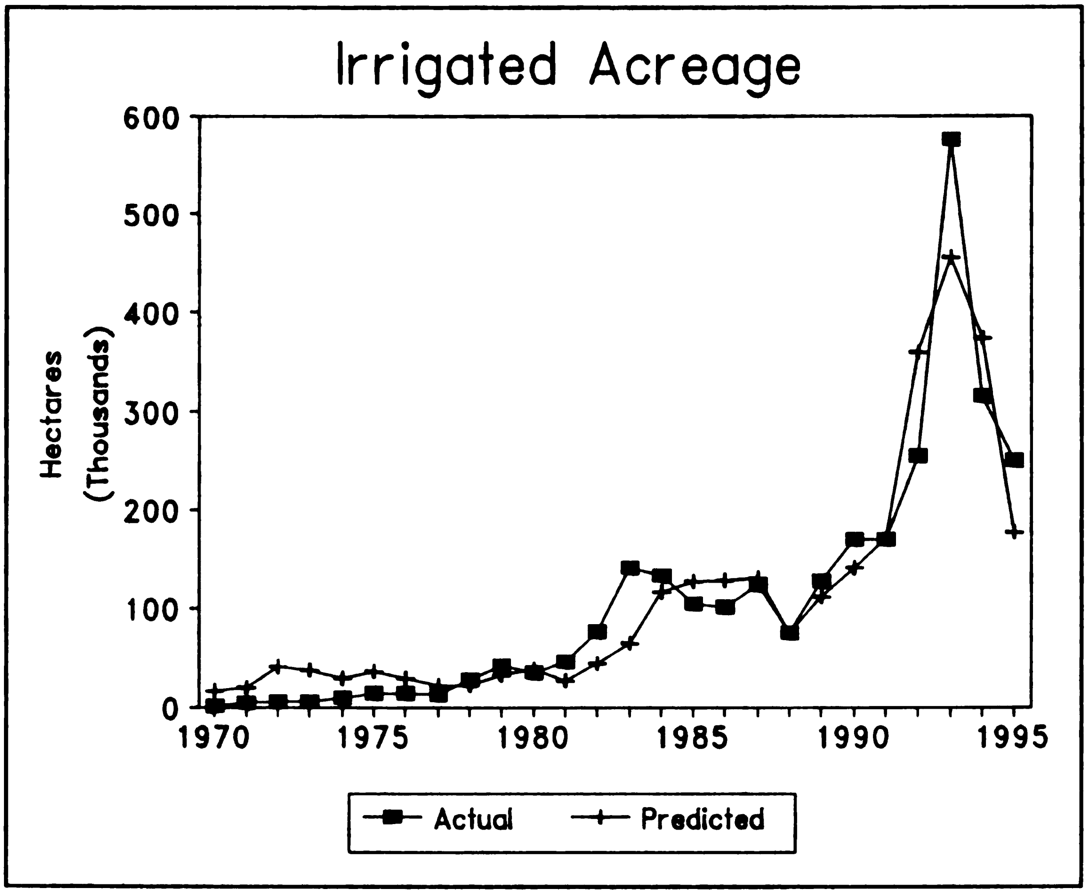

Figure 4.2. Actual and Predicted Irrigated Sunflowerseed Area in Spain, (1970-1995).

weather, real institutional prices for sunflowerseed and a trend variable reflecting technology improvements.

Again, the variable reflecting the influence of weather on irrigated sunflowerseed yields, in any given year t, was a weighted average of the rainfall, from October of year t-1 to June of year t, in the four main producing provinces of Spain.

In this case, dry periods have resulted in significant decreases in the availability of irrigation water, and, consequently, have affected negatively over time the irrigated sunflowerseed yields in Spain.

On the other hand, in high rainfall years farmers have generally been able to follow the necessary irrigation practices and to obtain higher yields in the production of irrigated sunflowerseed.

Therefore, the coefficient for the variable reflecting the influence of weather on sunflowerseed yields is expected to have a positive sign also in the case of irrigated sunflowerseed.

As noted in the previous section, the decrease in the real prices received by sunflowerseed farmers that has accompanied the reform of the CAP, has resulted in a significant decline in input application rates, variable costs and yields in the production of rain fed sunflowerseed.

As it has been shown in Chapter III, the situation was similar for the production of irrigated sunflowerseed where yields have also been correlated to the levels of institutional prices.

Accordingly, the institutional prices for sunflowerseed have also been included in the irrigated sunflowerseed yield equation as a variable that, a priori, should have a positive effect on irrigated sunflowerseed yields.

Finally, technological change has also had a significant positive impact on the yields obtained in the production of irrigated sunflowerseed.

Hence, a time variable that takes the value of the current year is also included in the irrigated yield equation. Again, such a variable is expected to have a positive sign. Therefore, the econometric specification of the yield equation for irrigated sunflowerseed is as follows:

(4.69) $ISY_t = a + b*SIPD_t + c*WEA_t + d*YEAR_t + \epsilon_t$

Where,

ISY = Actual yields in the production of irrigated sunflowerseed at period t (kg/ha.)

SIPD = Institutional price for sunflowerseed, deflated (pts/kg.) It would be equal to the minimum contractual prices, for the 1970-1985 period; to the intervention price, for the 1986-1991 period; and to the world market price for the 1992-1995 period

YEAR = Time variable

WEA = Rainfall, from October of year t-1 to June of year t, in the main sunflowerseed producer provinces (liters/m^2)

After applying OLS to such specification for the 1970-1995 period, the estimation results were the following ones:

$$(4.70)\ ISY_t = \underset{(-2.54^{**})}{-92{,}426.5} + \underset{(1.95^{*})}{21.578}*SIPD_t + \underset{(1.883^{*})}{1.3524}*WEA_t + \underset{(2.57^{**})}{46.763}*YEAR_t$$

$R^2 = .358$ d.f = 22 dw = 1.944

According to the Durbin-Watson test the null hypothesis of no AR(1) autocorrelation in the disturbances could not be rejected, even at the 5% significance level. Thus, the OLS results are taken as valid, not requiring further transformations of the data. All the coefficients have the theoretically right signs and all of them are significant at least at the 10% confidence level.

The "goodness of the fit" is measured with the use of the coefficient of determination R^2 and is below the value for the rain fed yield equation. The values of Theil's U statistics were also computed for the irrigated sunflowerseed yield equation. Such statistics are shown in Table 4.5.

Table 4.5. Evaluation of the Rain Fed and Irrigated Yield Equations.

Measures of Performance	Rain Fed Yield Equation	Irrigated Yield Equation
Correctness of All Coefficients ...	Yes	Yes
Significance of All Coefficients ...	Yes	Yes
R^2	0.615	0.358
U_1	0.3058	0.4224
U_2	0.5982	0.7665
U_3	0.7908	1.0943

Again, to confirm the hypothesis that the disturbances were uncorrelated in the irrigated area and yield equations, the errors obtained from Model 1 in the irrigated area equation were regressed on the errors obtained from the irrigated sunflowerseed yield equation, including an intercept in the regression. Then, a two tailed t-test was performed on the significance of the coefficient for the irrigated yield equation error. Thus, the t-test denoted that both sets of errors were uncorrelated even at the 10% significance level. Accordingly, the single equation estimation employed for the irrigated area and the yield equations is considered efficient.

Finally, the production of rain fed and irrigated sunflowerseed is deduced from two identities that respectively multiply dryland and irrigated areas by the appropriate yields. Thus,

(4.71) RFSP = SARF*RFSY/1000

(4.72) ISP = SAI*ISY/1000

Where,

RFSP = Rain fed sunflowerseed production (metric tons)

ISP = Irrigated sunflowerseed production (metric tons)

Summing the irrigated and the rain fed productions gives total production. Hence,

(4.72) TSP = RFSP + ISP

Where,

TSP = Total sunflowerseed production in Spain, for any given period t (metric tons).

II. Industrial Supply of Sunflowerseed Oil and Meal.

The sunflowerseed produced in Spain is crushed to obtain sunflowerseed oil; as noted in Chapter II, the resulting sunflowerseed meal is a by-product that is utilized by the livestock industry.

Historically, the domestic production of sunflowerseed has been able to satisfy the crushing requirements of the Spanish sunflowerseed oil industry. Sunflowerseed imports have generally remained at low levels, even after accession to the EC.

However, although Spain has been self-sufficient in sunflowerseed for most years, there have been very significant sunflowerseed imports in those years in which the domestic sunflowerseed production has not been able to satisfy the crushing needs of the sunflowerseed oil industry.

Thus for example, in 1981, due to an exceptionally low harvest, Spain imported 33% of its domestic sunflowerseed consumption. Moreover, during the first half of the 1990s, the reform of the CAP in the oilseeds sector has generated a large increase in the area planted with sunflowerseed but has resulted also in lower yields per hectare. The terrible drought that Spain has experienced during the 1991-1995 period has lowered yields even more.

As a consequence of this severe and prolonged drought, the decrease in yields has been especially severe in the years 1994 and 1995. The decrease in yields has resulted in an absolute decline in the quantity of sunflowerseed produced in Spain in the years 1994 and 1995, even if the total area planted with sunflowerseed was above one million hectares for both years. Consequently, Spain had to import 14% of its sunflowerseed consumption for 1994, and it is estimated that it is importing around 30% of its sunflowerseed consumption for 1995.

On the other hand, sunflowerseed exports have always remained at relatively low levels even in years of exceptionally good harvests. The oil industry have generally absorbed most of the produced sunflowerseed, and even in large harvest years only a small proportion of the domestic sunflowerseed production has been diverted toward external markets.

Thus, the oil industry has, so far, been generally willing to process most of the domestic sunflowerseed production. Before accession to the EC, this behavior could be explained because MAPA's public intervention in the sunflowerseed oil market was guaranteeing the sunflowerseed oil sales of the industry. On the other hand, since 1986, the adoption of the EC regulatory mechanisms in the oilseeds sector has facilitated sunflowerseed oil exports both to EU and, especially, non EU countries, and, therefore, has encouraged the crushing of domestic sunflowerseed.

Consequently, in most years since accession to the EC, the industry has been able to divert sunflowerseed oil surpluses toward the external market. Thus, although the industry is still mostly domestically oriented, the relative importance of sunflowerseed oil exports has grown significantly since 1986. Furthermore, the historical excess capacity of the oil industry has encouraged this tendency to absorb most domestic sunflowerseed production. This excess capacity is expected to prevail during the next few years.

The accumulation of stocks has had very little importance at the level of agricultural sunflowerseed supply, although it has been much more important at the vertical stage of sunflowerseed oil production. In fact, it is possible to find sunflowerseed stocks only in four years of the whole data sample, and at very low levels; this prevents the econometric modelling of the historical evolution of the change in sunflowerseed stocks.

In any case, the domestic availability of sunflowerseed in Spain for any given period is deduced as the difference between the Spanish sunflowerseed production and the sunflowerseed stock variation for that period. Thus,

(4.74) $SIA_t = TSP_t - SSV_t$

Where,

SIA_t = Sunflowerseed internal availability in Spain, for any given period t (metric tons).

SSV_t = Sunflowerseed stock variation in Spain, for any given period t (metric tons).

Also, deducting sunflowerseed net exports from the sunflowerseed internal availability gives the internal disappearance in sunflowerseed:

(4.75) $SID_t = SIA_t - SX_t + SM_t$

Where,

SID_t = Sunflowerseed internal disappearance in Spain, for any given period t (metric tons).

SX_t = Sunflowerseed exports in Spain, for any given period t (metric tons).

SM_t = Sunflowerseed imports in Spain, for any given period t (metric tons).

As noted elsewhere, most sunflowerseed is crushed to produce sunflowerseed oil and sunflowerseed meal. Only a very small proportion of the sunflowerseed available in the Spanish market is directed toward other uses.

The variable that defines the demand for sunflowerseed by the industry is the quantity of seed crushed in each period. This variable is modelled in Chapter V, which is devoted to the analysis of demand. Moreover, the quantity of seed crushed by the industry is deduced as the difference between the internal disappearance in sunflowerseed and the quantity of sunflowerseed directed towards other uses. Hence,

(4.76) $SC_t = SID_t - SOU_t$

Where,

SC_t = Sunflowerseed crushed in Spain, for any given period t (metric tons).

SOU_t = Sunflowerseed directed toward other uses, for any given period t (metric tons).

The quantity of sunflowerseed oil and sunflowerseed meal produced are specified as a direct function of the quantity of sunflowerseed crushed. Hence, the econometric specification for the production of sunflowerseed oil is defined as follows:

(4.77) $SOP_t = a + b*SC_t + \epsilon_t$

Where,

SOP_t = Sunflowerseed oil production in Spain, for any given period t (metric tons).

And similarly for sunflowerseed meal,

(4.78) $SMP_t = a + b*SC_t + u_t$

Where,

SMP_t = Sunflowerseed meal production in Spain, for any given period t (metric tons).

Again all the data are obtained from the different statistical collections of MAPA.

For the production of sunflowerseed oil, the results of applying OLS to the above defined specification for the 1970-1995 period, are the following ones:

$$(4.79)\ SOP_t = \underset{(-1.347)}{-6{,}110.2} + \underset{(74.02^{***})}{0.4264}*SC_t$$

$$R^2 = .995 \qquad d.f = 24 \quad dw = 1.260$$

In this case, the Durbin-Watson test for AR(1) autocorrelation is inconclusive even at the 5% significance level.

Accordingly, the Breusch (1978) -Godfrey (1978) test for AR(1) autocorrelation was applied to the sunflowerseed oil supply equation; the computed Breusch-Godfrey statistic was 3.232, which is below the 1% and 5% critical values for a chi-squared distribution with one degree of freedom. Therefore, the presence of autocorrelation could be rejected even at the 5% significance level.

Moreover, the magnitude of the coefficient for the independent variable is consistent with the information on oil yields that was provided in Chapter II of this dissertation.

For the sunflowerseed meal supply equation, the results of the OLS estimation for the 1970-1995 period are as follows:

$$(4.80)\quad SMP_t = \underset{(3.30^{***})}{13{,}110} + \underset{(86.60^{***})}{0.4471} * SC_t$$

$$R^2 = .997 \qquad d.f = 24 \quad dw = 1.789$$

For the sunflowerseed meal equation the value of the Durbin-Watson statistic denoted the lack of AR(1) autocorrelation even at the 5% significance level. The econometric analysis confirms that -as noted in Chapter II- sunflowerseed meal yields are slightly above sunflowerseed oil yields.

Although the oil content of sunflowerseeds has increased over time, it could be considered that, in the short term, a ton of sunflowerseed yields almost fixed proportions of sunflowerseed oil and sunflowerseed meal. This suggested that the disturbances of the oil and meal equations could be correlated and that, consequently, joint estimation would be more efficient than the single estimation of both equation.

To test this hypothesis the residuals obtained in the oil equation were regressed on the errors obtained from the meal equation, including an intercept in the regression. The two tailed t-test on the significance of the coefficient for the sunflowerseed meal equation residual denoted that both set of errors were uncorrelated, even at the 10% significance level.

Therefore, the single equation estimation employed for the sunflowerseed oil and sunflowerseed meal supply equations can be considered efficient. For both equations all the relevant variables are significant and have the correct signs. In this case, both equations provided also very high R^2 values.

CHAPTER V

ECONOMETRIC ANALYSIS OF DEMAND

The main objectives of this chapter are the modelling of: the retail domestic demand for bottled sunflowerseed oil, the demand for sunflowerseed meal by the Spanish livestock sector, and the demand for sunflowerseed by the Spanish sunflowerseed oil industry.

This dissertation is mainly focused on the analysis of supply in the sunflowerseed sector. The primary interest of the study concentrates on the effects of the reform of the CAP in the oilseeds sectors, on the area planted with sunflowerseed and, to a lower extent, on the Spanish production of sunflowerseed and derived products. Accordingly, most effort and detail have been dedicated to the analysis of supply.

However, there is also growing concern in Spain about the evolution of the demand for sunflowerseed oil under a context characterized by relatively low sunflowerseed and sunflowerseed oil prices. Furthermore, an econometric analysis of demand in the sunflowerseed market could serve to evaluate if the Spanish sunflowerseed sector will be able to respond, in the future, to the domestic demand for sunflowerseed and sunflowerseed products. Such an analysis can help to clarify the potential role that the external sector can play in the sunflowerseed market, and to orientate policy issues related to the levels of consumption, self-sufficiency and external trade in the sunflowerseed oil and sunflowerseed meal subsectors.

That being so, this chapter is devoted to construct econometric models that could be used to simulate the quantities domestically consumed of sunflowerseed oil, of sunflowerseed meal, as well as the quantities of sunflowerseed demanded by the oil industry. The amounts consumed of bottled sunflowerseed oil, sunflowerseed meal and sunflowerseed are set as dependent variables in the different demand equations. The exogenous character given to sunflowerseed prices and, indirectly, to the prices of its derived products, prevents the utilization of price dependent demand equations.

I. Demand of Bottled Sunflowerseed Oil.

Several researchers have worked on the econometric modelling of the Spanish human demand for fats and oils. However, more attention have been given to the econometric analysis of the demand for olive oil than to the study of sunflowerseed oil demand.

The first attempt to model the demand for oils in Spain was carried out by FORPA (1970), and did not take into account the sunflowerseed oil market. It focused only on the demand for olive oil and used single equation regression techniques.

Perhaps the most complete study on the demand for oils in Spain, is the analysis developed by Briz and Mili (1990). The focus of this study was again the demand for olive oil, and specifically the simulation of the quantities consumed of refined olive oil and virgin olive oil. Nevertheless, in this case, sunflowerseed oil was included as the main competing product. The analysis used single equation models, but the degree of econometric complexity was certainly higher than for previous studies.

From the point of view of this dissertation, the most positive aspect of the Briz and Mili study is that the researchers gathered unpublished data on retail prices and retail sales of bottled refined olive oil, bottled virgin olive oil and bottled sunflowerseed oil. Previous studies utilized only official published producer and wholesale data, that were not so appropriate for the modelling of consumption.

The only market study focused specifically on the demand for sunflowerseed oil was developed by Dios (1980). The Dios study on the market of sunflowerseed and sunflowerseed oil utilized a simultaneous treatment of supply and demand. In her model the prices received by agricultural sunflowerseed producers were determined by the demand for sunflowerseed oil. However, this approach reveals a lack of understanding of the reality of the sunflowerseed sector in Spain, where, previous to the reform of the CAP, the final prices received by agricultural sunflowerseed producers were mostly determined by the minimum guaranteed prices that were set each year by MAPA.

As noted elsewhere, the economics of the sunflowerseed sector can be explained much better in terms of sunflowerseed oil production and consumption than in terms of sunflowerseed meal production and consumption. Sunflowerseeds are crushed to produce and sell sunflowerseed oil, and the consumption of sunflowerseed oil has a much more significant influence in determining the quantities of sunflowerseed to be crushed than the demand for sunflowerseed meal.

This section models only the largest proportion of the domestic demand for sunflowerseed oil: the domestic demand for bottled sunflowerseed oil. Hence, the foreign demand for Spanish sunflowerseed oil -that is the export of Spanish sunflowerseed oil- is not modelled in this dissertation.

There are several obstacles that prevent the econometric modelling of Spanish sunflowerseed oil exports. For example, before Spain's accession to the EC Spanish exports of sunflowerseed oil were almost insignificant, which is a major difficulty for a reliable modelling of the Spanish sunflowerseed oil exports.

The adoption of the EC mechanisms in the oilseeds sector facilitated somehow the expansion of the Spanish sunflowerseed oil exports during the late 1980s and the 1990s. However, the Spanish exports of sunflowerseed oil have been very dispersed and mostly concentrated on non EU countries. MAPA does not publish any official detailed series on the specific destination of Spanish sunflowerseed oil exports, distinguishing only among EU and non EU destinations. This makes very difficult the gathering of data that could be used to model the specific foreign demand -from potential recipient countries- of Spanish sunflowerseed oil.

In any case, as was pointed out in Chapter II, Spanish sunflowerseed oil exports constitute a relatively small proportion of total Spanish sunflowerseed oil production. This could also justify the approach adopted in this dissertation, which consists in deducting sunflowerseed oil net exports as a residual from the projections obtained from the production and consumption models.

Furthermore, since 1986 the sunflowerseed oil industry has generally been able to direct its sunflowerseed oil surpluses to the external market. It could be reasonably safe to assume that, in the near future, the industry will still be able to export sunflowerseed oil surpluses, especially taking into account that the Spanish sunflowerseed oil prices are highly competitive in the international market. In relation to sunflowerseed oil imports, although they were relatively important during the early 1970s, they have become almost insignificant during the 1980s and 1990s.

The specification of the bottled sunflowerseed oil, sunflowerseed meal and sunflowerseed demand equations is done according to the guidelines of consumption theory. Thus, an important aspect to take into account in the theoretical analysis of demand is the examination of the different models available.

Early work in demand analysis focused on individual commodities while later developments in consumer theory have been focused on the consideration of demand systems. In each of the different demand systems available the theoretical specification is consistent with a particular utility function. The more important theoretical demand system models are the linear expenditure system, the Rotterdam model, the indirect translog model and the almost ideal demand system.

So far, all the studies focused on the analysis of the Spanish market for oils have been based on single equation techniques. However, in other countries demand system models have been applied to the analysis of the demand for fats and oils. A very good example is the study of Pierani and Rizzi (1991) on the Italian market for fats and oils; in that study

Pierani and Rizzi used an Almost Ideal Demand System (AIDS) (Deaton and Muellbauer, 1980) for the modelling of the italian oils and fats consumption. The study gave a simultaneous treatment to the italian demand for olive oil, oilseeds oil, and butter.

To validate their results, Pierani and Rizzi had to assume and test the separability of oils and fats from other food groups in order to be able to estimate a partial demand system focused exclusively on the fat and oils market. Their model was able to simulate simultaneously the quantities of the three commodities consumed, and to relate them to their prices and to the consumer's income.

In any case, this dissertation does not make use of demand system models because the present analysis focus solely on sunflowerseed oil demand. In part, this approach could also be justified because during the sample simulation period the Spanish fats and oils market has been monopolized by only two commodities: sunflowerseed oil and olive oil.

Furthermore, the Spanish bottled oils market (where most sunflowerseed oil is sold) is also monopolized by bottled sunflowerseed oil and bottled olive oil. Soybean oil disappeared from the bottled oils market in 1977, and has not had an important presence in this market even after the full liberalization of the Spanish oil market was accomplished in 1991. As noted elsewhere, most consulted key informants agree that this situation is unlikely to change dramatically in the short to medium term. Therefore, it seems reasonably safe to presume, in the utilization of the econometric consumption model for prediction purposes, that the Spanish bottled oils market will still be monopolized by bottled sunflowerseed oil and by bottled olive oil during the 1996-2005 period.

Because only two commodities are involved, the analysis of demand performed in this dissertation assumes that it is possible to simulate accurately the consumption of bottled sunflowerseed oil, without the utilization of demand system models. Hence, a more detailed discussion of demand system models is beyond the scope of this dissertation. Instead, a single equation approach is utilized; this simplifies the explanation of demand to a small number of variables and facilitates the estimation process.

The demand for bottled sunflowerseed oil comprise the largest segment of the domestic market demand for sunflowerseed oil. As noted in Chapter II, the demand for non bottled oil diverted toward food processing and toward inedible uses accounts only for a small proportion of the total market consumption of sunflowerseed oil.

Besides, data on retail sales of sunflowerseed oil is available from AFOEX, the Spanish association of vegetable oils processors, refiners and bottlers, and, more recently, from MAPA; furthermore, data on retail prices is also provided by the Spanish Ministry of Economy *(Ministerio de Economía y Hacienda)*, and, also recently, by MAPA. This facilitates the construction of models designed to simulate the demand for bottled sunflowerseed oil.

On the other hand, there is no official publication informing about the prices of the non bottled sunflowerseed oil that is sold for edible and inedible uses. There is not any official publication, either, on total sales of non bottled sunflowerseed oil. Hence, the national consumption of non bottled sunflowerseed oil is deduced as the difference between the estimation of total sunflowerseed oil consumption that MAPA publishes every year, and the figures on sales of bottled sunflowerseed oil facilitated by AFOEX.

The lack of accurate historical data on non bottled sunflowerseed oil consumption and prices makes very difficult the modelling of the Spanish demand for non bottled sunflowerseed oil in Spain. Besides, since this demand represents a small proportion of total sunflowerseed oil consumption this dissertation does not attempt to model it.

Thus, in Chapter VI, the future projections on the consumption of non bottled sunflowerseed oil are made upon reasonable assumptions about the proportions of the total sunflowerseed oil demand that are consumed bottled and non bottled.

Demand systems explain expenditure shares. In the present analysis, instead of explaining expenditure shares, the model for bottled sunflowerseed oil demand links directly quantities and prices. Hence, in the model the annual domestic consumption per capita of bottled sunflowerseed oil is set as the dependent variable and related to relevant independent variable.

The consumption of bottled sunflowerseed oil is measured by the annual figures on bottled sunflowerseed oil sales that AFOEX provides every year. The independent variables utilized in the model are: the average retail price for bottled sunflowerseed oil expressed in real terms, the average retail price for bottled olive oil expressed in real terms, and, finally, a deflated measure of the Spanish income per capita. In a first specification of the model a trend variable was initially included; however it was finally dropped because it proved to be non significant.

This dissertation assumes that the representative retail price of bottled olive oil is an average, weighted according to the relative importance in consumption, of the average retail prices for bottled refined olive oil and for bottled virgin olive oil. The measure of the real per capita income is the deflated annual disposable income expressed in per capita terms. As it was done in the analysis of supply, all the deflated variables are expressed in 1983 pesetas by using the consumer price index (1983=1.00).

There are official data on retail sales of bottled sunflowerseed and on retail prices of bottled sunflowerseed oil and bottled olive oil for the 1973-1995[1] period. However, the situation of the Spanish bottled oils market in the 1970s was significantly different from the market conditions that have prevailed in the 1980s and 1990s. In the 1970s sunflowerseed oil had a relatively small presence in the market and competed not only with bottled olive oil, but also with bottled soybean oil.

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[1]The figures for 1995 are provisional data.

For reasons already described, sunflowerseed oil and olive oil have monopolized the bottled oils market during the 1980s and 1990s; as a result poor estimation results were obtained when the 1973-1995 sample frame was utilized. On the other hand, the results improved significantly when the estimation of the Spanish consumption of bottled sunflowerseed oil was limited to the 1980-1995 period. Thus, although dropping the first seven observation implies an important reduction of scarce degrees of freedom, the remaining observations seem to describe much more accurately the actual situation of the Spanish bottled oils market.

One important issue to consider in the empirical analysis of demand is the separability problem. In the bottled sunflowerseed oil demand equation presented here, separability assumptions are needed for the demand for bottled sunflowerseed oil to be independent of other commodities different from bottled sunflowerseed oil and bottled olive oil.

Separability can be defined as the property that commodities can be partitioned into groups so that preferences within groups can be described independently of the quantities consumed in other groups (Deaton and Muellbauer, 1980).

Therefore, the model presented here assumes that the demand for bottled sunflowerseed oil is related exclusively to bottled oils prices, and that a single equation is a suitable representation of sunflowerseed bottled oil demand.

Moreover, the different variables utilized in the sunflowerseed oil demand model are expressed in natural logarithms because it proved to be the specification that best simulated the sample. This entails the assumption of a constant price elasticity for the bottled sunflowerseed oil demand, as well as a constant cross price elasticity for the demand of bottled sunflowerseed oil in relation to the price of bottled olive oil, and a constant income elasticity of demand, during the 1980-1995 period. This could be a plausible assumption, especially taking into account the relatively short length of the simulation period.

Hence, the formal specification of the demand model for bottled sunflowerseed oil is as follows:

$$(5.1)\ LNSOBCPC_t = a + b*LNSORPD_t + c*LNOORPD_t + d*LNDINPCD_t + \epsilon_t$$

Where,

$LNSOBCPC_t$ = Logarithm of the bottled sunflowerseed oil consumption per capita for any given year t (kgs).

$LNSORPD_t$ = Logarithm of the deflated retail price for bottled sunflowerseed oil for any given year t (pts/kg).

$LNOORPD_t$ = Logarithm of the deflated retail price for bottled olive oil for any given year t (pts/kg).

$LNDINPCD_t$ = Logarithm of the national disposable income, deflated and expressed in per capita terms, for any given year t (thousands of pts).

After applying OLS to the model, the estimation results are the following ones:

$$(5.2)\ LNSOBCPC_t = \underset{(-.373)}{-.61973} - \underset{(-3.169^{***})}{.15357}*LNSORPD_t + \underset{(1.694^{*})}{.28592}*LNOORPD_t + \underset{(1.793^{*})}{.2912}*LNDINPCD_t$$

$R^2 = .7281$ d.f = 12 d.w = 1.1802

The estimation results show that all the relevant coefficients are significant at least at the 10% level and have the expected signs. The Durbin-Watson test for AR(1) autocorrelation is in the inconclusive zone at the 5% percent significance level. Therefore, the Breusch (1978) - Godfrey (1978) test adapted to detect AR(1) serial correlation was applied to the bottled sunflowerseed oil demand model.

The value of the Breusch-Godfrey statistic was 2.156, below the 1% and 5% critical values for the null hypothesis of no AR(1) autocorrelation. This implies that serial correlation cannot be detected in the estimation of the model. On the other hand, the goodness of the fit was measured with the unadjusted R^2, which gave an acceptable level.

Since the results are expressed in logarithms the value of the coefficients can be interpreted as elasticities. The results show inelastic own price, cross price and income elasticities, which seems to be reasonable for a cooking oil.

The low values of the own price elasticity for bottled sunflowerseed oil, and of the cross elasticity with the price of bottled olive oil are consistent with the observation described in Chapter II: sharp variations in the price premium for olive oil are needed to produce appreciable changes in the quantities consumed of bottled sunflowerseed soil.

Furthermore, the positive and significant sign for the coefficient of $LNOORPD_t$ confirms that bottled sunflowerseed oil and bottled olive oil are substitutes. On the other hand, the positive and significant sign for the variable representing per capita income needs a more careful interpretation.

MAPA's official consumption surveys, which are published every year in the book *"El Consumo Alimentario en España"*, indicate that consumption of bottled sunflowerseed oil tends to be more elevated in low income households than in higher income households (MAPA, 1993). This could be easily explained by the high price premium for bottled olive oil over bottled sunflowerseed oil, and because in Spain there is a traditional preference for olive oil due to its importance in the typical mediterranean diet.

Thus, the positive sign for the coefficient of the variable representing real per capita disposable income could, apparently, contradict MAPA's consumption surveys. However, the deflated per capita disposable income utilized in the present study does not represent any measure of income distribution. Instead, it just represent a measure of the potential income of the average consumer.

As in other countries, in Spain higher levels of income per capita have been accompanied by an increase in the proportion of food expenses that takes place away from home. Moreover, MAPA's official consumption surveys show that the consumption of bottled sunflowerseed oil is significantly higher in restaurants than in households.

Thus, according to MAPA, during the 1989-1992 period the consumption of bottled sunflowerseed oil was equal to 35% of the total oil consumption in the Spanish households, and equal to 49% of the total oil consumption in the Spanish restaurants and hotels (MAPA, 1993). This can explain the positive coefficient for $LNDINPCD_t$: a higher proportion of food expenditures taking place away from home should result in an increase in the per capita consumption of bottled sunflowerseed oil.

Taking the exponential function of the values simulated in equation 5.2 gives the prediction of the Spanish consumption per capita of bottled sunflowerseed oil. Thus,

(5.3) $SOBCPC_t = EXP(LNSOBCPC_t)$

Where,

$SOBCPC_t$ = Bottled sunflowerseed oil consumption per capita for any given year t (kgs).

Multiplying 5.3 by the Spanish population gives the predicted total sunflowerseed bottled oil consumption in Spain.

(5.4) $SOBC_t = SOBCPC_t * POP_t / 1000$

Where,

$SOBC_t$ = Total bottled sunflowerseed oil consumption in Spain for any given year t (metric tons).

Table 5.1 presents the actual and predicted values of the total consumption of sunflowerseed bottled oil in Spain, expressed in metric tons. Most predicted values differ from the actual values by less than 5%, and the accuracy of the simulation results is especially high for the last observations in the sample.

To calculate the Spanish sunflowerseed oil total disappearance, the non bottled consumption of sunflowerseed oil is added to the bottled consumption of sunflowerseed oil. Hence,

(5.5) $SOID_t = SOBC_t + SOOU_t$

Where,

$SOID_t$ = Sunflowerseed oil total internal disappearance in Spain, for any given year t (metric tons).

$SOOU_t$ = Sunflowerseed oil directed towards other uses different from bottled consumption, for any given year t (metric tons).

Adding up net exports to the internal disappearance gives the Spanish internal availability in sunflowerseed oil.

(5.6) $SOIA_t = SOID_t + SOX_t - SOM_t$

Where,

$SOIA_t$ = Sunflowerseed oil total internal availability in Spain, for any given year t (metric tons).

SOX_t = Sunflowerseed oil exports, for any given year t (metric tons).

SOM_t = Sunflowerseed oil imports, for any given year t (metric tons).

Finally, adding the stock variation in sunflowerseed oil to the internal availability in sunflowerseed oil for any given period t, results in the Spanish production of sunflowerseed oil for the previous period t-1. As noted in Chapter II, the harvest of sunflowerseed begins usually at the beginning of September and continues until the end of October in many zones of Spain. The presumption adopted in this dissertation is that the harvested sunflowerseed is processed during the months of October and November.

It could also be reasonably safe to assume that the resulting sunflowerseed oil is refined and bottled during the months of October, November and December, and that begins to be commercialized during the month of December. Thus, all, or at least most, of the sunflowerseed oil produced in Spain in year t-1 would be ready for consumption in the month of January of the following year. The same assumption is adopted for the production and consumption of sunflowerseed meal.

This is essentially the same methodology that MAPA utilizes when constructing reports and balance sheets about the Spanish sunflowerseed

Table 5.1. Consumption of Bottled Sunflowerseed Oil in Spain, 1980-1995.

Year	Actual	Estimate	% Error
	Metric Tons		
1980	246,216	258,761	5.1
1981	237,868	253,505	6.6
1982	256,065	262,128	2.4
1983	266,743	262,851	-1.5
1984	286,397	264,812	-7.5
1985	292,584	269,751	-7.8
1986	267,644	270,240	.9
1987	263,123	271,930	3.3
1988	290,335	281,389	-3.1
1989	299,329	296,002	-1.1
1990	293,676	303,373	3.3
1991	318,978	308,159	-3.4
1992	311,700	312,874	.4
1993	308,713	308,499	-.06
1994	304,140	313,618	3.1
1995	334,554	336,472	.6

sector. Thus, for example, the data for the 1993/1994 agricultural year makes reference to sunflowerseed production, sunflowerseed net exports, sunflowerseed stock variation, utilization of sunflowerseed internal disappearance, and sunflowerseed oil and meal production, in 1993; while the data on sunflowerseed oil consumption, net exports, and stock variation, as well as the data on sunflowerseed meal consumption and net exports, refer to year 1994. Therefore,

(5.7) $SOP_{t-1} = SOIA_t + SOSV_t$

Where,

SOP_{t-1} = Sunflowerseed oil domestic production in Spain, in any given year t-1 (metric tons).

$SOSV_t$ = Sunflowerseed oil stock variation, for any given year t (metric tons).

Although the accumulation of stocks has had very little importance at the level of agricultural sunflowerseed production, it has been much more important at the vertical stage of sunflowerseed oil production. In fact, it is possible to find relevant accumulations and releases of sunflowerseed oil stocks since 1979. Previous to 1979, no official figures on stock variation are available; this suggests that during the 1970s the importance of stocks in the sunflowerseed oil subsector was very small or irrelevant.

The relative importance of sunflowerseed oil stocks has been much more significative during the 1980s and 1990s. Sunflowerseed oil stock variation accounted, on average, for 11.4% of the total internal availability of sunflowerseed oil during the 1980s; for that same period ending stocks were equal to 20% of total internal availability. During the 1990-1995 period, the annual stock variation was equal, on average, to 8.2% of total internal availability; on the other hand, during that period, ending stocks were equal to 37% of the total internal availability of sunflowerseed oil due, especially, to large stocks accumulation in 1992 and 1993 (MAPA, 1994).

oil

For the 1980s and 1990s, an econometric modelling of the historical evolution of the change in sunflowerseed oil stocks is presented here. The dependent variable in the estimated sunflowerseed oil stock variation equation is the amount of sunflowerseed oil released from or put into storage.

In principle, several independent variables were included in the equation to explain sunflowerseed oil stock variation for each period t: the difference between sunflowerseed oil domestic production in the previous period and sunflowerseed oil internal disappearance -that is sunflowerseed oil domestic consumption- in the current period[2], the sunflowerseed oil ending stocks in the previous period, and, finally, the sunflowerseed oil price in the current period.

However the estimated coefficient for the sunflowerseed oil price at period t proved to be not significant. Therefore, that variable was not included in the estimation. This suggests that the formation of sunflowerseed stocks cannot be explained very well as the result of the speculative behavior of producers.

This could be a plausible explanation, especially if it is taken into account that the actual institutional conditions of the Spanish sunflowerseed oil market do not provide many opportunities for speculation: there are very little barriers in the Spanish sunflowerseed sector to external competition -hence, potential sunflowerseed and sunflowerseed oil shortages could be easily covered with imports- and, besides, large interanual price variations are not usual in the market.

Thus, large sunflowerseed oil stock accumulations are rather the consequence of large sunflowerseed oil productions. As noted elsewhere, in many years the Spanish production of sunflowerseed oil has exceeded domestic requirements.

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[2]As noted previously, balance sheets are constructed so that sunflowerseed oil production in period t-1 is consumed in period t.

In general, the Spanish sunflowerseed oil industry has not experienced many problems, so far, in directing most surpluses toward exports markets; however, part of the sunflowerseed oil surpluses tends to go also into stocks, and it is usually released toward the internal or the export market in years of lower sunflowerseed oil production. The variable that is presented as the difference between SOP_{t-1} and $SOID_t$ captures well this effect in the econometric specification of the sunflowerseed oil stock equation.

It is also plausible to expect large sunflowerseed oil stock releases when the existing sunflowerseed oil ending stocks reach relatively high levels. That is the reason to include the level of the sunflowerseed oil ending stocks in period t-1, as one of the possible factors explaining sunflowerseed stock variation in period t. Hence, the final econometric specification of the sunflowerseed oil stock equation is defined as follows:

(5.8) $SOSV_t = a + b*(SOP_{t-1} - SOID_t) + c*SOES_{t-1} + \epsilon_t$

Where,

$SOES_{t-1}$ = Sunflowerseed oil ending stocks in any given year t-1 (metric tons).

To be consistent with the estimation of the sunflowerseed oil demand equation, the estimation of the sunflowerseed oil stock equation was limited to the 1980-1995 period. The results obtained after applying OLS to the sunflowerseed oil stock equation are the following ones:

(5.9) $$SOSV_t = \underset{(1.5)}{24,804} + \underset{(2.303^{**})}{0.3788}*(SOP_{t-1} - SOID_t) - \underset{(-2.037^{*})}{.33729}*SOES_{t-1}$$

$R^2 = .320678$ d.f = 13 d.w = 1.692

As it can be seen all the relevant variables are significant at least at the 10% level; however the coefficient of determination is somehow low.

Since $SOSV_{t-1}$ is utilized in the computation of $SOES_{t-1}$, the presence of serial correlation could result in a problem of stochastic regressors. However, the Breusch (1978) -Godfrey (1978) statistic -which is equal to 0.34727- denoted a lack of autocorrelation even at the 5% significance level; therefore the OLS results can be regarded as consistent.

Furthermore, the signs of the coefficients of the explanatory variables are as expected: the positive sign for the coefficient of (SOP_{t-1} - $SOID_t$) shows that the larger the difference between sunflowerseed oil production and consumption, the larger the amount of sunflowerseed oil that is put into storage.

On the other hand, the negative sign for $SOES_{t-1}$ confirms that the larger the ending stocks in the previous period, the larger the quantities of sunflowerseed oil stocks that tend to be released in the current period.

Finally, the residuals of the stock variation equation were regressed on the residuals of the bottled sunflowerseed oil demand equation plus a constant term, in order to test for the potential correlation among the disturbances of both equations. This test denoted the lack of correlation among both sets of disturbances; therefore the single equations techniques utilized here prove to be efficient.

II. Demand of Sunflowerseed Meal.

The present section models the Spanish consumption of sunflowerseed meal. As noted in Chapter II, sunflowerseed meal can be regarded as a by-product of the sector. Its protein content is below the protein contents of other widely utilized livestock feeds; hence, it has also a relatively low price. Moreover, the price of a kilogram of sunflowerseed meal -approximately 27 pesetas in 1995- is significantly below the price of a kilogram of sunflowerseed oil -around 150 pesetas in 1995- (MAPA, 1995).

Soybean meal is the main product with which sunflowerseed meal is competing in the market. As noted elsewhere, the Spanish production of sunflowerseed meal is clearly insufficient to satisfy all the livestock feed needs of the Spanish livestock sector, and massive amounts of soybeans and soybean meal are imported. Due to the structural deficiency of Spain in the production of livestock feeds, the sunflowerseed meal, soybean and soybean meal markets have historically been subjected to little or no protection.

Because of the high degree of substitutability between sunflowerseed meal and soybean meal, most of the domestic production of sunflowerseed meal is consumed in the domestic market. Historically, the external sector has had little importance in the sunflowerseed meal market: during the 1970s and the 1980s, a relatively small proportion of the Spanish sunflowerseed meal production was exported, and a modest percentage of the Spanish sunflowerseed meal consumption was imported.

The domestic consumption of sunflowerseed meal has experienced a slightly increasing trend during the 1980s and 1990s, perhaps because there has been a higher availability of sunflowerseed meal in the Spanish market. The increase in sunflowerseed meal consumption has also resulted in more significant imports of sunflowerseed meal during the 1990s: thus, during the 1990-1995 period Spain imported around 11% of its sunflowerseed meal consumption.

As noted elsewhere, sunflowerseed meal is used in the beef, pork and even poultry sectors. Most key informants consider that the highest use of sunflowerseed meal perhaps takes place in the beef sector; nonetheless, MAPA does not publish any official data indicating the exact utilization of sunflowerseed meal among the different livestock sectors.

Consequently, it is very difficult to determine the influence that the different livestock prices could have on the Spanish consumption of sunflowerseed meal. In any case, most of the consulted key informants estimated that, apparently, the main factor explaining the consumption of sunflowerseed meal in Spain is the magnitude of the price premium paid for soybean meal over sunflowerseed meal.

Only a small proportion of the Spanish livestock feed requirements are satisfied with sunflowerseed meal. Therefore, an increase in livestock prices could lead to a general increase in the consumption and imports of livestock feeds (soybean meal and corn mainly), but it is unlikely that it would lead to a significant increment in the demand for sunflowerseed meal *per se*.

In the demand model developed in this section the annual amounts of sunflowerseed meal consumed -that is the internal disappearance of sunflowerseed meal- is taken as the dependent variable.

The independent variables utilized in the model are: the price paid by farmers for sunflowerseed meal expressed in real terms, the price paid by farmers for soybean meal expressed in real terms, and finally a trend variable that is equal to the consumption year. This last variable is included to reflect the increasing trend in sunflowerseed meal consumption.

Thus, the econometric specification for the sunflowerseed meal demand equation is as follows:

(5.10) $SMID_t = a + b*SMPRD_t + c*SBMPRD_t + d*YEAR_t + \epsilon_t$

Where,

$SMID_t$ = Sunflowerseed meal internal disappearance (metric tons).

$SMPRD_t$ = Price paid by farmers for sunflowerseed meal, expressed in real terms (pts/kg).

$SBMPRD_t$ = Price paid by farmers for soybean meal, expressed in real terms (pts/kg).

The coefficient for the real price of sunflowerseed meal is expected to have a negative sign, while the coefficient for the real price of the substitutive product soybean meal is expected to have a positive sign. As usual, all the deflated variables are expressed in 1983 pesetas.

MAPA has only published data on the prices paid for sunflowerseed meal and for soybean meal since 1977. Therefore the estimation is limited to the 1977-1995 period. The data on prices and disappearance for 1995 are provisional data (MAPA, 1995). The results of applying OLS to the selected sample are:

$$(5.11)\quad SMID_t = \underset{(-2.877^{**})}{-32{,}919{,}886} - \underset{(-2.271^{**})}{26{,}615} * SMPRD_t + \underset{(1.863^{*})}{14{,}726} * SBMPRD_t + \underset{(2.941^{***})}{16{,}834} * YEAR_t$$

$R^2 = .93924$ d.f = 15 d.w = 2.621

The estimation results show that all the relevant coefficients are significant at least at the 10% level and have the expected signs. In particular, the positive sign for $SBMPRD_t$ confirms the substitutability between sunflowerseed meal and soybean meal.

Moreover, the high value of the coefficient of determination shows that the selected independent variables explain very well the variance of the dependent variable. The Durbin-Watson test for AR(1) autocorrelation is inconclusive at the 5% significance level. However, the value of the Breusch (1978) -Godfrey (1978) statistic -in this case 2.9892- denotes the absence of serial correlation at the 5% significance level.

Adding up net exports to the internal disappearance gives the Spanish internal availability in sunflowerseed meal:

$$(5.12)\quad SMIA_t = SMID_t + SMX_t - SMM_t$$

Where,

$SMIA_t$ = Sunflowerseed meal total internal availability in Spain for any given year t (metric tons).

SMX_t = Sunflowerseed meal exports, for any given year t (metric tons).

SMM_t = Sunflowerseed meal imports, for any given year t (metric tons).

There is no historical accumulation of stocks in the Spanish sunflowerseed meal subsector; consequently, the internal availability in sunflowerseed meal must be equal to the production of sunflowerseed meal in the previous period. Again, the assumption adopted is that all, or at least most, of the sunflowerseed meal produced in Spain in the year t-1 would be ready for consumption in the month of January of year t. Thus,

(5.13) $SMP_{t-1} = SMIA_t$

Where,

SMP_{t-1} = Sunflowerseed meal domestic production in Spain in any given year t-1 (metric tons).

As in the case of sunflowerseed oil, there is no attempt to model external trade in the sunflowerseed meal subsector. Hence, external trade in sunflowerseed meal is deduced as a residual in the projection of sunflowerseed meal production and consumption that is carried out in Chapter VI of this dissertation.

III. Demand of Sunflowerseed by the Oil Industry.

The quantities of sunflowerseed crushed by the Spanish sunflowerseed industry affect very significantly the amounts produced domestically of sunflowerseed oil and sunflowerseed meal.

Historically, the Spanish sunflowerseed oil industry has tended to crush most of the domestic agricultural production of sunflowerseed. As noted elsewhere, low sunflowerseed harvests have resulted in large sunflowerseed imports. However, large sunflowerseed harvests have not resulted in large sunflowerseed exports: the industry has crushed most of the domestic production of sunflowerseed.

Before Spain entered the EC, the tendency of the industry to crush most sunflowerseed production could be explained because the public intervention of MAPA in the sunflowerseed oil market guaranteed the sunflowerseed oil sales of the industry. On the other hand, after accession to the EC, the industry has still tended to crush most of the sunflowerseed domestic production because it has generally been able to direct sunflowerseed oil surpluses toward external markets.

In the model developed in this section the annual amounts of sunflowerseed crushed in each period t are taken as the dependent variable. For reasons already outlined, one of the independent variables included in the model is the domestic agricultural production of sunflowerseed in period t.

In any case, sunflowerseed has also been crushed in Spain because since the 1970s a strong demand for sunflowerseed oil has emerged in the Spanish oils market.

Thus, the sunflowerseed oil internal disappearance in period t is included as the other independent variable in the model. This last variable should reflect the influence that the demand for sunflowerseed oil has had in the amounts of sunflowerseed crushed by the Spanish sunflowerseed oil industry.

As noted elsewhere, the sunflowerseed produced and crushed in period t is consumed as sunflowerseed oil in period t+1. However, the sunflowerseed oil internal disappearance at period t+1 is not observable at period t.

Therefore, by including the sunflowerseed oil internal disappearance valued at period t, this analysis is assuming that the oil industry regards the sunflowerseed oil internal disappearance at period t as the most plausible approximation to the sunflowerseed oil internal disappearance at period t+1.

Thus, the econometric specification for the equation modelling the demand of sunflowerseed by the Spanish oil industry is as follows:

(5.14) $SC_t = a + b*SOID_t + c*TSP_t + \epsilon_t$

Where,

SC_t = Sunflowerseed crushed in Spain in period t (metric tons).

$SOID_t$ = Sunflowerseed internal disappearance in period t (metric tons).

TSP_t = Total sunflowerseed production in period t (metric tons).

The coefficients for both independent variables are expected to have positive signs. The estimation of the coefficients is carried out with the use of OLS, and is focused on the 1970-1995 sample period to be consistent with the econometric analysis of supply developed in Chapter IV. Hence, the estimation results are the following ones:

$$(5.15)\quad SC_t = \underset{(-1.48)}{-47,885} + \underset{(3.807^{***})}{0.87412}*SOID_t + \underset{(11.445^{***})}{0.75592}*TSP_t$$

$$R^2 = .97388 \qquad d.f = 23 \quad d.w = 1.2103$$

All the relevant coefficients are significant at the 1% level and have the expected signs. The high value of the coefficient of determination shows that the selected independent variables explain very well the variance of the dependent variable. The Durbin-Watson test for AR(1) autocorrelation is inconclusive at the 5% significance level. Nevertheless, the value of the Breusch (1978) -Godfrey (1978) statistic - in this case 2.765- denotes the absence of serial correlation at the 5% significance level.

Finally, the residual series that resulted from the three demand equations that have been estimated in the first three sections of this chapter, were regressed on each other to test for the possible correlation among the disturbances of the bottled sunflowerseed oil, sunflowerseed meal, and crushed sunflowerseed demand equations. This testing procedure denoted that the disturbances of these equations were uncorrelated among them; therefore the single equations techniques employed in the different estimation processes can be regarded as efficient.

IV. Price Equations.

As noted in Chapter I of this dissertation, sunflowerseed prices are considered as exogenous in this study: they are not determined by any of the econometric models developed here. However, it cannot be denied that sunflowerseed prices have a large influence on the prices at which sunflowerseed oil is sold in the market.

Previous to the reform of the CAP in the oilseeds sector, the Spanish sunflowerseed sector was characterized by relatively high sunflowerseed prices and a protected sunflowerseed oil market: this also resulted in relatively high prices for sunflowerseed oil, if compared with the prices prevailing in the international market. The reform of the CAP and the end of the stand-still period have liberalized the Spanish sunflowerseed and sunflowerseed oil markets. Thus, CAP reform and the end of the stand-still period have led to lower sunflowerseed prices and to significant nominal decreases in sunflowerseed oil prices.

Historically, apart for the prices paid for sunflowerseed, there has been different factors that could have influenced the prices of sunflowerseed oil. However most of these factors have not been present during the whole 1970-1995 period. In any case, most key informants consider that, during that period, perhaps the most important determinant of sunflowerseed oil prices was the level of sunflowerseed prices.

Previous to 1985, the intervention price for sunflowerseed oil had an important influence on the final retail price for sunflowerseed oil; however, the public intervention price for sunflowerseed oil was also very influenced by the sunflowerseed price levels.

Moreover, during the stand-still period, and due to the isolation of the Spanish oils market, the domestic demand for sunflowerseed oil could have had also some influence on sunflowerseed oil prices; nonetheless, the utilization of price dependent sunflowerseed oil demand equations would not be appropriate to describe the market regime that has prevailed since 1991, after the end of the stand-still period. Besides, most key informants indicated that sunflowerseed prices also had a strong influence on sunflowerseed oil prices during the years of the stand-still.

After the stand-still period the Spanish sunflowerseed oil prices have been very linked to the sunflowerseed oil prices in the world market, which, in turn, are very influenced by the international prices for sunflowerseed. Hence, after CAP reform, it seems reasonably safe to assume that sunflowerseed oil prices could, very probably, be explained only in terms of sunflowerseed prices.

Thus, sunflowerseed prices could be identified as the major factor determining sunflowerseed oil prices under the 1990s market regime. Moreover, sunflowerseed prices are perhaps the only variable that has had a significant influence over sunflowerseed oil prices during the whole 1970-1995 period; therefore, sunflowerseed prices could be regarded as the most important historical determinant of sunflowerseed oil prices.

On the other hand, sunflowerseed meal prices are much more influenced by soybean meal prices than by the prices paid for sunflowerseed by the oil industry. The livestock feeds market was already almost fully liberalized before CAP reform; thus, the reform of the CAP has not had significant effects on sunflowerseed meal prices.

In fact, the prices paid for sunflowerseed meal have been historically very influenced by the prices paid for soybean meal, which, in turn, have been determined by world market levels, and, accordingly, are taken as exogenous in this study.

In this section two models are constructed, relating sunflowerseed oil prices and sunflowerseed meal prices to sunflowerseed prices and soybean meal prices respectively.

This permits to make projections, in Chapter VI of this dissertation, about the future evolution of sunflowerseed oil and meal prices; these projections are based upon reliable assumptions on the evolution of sunflowerseed prices and soybean meal prices during the 1996-2005 period.

Specifically, the formal model that relates sunflowerseed oil prices to sunflowerseed prices is the following one:

(5.16) $SORP_t = a + b*SPR_{t-1} + \epsilon_t$

Where,

SPR_{t-1} = Sunflowerseed price in Spain in period t-1 (pts/kg).

$SORP_t$ = Sunflowerseed oil retail price in period t (pts/kg).

As it was done previously it is assumed that the sunflowerseed bought by the industry in period t-1 is sold as oil in period t. To be consistent with the previous analysis of demand, the estimation of the coefficients was done by applying OLS to the 1980-1995 sample period. The estimation results are:

$$(5.17)\quad SORP_t = \underset{(6.293^{***})}{97.818} + \underset{(4.247^{***})}{1.3919}*SPR_{t-1}$$

$$R^2 = .563 \qquad d.f = 14 \quad d.w = 1.2955$$

The coefficient for the independent variable is significant and has the expected sign. The Durbin-Watson test is inconclusive at the 5% significance level, but the value of the Breusch-Godfrey statistic -which was 0.208- denotes the lack of AR(1) autocorrelation at that same significance level.

In relation to the equation for sunflowerseed meal prices the formal specification of the model is:

$$(5.18)\quad SMPR_t = a + b*SBMPR_t + \epsilon_t$$

Where,

$SMPR_t$ = Price paid for sunflowerseed meal in Spain, in period t (pts/kg).

$SBMPR_t$ = Price paid for soybean meal in Spain, in period t (pts/kg).

MAPA has only published official series on the prices paid by farmers for sunflowerseed meal and soybean meal since 1977. Thus, the estimation results obtained after applying OLS to the 1977-1995 sample period are:

$$(5.19)\quad SMPR_t = \underset{(3.426^{***})}{5.9013} + \underset{(10.948^{***})}{0.5084}*SBMPR_t$$

$$R^2 = .87579 \qquad d.f = 17 \quad d.w = 1.196$$

Again, the coefficient for the independent variable is significant and has the expected sign; as it can be seen soybean meal prices do influence significantly sunflowerseed meal prices. In this case the Durbin-Watson test is also inconclusive at the 5% significance level; however the value of the Breusch-Godfrey statistic -which now was 2.8272- denotes the lack of AR(1) autocorrelation at the 5% significance level.

CHAPTER VI

PRODUCTION, CONSUMPTION AND TRADE PROJECTIONS

This chapter is devoted to generate different sets of projections on the Spanish production, consumption and net trade of sunflowerseed, sunflowerseed oil and sunflowerseed meal for the 1996-2005 period.

The econometric supply and demand models constructed in Chapter IV and Chapter V of this dissertation are utilized here to evaluate potential future developments of the CAP, in relation to issues affecting the EU oilseeds sector. As noted elsewhere, net trade on sunflowerseed, sunflowerseed oil and sunflowerseed meal is deduced as a residual from the projections that are obtained using the supply and demand models.

More specifically, the present chapter tries to assess the potential impacts on the Spanish sunflowerseed sector of the possible future evolution of the levels of compensatory payments that the EU could grant to the Spanish sunflowerseed producers, as well as of the institutional subsidies that could be granted to the production of rain fed wheat, during the 1996-2005 period.

This approach is adopted because the compensatory payment levels granted to sunflowerseed farmers, as well as the institutional prices and subsidies related to crops that represent an alternative to producing sunflowerseed, are the main policy variables with which the EU legislators could be influencing the development of the Spanish sunflowerseed sector during the next years.

Five different scenarios are constructed according to five alternative sets of assumptions on the potential course of the levels of compensatory payments granted per harvested hectare of rain fed and irrigated sunflowerseed, as well as of the levels of compensatory payments received by rain fed wheat producers. Thus, the future levels of compensatory payments paid per harvested hectare of irrigated or rain fed sunflowerseed, and the compensatory payments received for producing rain fed wheat, vary among the different scenarios; on the other hand, the projections of all the other exogenous variables, including the market prices for sunflowerseed and the intervention and market prices for wheat, are identical under the five scenarios.

EAGGF has already announced the reference amounts that will be used to compute the compensatory payments for sunflowerseed and wheat in 1996. Thus, the five scenarios developed in the present analysis focus on potential alternative evolutions of the compensatory payments granted to sunflowerseed and wheat production during the 1997-2005 period.

The baseline scenario and the third scenario assume that the levels of compensatory payments granted to sunflowerseed and rain fed wheat production will grow at rates below the average rates for the 1992-1996 period.

The second scenario presumes that the institutional subsidies related to the sunflowerseed and wheat sectors will increase, during the 1997-2005 period, at the average rates of the 1992-1996 period[1].

Finally, the fourth and fifth scenarios are based on more radical assumptions about the future evolution of the subsidy levels of the CAP in the arable crops sector.

Hence, the fourth scenario presumes that the compensatory payments for wheat and sunflowerseed will remain constant, in nominal terms, during all the 1996-2005 projection period. Moreover, the fifth scenario takes into account the possibility of sharp nominal decreases in the institutional subsidies and prices related to the sunflowerseed sector. Specifically, this last scenario assumes that all compensatory payments for wheat and sunflowerseed will be progressively reduced to half of their nominal values, over the 1997-2005 period.

[1]In the case of rain fed wheat, at the average rate of the 1993-1996 period.

The different scenarios developed here affect significantly the projections obtained from the supply models estimated in Chapter IV of this dissertation. Accordingly, net trade projections also tend to be somehow affected by scenario changes.

Nevertheless, the demand models projections are relatively unaffected by varying the scenarios. More specifically, only the amounts of sunflowerseed crushed by the industry, as well as the sunflowerseed oil stock variation equation, are affected differently by alternative scenarios; this can be explained through the distinct amounts of sunflowerseed produced and crushed and, consequently, the different sunflowerseed oil production projections, that result under alternative scenarios.

Since it is impossible to exactly anticipate all the events that may occur over the next ten years, it would be excessively ambitious to pretend that the projections of the exogenous variables, that are utilized to replicate the supply and demand models, will be able to accurately portray all the future developments in the sector. As a matter of fact, some of the exogenous variables projections utilized in the supply and demand models could change dramatically due to unexpected events.

Accordingly, the projections of the production, consumption and trade figures presented in this chapter should be regarded as an exercise in comparative statics. Thus, it should not be expected that the projections of the endogenous variables will turn out to be exact, because too many unanticipated events may develop during the 1996-2005 period. Comparing the endogenous variables projections under the five alternative scenarios can provide insights into potential changes and their relative importance, instead of their exact magnitude.

I. Exogenous Variables Projections.

As noted elsewhere, the projections on most of the exogenous variables are the same in all scenarios. This is done in order to isolate the impact of changes in the main policy variables.

More specifically, the exogenous variables whose projections are identical under the five scenarios are the following ones:

1- Set aside percentage for arable crops: this policy variable is needed to compute the expected gross revenues and gross margins series, as were defined in the sunflowerseed rain fed and irrigated acreage equations selected in Chapter IV of this dissertation.

As noted, the rotational set-aside percentage was established at 15% for the 1992-1994 period, and was reduced to 12% in 1995.

The regulation 2336/95 of the European Commission (European Commission, 1995) has further reduced the rotational set-aside requirement to 10% for 1996. It is very unlikely that the rotational set-aside percentage could, in the next years, go below this figure because 10% was the minimum set-aside percentage required for the EU oilseeds sector in the Blair-House agreements.

On the other hand the set-aside requirements could be subjected to increases in the future; however, there is no clear evidence indicating a future movement in that direction during the 1997-2000 period. Therefore, this dissertation assumes that the rotational set-aside requirements for arable crops will remain at 10% during all the 1997-2000 projection period.

Accordingly, for the 1996-2000 projection period, the expected gross margins for rain fed sunflowerseed utilized in the selected rain fed sunflowerseed acreage equation, are computed as follows:

$$(6.1)\quad EGMRFS_t = 0.9*(RFSYS_t*SPR_t) + 0.9*(ACPRFS_t) + 0.1*CPIRFL_t - 0.9*RFSVC_t$$

Where $EGMRFS_t$, $RFSYS_t$, SPR_t, $ACPRFS_t$, $CPIRFL_t$, $RFSVC_t$ are relevant sunflowerseed variables described in the model specification of the rain fed sunflowerseed acreage equation selected in Chapter IV, and whose projections are described later in this chapter.

Moreover, for the same projection period, the expectations about gross margins for rain fed wheat incorporated into the selected rain fed sunflowerseed area equation, are calculated according to the following mathematical expression:

$$(6.2)\ EGMRFW_t = 0.9*(RFWYS_t*WIP_t^2) + 0.9*(ACPRFW_t) + 0.1*CPIRFL_t - 0.9*RFWVC_t$$

Where $EGMRFW_t$, $RFWYS_t$, WIP_t, $ACPRFW_t$, $RFWVC_t$ are also relevant wheat variables incorporated into the model specification of the rain fed sunflowerseed acreage equation previously selected in Chapter IV; such variables are also projected later in this chapter.

Finally, the expected gross margins for irrigated sunflowerseed incorporated into the selected irrigated sunflowerseed area equation are computed as follows, for the 1996-2000 period:

$$(6.3)\ EGMIS_t = 0.9*(ISYS_t*SPR_t) + 0.9*(ACPIS_t) + 0.1*CPIIL_t - 0.9*ISVC_t$$

Similarly, $EGMIS_t$, $ISYS_t$, $ACPIS_t$, $CPIIL_t$ and $ISVC_t$ are relevant variables in the model specification of the irrigated acreage equation selected in Chapter IV; again, the projection of these variables is also explained later in this chapter.

The Uruguay Round GATT agreement will constrain EU subsidized cereal exports after 2000. For example, under this agreement, the EU's subsidized wheat and flour exports (excluding food aid) are expected to fall from 19.1 million tons in 1995 to 13.4 million tons in 2000 (USDA, 1995). To avoid building stocks, some sources estimate that, after 2000, the EU will increase the arable set-aside requirements to restrain production growth in the cereal sector (USDA, 1995).

More specifically, this dissertation assumes that, during the 2001-2005 interval, the set-aside requirements for arable crops will return to the levels of the 1992-1994 period. Thus, the presumption is that the rotational set-aside percentage will be established at 15%, for the 2001-2005 period.

[2]For reasons that will be explained later, the dissertation will use the projected market price, instead of the intervention price, to project farmers' expectations about rain fed wheat gross margins from year 2000 onwards.

Therefore, for the 2001-2005 projection interval, the expected gross margins for rain fed sunflowerseed utilized in the selected rain fed sunflowerseed acreage equation, are computed exactly as in equation 4.6.

Furthermore, for the same projection period, the expected gross margins for rain fed wheat incorporated into the selected rain fed sunflowerseed area equation, are calculated as:

$$(6.5)\ EGMRFW_t = 0.85*(RFWYS_t*WPR_t) + 0.85*(ACPRFW_t) + 0.15*CPIRFL_t - 0.85*RFWVC_t$$

Where WPR_t is the projected wheat market price in Spain. Finally, the expected gross margins for irrigated sunflowerseed incorporated into the selected irrigated sunflowerseed area equation are computed exactly as in expression 4.51, for the 2001-2005 projection period.

2- Agricultural conversion rate of the ECU in pesetas: the agricultural value of the ECU is necessary to convert the institutional prices and subsidies that EAGGF announces every year, to the payments in pesetas that finally will be received by Spanish farmers. As noted, since 1995, the agricultural conversion rate of the ECU is equal to the value of the peseta versus the ECU in the monetary markets, on the first of July of every agricultural year.

Therefore, over future years the agricultural conversion rate of the ECU would vary depending on the movements of the peseta within its fluctuation bands in relation to the ECU, established in the European Monetary System (EMS).

If Spain fulfills the conditions for accession to the Single European Currency in 1999, then the agricultural conversion rate of the ECU in pesetas will become completely fixed. However, relatively abrupt devaluations -as it occurred during the monetary unrest of 1993- or revaluations are also possible before Spain gains accession to the future European Single Currency.

Consequently, it is almost impossible to predict the exact path that the peseta will follow in relation to the ECU during the 1996-2005 period. In any case, the EMS guarantees that the peseta will remain at relatively fixed levels in relation to the ECU. Thus, assuming the absence of future devaluations or revaluations within the EMS, it might be plausible to presume that the agricultural conversion rate of the ECU in pesetas could remain, for the 1996-2005 projection period, at the same levels as in 1995, that is around 165.2 pesetas/ECU.

3- Historical rain fed and irrigated cereal yields: as noted elsewhere, the rules that EAGGF has established to compute the compensatory payments for irrigated and rain fed sunflowerseed, for rain fed wheat, as well as for rain fed and irrigated idle land, take into account the historical cereal yields, over the 1989-1991 period, in each agricultural district or *comarca*[3].

It is possible that in the future EAGGF will revise these historical yields, updating the period for their computation. However, the European Commission has not made, so far, any official announcements in relation to this issue.

Therefore, when constructing the announced compensatory payments projections, for the computation of the projected farmers' expectations about gross margins, this dissertation presumes that the historical cereal yields remain as defined in Chapter II and Chapter IV.

4- Restrictions to the production of sunflowerseed: as suggested in Chapter II and confirmed in Chapter IV of this dissertation, the legal restrictions that, during the years 1994 and 1995, MAPA imposed on the Spanish farmers producing oilseeds, proved as very effective policy instruments in containing the enormous growth in both the rain fed and the irrigated sunflowerseed acreages, that resulted after the reform of CAP in the oilseeds sector.

The imposition of such severe restrictions on the production of sunflowerseed has certainly helped to avoid severe penalizations for the Spanish sunflowerseed producers in 1994 and 1995. Moreover, MAPA announced

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[3] As noted in Chapter III, this dissertation considers the average historical cereal yields, during the 1989-1991 period, in the four main sunflowerseed producer provinces, as the most accurate representation of the historical yield assigned to the typical district producing sunflowerseed.

the same set of restrictions in effect in 1996. Hence, in the rain fed and irrigated acreage equations, the dummy variable DVR_t still takes the value $DVR_t=1$ for the projection for 1996.

In any case, the strict restrictions that MAPA has imposed to the production of sunflowerseed, during the 1994-1996 period, should be regarded as exceptional policy measures that have arisen in the context of an extraordinary growth in the area planted with sunflowerseed in Spain.

Therefore, it would be excessively rigorous to assume that these exact restrictions are going to prevail during all the 1997-2005 projection period. Instead, all the projections developed in this analysis, are made upon the presumption that such restrictions are not effective during the years of the 1997-2005 period.

Consequently, the dummy variable DVR_t takes the value $DVR_t=0$ for the years of the projection period 1997-2005. Thus, the acreage projections generated under the different scenarios considered in the present analysis will provide an estimation of potential sunflowerseed acreages, under the assumption of the *absence*, during the 1997-2005 period, of restrictions on the production of sunflowerseed.

Hence, the acreage figures thus projected, could provide an impression on the likelihood of future penalizations for Spanish sunflowerseed farmers if no restrictions are adopted, as well as a basis for policy recommendations on the necessity of future legal restrictions to the production of sunflowerseed in Spain.

Accordingly, the projections on sunflowerseed, sunflowerseed oil and sunflowerseed meal production, consumption and net trade, are also made only under the assumption that MAPA's legal restrictions on sunflowerseed production are not maintained during all the years of the 1997-2005 period.

5- <u>Consumer Price Index (CPI)</u>: the projection of the CPI is essential to project all the deflated variables that are utilized in the model. It is also important in order to project the prices of the different inputs utilized in the computation of the variable costs series.

This dissertation utilizes the CPI projections for Spain facilitated by OECD, for the period 1996-2000 (ABC, 1995).

OECD predicts an inflation rate of 3% for Spain in year 2000. Unfortunately, the author was unable to find projections of the Spanish inflation rate for the years of the period 2001-2005; therefore, this dissertation adopts the conservative assumption of considering that the Spanish inflation rate will also be 3% for all the years of the 2001-2005 period.

6- Sunflowerseed market prices: sunflowerseed prices are exogenous to the model; nevertheless, the projection of sunflowerseed prices, for the 1996-2005 period, is necessary to project sunflowerseed oil prices according to equation 5.17.

Moreover, as noted in Chapter IV, since 1992 this study assumes that farmers are able to include sunflowerseed market prices -instead of the abolished intervention prices- in the formation of their expectations about gross margins; besides, since 1992, sunflowerseed market prices also have replaced sunflowerseed intervention prices in the sunflowerseed yield equations.

Therefore, the projection of sunflowerseed prices is also needed[4] in order to be able to use the selected acreage and yield equations in the prediction of the sunflowerseed total harvested area and production.

In Spain, there are no official publications providing projections on the future Spanish prices for sunflowerseed. Nonetheless, as noted previously, the Spanish sunflowerseed prices have been around world market levels since 1992. Unfortunately, the author was not able to find, either, any official source of projections for the international price of sunflowerseed during the 1996-2005 period.

[4]In any case, since 1992, gross revenues and gross margins in the production of sunflowerseed have been mostly influenced by the levels of direct compensatory payments received by farmers. Therefore, the exactitude of the sunflowerseed price projections has a relatively low impact on the accuracy of the sunflowerseed supply predictions.

Nevertheless, the Food and Agricultural Policy Research Institute (1995) has published a projection series, for the 1996-2003 period, on soybean prices in the Rotterdam market. In general, the Food and Agricultural Policy Research Institute (FAPRI) suggests moderate increases in the international market price for soybeans during the 1996-2003 projection period. Moreover, soybeans and sunflowerseed are substitutive products in the international market and, therefore, their prices tend to be very correlated.

For 2004 and 2005 there were not any available projections on the prices of soybeans in the Rotterdam market; however, USDA (1995) provides projections, up to year 2005, on the US market price for soybeans. The US is one of the major world sunflowerseed producers and exporters, and their sunflowerseed sector is very export oriented; it is also the main international soybean and soybean meal exporters.

Furthermore, since the US dominates the international soybean market, the projections of the US soybean price could perhaps represent the best available approximation of future trends in the international price for soybeans during the 2004-2005 period.

Since the Spanish sunflowerseed prices are linked to the international oilseeds market prices, this dissertation assumes that the future evolution of the Spanish sunflowerseed market prices can be approximated by the FAPRI projections for the Rotterdam soybean prices, during the 1996-2003 period, and by the USDA projections for the US soybean prices, during the 2004-2005 period.

This approach results in moderate increases in the market price for sunflowerseed in Spain, over most years of the 1996-2005 period, which seems, in fact, a plausible projection of sunflowerseed prices.

In any case, if future researchers find that this projection of the Spanish sunflowerseed prices varies significantly from the future real trend in prices, they could incorporate more realistic price projections (if available in the future for the Spanish sunflowerseed prices) into the supply and demand models estimated in the present study.

7- <u>Wheat institutional prices</u>: the projection of the intervention prices in the wheat sector is necessary to be able to project farmers' expectations about gross margins in the production of wheat, which in turn affects projections in the rain fed sunflowerseed acreage equation.

Since 1989 to 1995, the intervention prices for wheat have suffered nominal decreases, which were especially sharp in 1993. The policy that EAGGF has announced in the wheat sector, for 1996 onwards, consists of freezing the intervention prices for wheat at 100 ECU/MT. Wheat producers are to be compensated with annual increases in the compensatory payments received for wheat production, due to the decline in the real value of the intervention prices for wheat.

Although sometimes agricultural policy decisions tend to be modified over time, this dissertation takes for granted EAGGF decision of freezing cereal intervention prices, and assumes a wheat intervention price of 100 ECU/MT during the whole 1997-2005 period; this is mainly because of the strong commitment of the CAP to decrease the relative importance of price intervention in the arable crops markets, as has, in fact, occurred for all the years of the 1989-1996 period.

Therefore, the five scenarios constructed in this chapter assume the same decrease in the real value of the intervention prices paid for rain fed wheat during the 1996-2005 projection period. However, each scenario presents a different set of assumptions about the compensatory payments that could be received in the future by wheat producers.

In 1995, the EU intervention price for wheat -which was 100 ECU/MT- was significantly below the world price for wheat, which in the Rotterdam market averaged around 126 ECU/MT. However, this could be considered as an exceptional situation because the world cereal markets experienced atypically high price levels during 1995, due to especially adverse weather conditions in the main exporter countries.

The sources utilized in this dissertation to project the international price for wheat suggest that wheat prices are very likely to return to lower levels, at least during the early years of the 1996-2005 projection period. More specifically, this dissertation utilizes the projections provided by FAPRI (1995) for the Rotterdam wheat price during the 1996-2003 period.

If the EU intervention price remains at 100 ECU/MT, for all the years of the 1996-2005 period, and the international price for wheat follows the path forecasted by FAPRI (1995), then, during the 1996-1999 period, the Rotterdam wheat price should be only slightly above the EU intervention price.

Hence, it seems plausible to assume that Spanish farmers will still use, during the 1996-1999 period, the institutional wheat price when forming their gross margins expectations in the production of rain fed wheat.

However, in year 2000 the projected wheat Rotterdam price (FAPRI, 1995) would be at what could be considered significantly higher levels (115.87 ECU/MT) than the projected intervention price for wheat. Moreover, during all the years of the 2000-2003 period the international price for wheat is expected to be well above the EU intervention price: for example, in 2003, the projected Rotterdam wheat price (FAPRI, 1995) is expected to be 126.9 ECU/MT.

Therefore it seems plausible to presume -as it is specified in expression 6.5- that in the years of the 2000-2005 period, Spanish farmers would use the market wheat prices, instead of the intervention wheat prices, in computing their gross margins expectations[5] in the production of rain fed wheat. It is also assumed that, from year 2000 onwards, the Rotterdam wheat price projections expressed in pesetas could provide a good approximation of the market wheat price in Spain.

Hence, this dissertation assumes that, when forming their gross margins expectations, rain fed wheat producers will consider a wheat price of 100 ECU/MT for the 1996-1999 period, and the projected Rotterdam wheat prices for the 2000-2005 projection interval.

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[5]Just as it has been assumed in the production of sunflowerseed since 1992.

Unfortunately, the author was unable to find reliable sources of projections for the international price for wheat during the 2004-2005 period. However, since the US is one of the leading wheat exporters, the USDA (1995) projections for the US wheat price could provide a plausible approximation to the evolution of the price of wheat in the international market during the 2004-2005 projection period[6]. Thus, assuming that the international wheat price will follow the same path that the US wheat price during the 2004-2005 period, then in year 2005 the Rotterdam wheat price is expected to be at 132.12 ECU/MT.

8- Sunflowerseed and wheat variable cost series: the projection of the different variable cost series is important to compute the expectations about gross margins, such as they were defined in the acreage equations selected in Chapter IV.

In this case, it is assumed that the input application rates in the production of rain fed and irrigated sunflowerseed will remain constant during all the 1996-2005 projection period, and that input prices will change at the rate of inflation during that same period. This could be regarded as a plausible assumption because no major qualitative policy changes in the CAP for the oilseeds sector are expected during the 1996-2005 projection period.

In the case of rain fed wheat, the situation is more complicated because it is possible that input application rates in the production of rain fed wheat would decrease in the future, due to a gradual decrease in the real value of the intervention price for wheat.

However, so far, no study has detected a significant decrease in the input application rates, and hence in the variable costs in the production of rain fed wheat. As noted in Chapter III, most consulted key informants consider that rain fed wheat production practices have not experienced significant changes during the 1993-1995 period. This could be mainly

[6]USDA (1995) predicts that wheat prices will increase at relatively fast rates due, in part, to a slower yield growth for wheat than for most other arable crops.

explained by the devaluation of the peseta in 1993, which has offset partly the decrease in the real value of the intervention prices for wheat, and because the Spanish cereal market has failed, somehow, to reflect the decreases in the intervention price for wheat that have occurred during the first half of the 1990s.

In any case, most of the key informants consulted consider that abrupt decreases in input application rates should not be expected in the production of rain fed wheat, as occurred in 1992 in the production of rain fed sunflowerseed. This is because the decline in the real value of the wheat intervention price is expected to take place *gradually* during the 1996-2005 projection period; accordingly, it could be plausible to assume only moderate and gradual decreases in the real value of the variable costs associated to the production of rain fed wheat, over the 1996-2005 period.

Unfortunately, at the moment of writing this dissertation it was not possible to know the exact magnitude of the potential changes that could occur, during the 1996-2005 period, in the input application rates and in the variable costs related to the production of rain fed wheat.

In fact, to measure such effects, it would be necessary to incorporate agricultural studies relating appreciable changes in the rain fed wheat production practices to the decrease in the real value of the wheat intervention and market prices, and these studies are not available yet.

The presumption that this dissertation adopts, to generate variable costs projections in the production of rain fed wheat, is that the reform of the CAP will have similar impacts for rain fed wheat and for rain fed sunflowerseed, but that the effects will be more distributed over time in the production of rain fed wheat.

Thus, in the production of rain fed sunflowerseed, the average real value of the sunflowerseed prices received by farmers during the 1992-1995 period was equal to only 36.2% of the average real value of sunflowerseed prices during the 1985-1991 period. As a consequence, the real value of the variable costs in the production of rain fed sunflowerseed during the 1992-1995 period decreased to 68.5% of the real value of the variable costs during the 1985-1991 period.

For rain fed wheat, the assumption adopted in this analysis is that the proportionality between real prices and real variable costs reductions will be the same as in the production of rain fed sunflowerseed[7]. As noted, for the projections made for the 2000-2005 period, it is assumed that wheat producers will base their gross margins expectations on the wheat market price instead of on the wheat intervention price. If the projection of the wheat market price for year 2005 (around 132 ECU/MT) is accurate, then the real value of the rain fed wheat market price in 2005 should be around 65% of the real average value of the wheat market prices during the 1992-1995 period.

If rain fed wheat production responds as the production of rain fed sunflowerseed, then rain fed wheat producers should be able to reduce gradually their variable costs and, accordingly, in year 2005 the real value of the rain fed wheat variable costs per hectare should be equal to around 83% of the real value of the rain fed wheat variable costs for 1995. Therefore, this dissertation assumes that rain fed wheat producers will be able to reduce annually real variable costs by almost 500 real pesetas[8] per hectare during all the years of the 1996-2005 projection period.

9- <u>Farmers' expectations about sunflowerseed and wheat yields</u>: as noted in Chapter IV, the selected acreage equations presume that the application of the DES technique to the actual sunflowerseed and wheat series for the 1964-1995 period, provides a good approximation of the

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[7]This is only a rough approximation. In fact, rain fed wheat and rain fed sunflowerseed producers might react differently to the same decreases in real prices. However, so far, there are no case studies on how rain fed wheat producers could respond, over time, to the moderate decreases in the real value of the intervention and market prices for wheat that are expected for the 1996-2005 projection period. Besides, a very detailed study on rain fed wheat production practices is beyond the scope of this dissertation.

[8]Valued at year 1983, like all the real variables utilized in this dissertation.

farmers' expectation about the potential yields that could be obtained in the production of these crops in any given period.

In fact, the application of DES to the actual sunflowerseed and wheat yield series during the 1964-1995 period can generate expected yield projections for the 1996-2005 period. However, in the case of rain fed and irrigated sunflowerseed, the 1996-2005 DES expected yield projections obtained from the original 1964-1995 sample were excessively low; as a matter of fact, this method did even generate negative rain fed sunflowerseed yields for the late years of the 1996-2005 projection period. Therefore, this study considers that the application of DES to the original 1964-1995 sunflowerseed yields does not generate reliable estimations of farmers' expectations about yields in the production of sunflowerseed.

In any case, the supply model developed in this dissertation does generate projections of potential *actual* irrigated and rain fed sunflowerseed yields during the 1996-2005 period. These projections can be utilized in the generation of estimations of the *farmers'* expectations about yields in the production of rain fed and irrigated sunflowerseed for that same interval. Thus, the projections on the *expected* sunflowerseed yields, for the years of the projection period, would be calculated taking into account the estimated *actual* yields for the 1996-2005 interval.

To generate the expected yield projections, the actual yields estimates for the 1996-2005 period were incorporated to the historical actual irrigated and rain fed sunflowerseed yields series for the 1964-1995 period; the series thus constructed include all the 1964-2005 period. The next step consisted in applying DES to the whole 1964-2005 sample.

To be consistent with the specification of the rain fed acreage equation selected in Chapter IV, this study considers that the expectations of farmers about rain fed sunflowerseed yields for the 1996-2005 projection period could be approximated after computing a three step moving average of the 1964-2005 DES rain fed sunflowerseed yields series; similarly, farmers' expectations about irrigated sunflowerseed yields are calculated from a two step moving average of the 1964-2005 DES sunflowerseed irrigated yield series.

In the case of rain fed wheat, the 1996-2005 DES yield projections obtained from the application of DES to the original 1964-1995 sample resulted in significant annual increases in the farmers' expectations about rain fed wheat yields. This result is difficult to accept in the context of declining real intervention and market prices for wheat that has arisen with the reform of the CAP in the arable crops sector.

Moreover, this dissertation has not generated supply models for rain fed wheat because it focuses solely on the sunflowerseed sector. Therefore, a prediction of the potential future evolution of actual yields in the production of rain fed wheat cannot be deduced from the models developed in this study.

Furthermore, at the present moment, it is difficult to generate estimations of the farmers' expectations about yields in the production of rain fed wheat for the 1996-2005 period, mainly because reliable studies relating rain fed wheat production practices to the evolution of the CAP in the arable crops sector are not available yet for that period.

Therefore, this dissertation adopts the conservative assumption of considering that the farmers' expectations about rain fed wheat yields, during all the years of the 1996-2005 period, could be approximated by the average Spanish rain fed wheat yields during the 1989-1991 period. The years of the 1992-1995 period are not included in this computation because of the adverse effects on yields of the drought that affected Spain during that interval.

Thus, during the 1996-2005 period it is assumed that rain fed wheat yields are not expected to increase with relation to the 1989-1991 historical yields; this could be explained by the depressing effects that the decline in the real value of wheat intervention and market prices in Spain could have on rain fed wheat yields.

On the other hand it seems plausible also to assume that rain fed wheat yields are not expected to decrease either with respect to the 1989-

1991 historical yields; this could be explained by the positive effects of technological change, and because the decline in the real value of wheat intervention prices is going to be gradual and moderate over the years. Therefore, this dissertation adopts the assumption of constant expectations about rain fed wheat yields for the 1996-2005 period.

10- Availability of irrigation water: as noted in Chapter IV, the selected irrigated acreage equation included the dummy variable DVD_t for the 1992-1995 period, due to the tremendous decline in the availability of irrigation water that most of the Spanish agriculture has experienced during that interval.

The terrible drought that affected Spain during the first half of the 1990s seems to have ended in the fall of 1995 and the winter of 1996. Therefore, it is expected that the average rainfall for 1996 would be what could be considered normal levels for Spain.

Nevertheless, it is likely that for the 1996 agricultural year there will still be restrictions in the availability of irrigation water, due to the low levels registered in most reservoirs in Southern and Central Spain. Hence, this study assumes that the DVD_t dummy variable should still take the value $DVD_t=1$ for the projection for 1996.

On the other hand, the present analysis regards as very atypical the drought situation that Spain has experienced during the first half of the 1990s. Thus, it is assumed that the rainfall levels will take average values for all the years of the 1996-2005 period. This should imply the end of the restrictions to the use of irrigation water from 1997 onwards. Hence, the study presumes that the dummy variable constructed for the availability of irrigation water should take the value $DVD_t=0$ for all the years of the 1997-2005 projection period.

11- Rainfall data: rainfall in the main sunflowerseed provinces proved to be a significant variable in the sunflowerseed yield equations; however, it is almost impossible to predict accurately the exact annual rainfall data for the 1996-2005 period. This dissertation adopts the conservative assumption of presuming that every year of the 1996-2005 interval will receive the average, or "normal", rainfall for the main sunflowerseed producer provinces.

The average rainfall is computed averaging the rainfall data for the four main sunflowerseed provinces during the 1970-1991 period. The data for the 1992-1995 period are not included because these have been the driest years of the present century, and it seems that it would be unlikely that such an exceptional situation could be repeated during the years of the 1996-2005 interval.

12- Sunflowerseed stock variation: the historical data shows sunflowerseed stock accumulations or releases during only four years[9] of the whole sample, and at almost insignificant levels. Therefore, it seems plausible to assume that there will be no sunflowerseed stock accumulation during all the 1996-2005 period.

13- Proportion of the sunflowerseed internal disappearance that is not crushed: as noted in Chapter II, some proportion of the Spanish domestic sunflowerseed consumption goes into uses different from the production of sunflowerseed oil: direct human consumption, livestock feed and utilization in the farm as seed.

The proportion of Spanish sunflowerseed domestic disappearance that is not crushed tends to be fairly small and, consequently, it has not been modelled in this dissertation. Instead, the present study assumes that this proportion will remain at the average level of the 1990-1995 interval -that is 2.12% of the internal sunflowerseed disappearance- during all the years of the 1996-2005 projection period.

14- Olive oil retail prices: the projection of potential average retail prices for bottled olive oil is necessary to project the Spanish consumption of bottled sunflowerseed oil, according to the sunflowerseed oil demand equation estimated in Chapter V. Nevertheless, a detailed analysis of the future developments in the olive oil sector is beyond the scope of this dissertation. Therefore, the projection of olive oil prices

[9] Specifically, the years of the 1987-1990 period.

that is carried out here is just a rough approximation, that is based on the opinions of consulted key informants.

In any case, the estimation of the bottled sunflowerseed oil demand equation, carried out in the previous chapter, denoted low own price and cross-prices elasticities for the consumption of sunflowerseed oil. This suggests that the demand for sunflowerseed oil should follow relatively stable patterns over the next years, and that its evolution is not likely to be extremely affected by the future progression of the price premium paid for olive oil.

Spain is one of the leading olive oil producers and exporters in the world, and shortages in the Spanish olive oil production affect both the Spanish domestic price and the world price for olive oil. As noted elsewhere, in 1995, olive oil prices in Spain experienced a very significant increase, mainly due to a very bad domestic olive harvest in 1994. Most of the year 1995 was also subjected to very severe drought conditions, which did, in turn, result in a low olive harvest.

Therefore, in 1996, olive oil prices are expected to reach even higher levels than in 1995 (ABC, 1995). Some key informants consider that the average olive oil retail prices could be around 630 pesetas/liter for 1996; accordingly this is the value used in this analysis for the projection of olive oil retail prices for 1996.

The projection of olive oil prices for the years of the 1997-2005 period is a more complicated issue because, unfortunately, MAPA does not provide long-term projection series for the Spanish olive oil prices. In any case, at the end of 1995 and at the beginning of 1996 rainfall levels in Spain increased substantially with respect to previous years. Therefore, large increases in the price of olive oil, caused by bad weather conditions, should not be expected in 1997. For the rest of the projection period, this analysis is also assuming average rainfall levels in Spain.

Moreover, a reform of the CAP in the olive oil sector is expected to take place in 1997 or 1998. The exact content and nature of this reform is still unknown and, accordingly, it is unclear what would be its effects on olive oil prices, although it is possible that it could lead to an increase in prices if the consumption aid is abolished.

In any case, it is unlikely that olive oil prices could experience in 1997 the same increases as in 1995, and as the projected increases for 1996. Moreover, since prices for 1996 are expected to be exceptionally high, it could even be plausible to expect a decrease in the olive oil price for 1997. Nonetheless, the historical data shows that large price decreases are not common in the olive oil market. Therefore, it seems very unlikely that prices in 1997 will return to levels similar to those prevailing in 1994, before the explosion in olive oil prices. Hence, this study assumes that olive oil prices in 1997 will be equal to the arithmetic average of the prices for 1995 and 1996.

For the 1998-2005 period, this dissertation presumes that olive oil prices will increase at a 2.5% annual rate. This is the average annual rate at which olive oil prices increased during the years of the 1990-1994 period; these years could be regarded as relatively "normal" years because the drought that affected Spain, during the first half of the 1990s, had not resulted yet in large shortages in the production of olive oil.

15- Population: the projection of the Spanish population for the 1996-2005 period is necessary to forecast all the variables that are expressed in per capita terms. The present study utilizes the series on population projections published by MAPA (1995) for the 1996-2010 period.

16- Spanish national disposable income: the projection of this variable is necessary to project the Spanish consumption of bottled sunflowerseed oil during the 1996-2005 period. For 1996 and 1997, this study assumes that the Spanish disposable income will grow at the growth rates that OECD (1995) predicts for Spain's Gross Domestic Product (GDP).

The author was unable to find GDP projections for the 1998-2005 period focused solely on Spain. Nevertheless, this dissertation assumes that the growth rates of the Spanish disposable income, during the 1998-

2005 interval, could be approximated by the average GDP growth rates that USDA (1995) predicts for the EU-12 during the years of that period.

17- Proportion of the sunflowerseed oil internal disappearance that is not consumed bottled: as noted in Chapter II, the sales of bottled sunflowerseed oil account for most of the Spanish sunflowerseed oil internal disappearance. However, a relatively small proportion of the sunflowerseed oil internal disappearance is not sold bottled, but is utilized directly as a raw material in food processing and other uses.

This dissertation does not model the non bottled domestic consumption of sunflowerseed oil; as pointed out in Chapter V, this can be justified by the relatively minor importance of this kind of consumption, as well as by the lack of official sources of data on non bottled sunflowerseed oil prices. There is also a lack of reliable data on the distribution of non bottled sunflowerseed oil sales among potential different uses.

Instead, the present analysis assumes that the proportion of the sunflowerseed oil internal disappearance that is not bottled is going to remain fixed, during all the years of the 1996-2005 period. More specifically, this study assumes that, during all the years of the 1996-2005 period, the proportion of the sunflowerseed oil domestic disappearance that is not bottled will remain at the average level of the 1990-1995 interval, which was around 16%. Thus, for the 1996-2005 period this dissertation assumes that 16% of the sunflowerseed oil internal disappearance corresponds to sales outside the sunflowerseed bottled oil market.

18- Soybean meal market prices: the projection of soybean meal prices is needed to predict the sunflowerseed meal prices according to equation 5.19. Soybean meal prices are also an important component of the sunflowerseed meal demand equation estimated in Chapter V, and, therefore, need to be projected in order to obtain estimations of the Spanish future consumption of sunflowerseed meal.

There are no official sources of projections for the Spanish prices of soybean meal. Nonetheless, this dissertation utilizes the prices projected by FAPRI (1995) for the Rotterdam soybean meal prices, during the 1996-2003 period, as an approximation to the future evolution of soybean meal market prices in Spain during that time interval.

Since FAPRI's projections are limited to the 1996-2003 period, for years 2004 and 2005 this dissertation assumes that the projected US market prices for soybean meal (USDA, 1995) can provide a relatively good estimation of the evolution of soybean meal prices in the Spanish market. This approach can be justified because the US is one of the leading world soybean meal exporters, having a very significant influence on soybean meal prices in the international market, and also because most of the Spanish soybean meal imports come from the US and are not subjected to any protective arrangements.

II. Compensatory Payments and Endogenous Variables Projections.

As noted in Chapter II, this dissertation assumes that the average compensatory payments per hectare received in the productions of sunflowerseed and wheat, can be computed multiplying the reference amounts granted by EAGGF -once they have been translated to pesetas- by the historical average yields for rain fed or irrigated cereals, obtained in the main sunflowerseed producer provinces during the 1989-1991 period.

Moreover, the projection of future reference amounts, and hence of future compensatory payments levels, is necessary in order to incorporate, into the acreage equations, future estimations of the farmer's expectations about gross margins in the production of sunflowerseed and wheat.

EAGGF has announced that the reference amount for sunflowerseed -which was 143.6 ECU/MT for 1995- will be established at 165.75 ECU/MT for 1996 (European Commission, 1995). However, so far, EAGGF has not revealed the reference amounts that will be utilized to compute the compensatory payments in the production of sunflowerseed for the years of 1997-2005 period.

The potential evolution of the reference amounts granted in the wheat sector is also a key issue in this dissertation, due to the significant effects of the expected rain fed wheat gross margins on the sunflowerseed rain fed area equation. In the wheat sector, the reference amount for 1995 was 45 ECU/MT.

Most of the consulted key informants consider that the tendency in this sector is to maintain constant nominal intervention prices and to increase the compensatory payments per hectare. In fact, for 1996, EAGGF has announced that the reference amount -with respect to which the compensatory payments for wheat are deduced- will be equal to 54.34 ECU/MT (European Commission, 1995).

Nonetheless, EAGGF has not revealed, either, the reference amounts that will be used to calculate the compensatory payments in the production of rain fed wheat for the years of 1997-2005 period.

The projection of the reference amounts granted to idle land is also needed to compute the future compensatory payments that could be received by the base hectares planted with rain fed sunflowerseed and wheat and with irrigated sunflowerseed. EAGGF has also announced that, in 1996, the reference amount granted for the land that is left idle to fulfill the set-aside requirements is established at 68.83 ECU/MT (European Commission, 1995). However, the potential reference amounts for idle land for the 1997-2005 period are still unknown.

Consequently, the five different scenarios constructed in this chapter will be based on potential alternative evolutions of the average levels of compensatory payments granted to the productions of rain fed sunflowerseed and wheat, and to the production of irrigated sunflowerseed, during the 1997-2005 period. Nonetheless, the proportion of gross revenue that is obtained from the market in the production of rain fed sunflowerseed and wheat, as well as in the production of irrigated sunflowerseed, remains constant among scenarios.

On the other hand, all the supply and demand projections for 1996, are the same under the five distinct scenarios, because, with independence of the scenario utilized, these projections will be based on the actual reference amounts that EAGGF has announced for 1996.

At the present moment, it is very difficult to predict which will be the future growth rates in the reference amounts -which in turn will determine the growth rates in the compensatory payments- for sunflowerseed, wheat and idle land. The first three scenarios are based on the assumption that the levels of deficiency payments that EAGGF guarantees to the Spanish sunflowerseed and wheat producers, will increase, in nominal terms, during all the years of the 1997-2005 period. So far, this has been the path effectively followed by the compensatory payments in the sunflowerseed and wheat sectors, since the reform of the CAP in oilseeds and other arable crops was first put into practice.

II.a. First Scenario.

This first scenario should be regarded as the baseline scenario: according to consulted key informants, the assumptions on which this first scenario is based could, perhaps, represent the most plausible evolution of the compensatory payment levels that could be granted in the sunflowerseed and wheat sectors, during the 1997-2005 projection period.

During the 1992-1996 period, the compensatory payments granted in the EU's arable crops sector have grown at considerably high rates. More specifically, the reference amounts for sunflowerseed and for idle land have increased, during the 1992-1996 period, at a 9.3% average annual rate and at a 19% average annual rate respectively.

Furthermore, the average annual growth rate in the reference amounts for wheat has been at much higher levels than for sunflowerseed; as a matter of fact, during the 1993-1996 period, the reference amount for wheat has increased at an average annual rate of 29.8%.

As can be seen, the compensatory payments granted in the production of sunflowerseed and wheat, as well as for idle land, have grown at

significantly high rates since the reform of the CAP in the oilseeds and other arable crops sectors was put into practice. It is expected that as the reform of the CAP develops, EAGGF will moderate the increases in the reference amounts for sunflowerseed and for idle land.

In fact, since sunflowerseed and idle land compensatory payments are currently at substantially high levels, a significant moderation in the growth rates of the reference amounts for sunflowerseed and idle land could be expected during the 1997-2005 period. Thus, this first scenario presumes very modest increases in the sunflowerseed and idle land reference amounts: specifically, the first scenario assumes that the sunflowerseed and idle land reference amounts will grow at a 2% annual rate during all the years of the 1997-2005 period, which is even below the projected inflation rates for that interval.

The reference amounts granted in the production of wheat could also be subjected to some moderation in the future, although, probably, will still continue to grow at significant rates, mainly because the compensatory payments for rain fed wheat were still at relatively low levels for 1996. Thus, in the first scenario the wheat reference amounts are projected to increase at a 15% rate, which is still at substantial levels, but is also significantly below the 1993-1996 historical growth rates of the wheat reference amounts.

As noted, the projections of the variables $EGMRFSD_t$, $EGMRFWD_t$ and $EGMRFWD_t$ under this first scenario are different from the projections in the other four scenarios (because of the different deficiency payments levels projected under alternative scenarios); accordingly, the projections of the irrigated and rain fed sunflowerseed acreages and productions are also different among the different scenarios.

The results of the acreage projections for the first scenario are summarized in Table 6.1. To obtain these projections it is necessary to utilize the rain fed and irrigated sunflowerseed area equations that were selected in Chapter IV. These are recursive equations in which the lagged acreage is one of the independent variables. Thus, the projected lagged

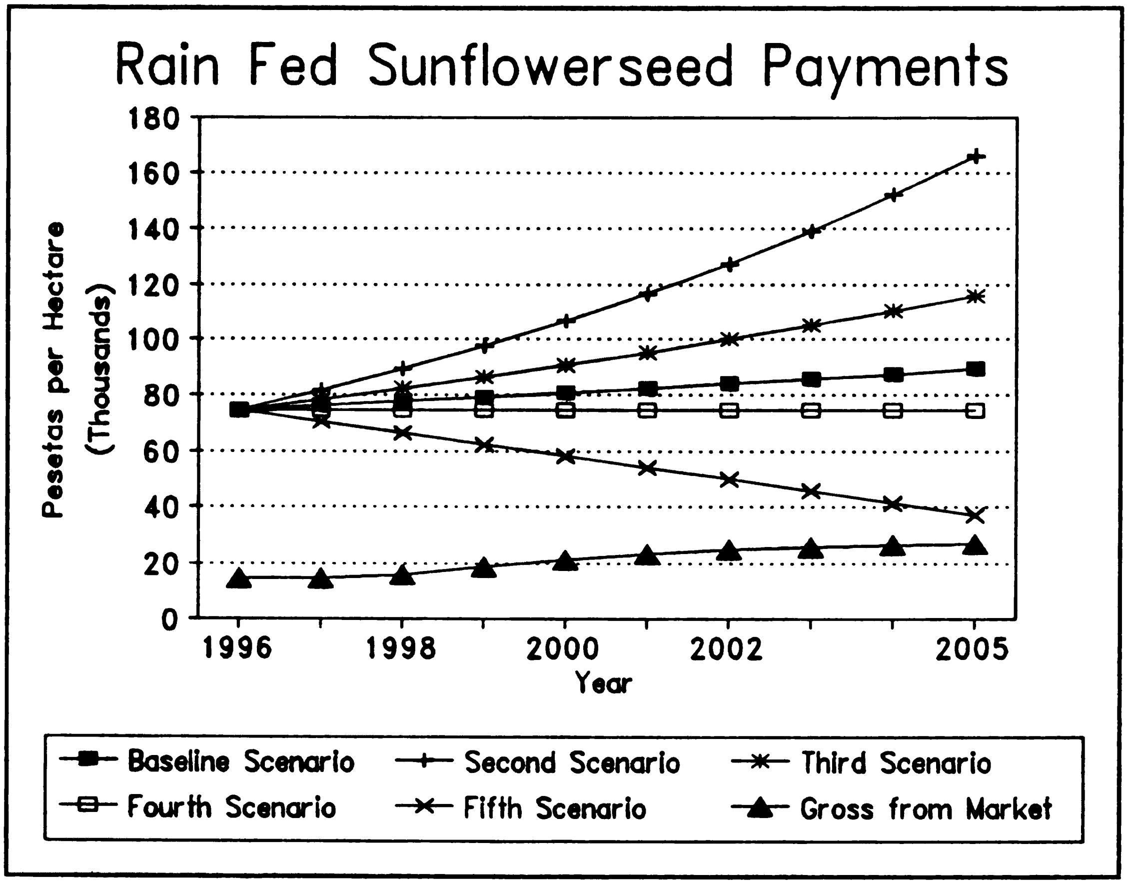

Figure 6.1. Projected Average Compensatory Payments for Rain Fed Sunflowerseed, under the Different Scenarios, (1996-2005).

acreage for period t-1 is utilized in the computation of the projected area for period t. Errors are therefore compounded in the projections, and the longer the projection period, the greater the inaccuracies.

The production of irrigated and, especially, of rain fed sunflowerseed is very generalized in the Spanish agricultural sector. Therefore, it is unlikely that the sunflowerseed acreage will reach excessively low levels in Spain, even under extremely adverse scenarios.

Hence, the projections that result in unreasonably low sunflowerseed areas are disregarded in this study. Therefore, lower bounds of 200,000 rain fed sunflowerseed hectares and of 50,000 irrigated sunflowerseed hectares were established for all the acreage projections made under the different scenarios considered in this dissertation.

As noted elsewhere, the rain fed and irrigated sunflowerseed acreages are projected under the assumption that MAPA will lift all the legal restrictions to the production of sunflowerseed that have been in effect during the 1994-1996 period. Therefore, the different scenarios presume that these restrictions do not hold during all the years of the 1997-2005 period[10].

It is very possible that MAPA will again impose restrictions on the production of sunflowerseed. This could result in actual sunflowerseed areas below the acreages projected here under the five alternative scenarios. In fact, the acreage projections under the different scenarios considered in this dissertation are also utilized to make policy recommendations on the possibility of re-imposing restrictions to the Spanish sunflowerseed producers during the 1997-2005 period, rather than to provide exact estimates of potential sunflowerseed areas.

The present EU regulations make it difficult to predict if Spanish farmers will be penalized in the future for planting large sunflowerseed areas. For the 1997-2005 projection period, the maximum guaranteed area for oilseeds will be determined jointly for the whole EU. Therefore,

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[10]Accordingly, $DVR_t=0$ during all the years of that period.

Spanish farmers could avoid being penalized, even with large sunflowerseed acreages in Spain, as long as the joint EU oilseeds area is below the limits established by EAGGF. In any case, most key informants consider that the likelihood of penalizations to the Spanish farmers will increase significantly if the total sunflowerseed harvested acreage in Spain is above 1,250,000 hectares.

As can be seen in Table 6.1, the total sunflowerseed acreages projected under the first scenario suggest that the Spanish sunflowerseed farmers are very likely to be subjected to penalizations during the years of the 1998-2003 period, due to large sunflowerseed areas projected for Spain in that interval.

Therefore, according to the first scenario, it seems that MAPA should impose some kind of restrictions to the production of sunflowerseed in Spain (probably similar to the restrictions that were in effect in 1994, 1995 and 1996), during at least some of the years of the projection period.

On the other hand, under the first scenario, around year 2004, compensatory payments will begin to be at similar levels in the production of rain fed wheat and in the production of rain fed sunflowerseed; consequently, relatively equilibrated sunflowerseed acreages are expected toward the end of the projection interval.

The projection of rain fed and irrigated sunflowerseed yields for the 1996-2005 period, is the same under the five different scenarios. This is because sunflowerseed yields are not affected by the compensatory payments levels, which, as noted, are granted in a per hectare basis. The projection results reflect moderate increases for rain fed and irrigated sunflowerseed yields during the years of the 1996-2005 period, due mainly to technological change.

In any case, different acreage projections imply different sunflowerseed production projections for the five alternative scenarios. The Spanish production and utilization of sunflowerseed under the first scenario is summarized in Table 6.2.

Table 6.1. Projection of Sunflowerseed Area in the Baseline Scenario (1996-2005).

Year	Rain Fed Area	Irrigated Area	Total Area
Historical data (Ha.)			
1986	965,803	127,821	1,093,624
1987	936,002	130,071	1,066,073
1988	903,428	74,574	978,002
1989	932,344	112,156	1,044,569
1990	970,026	141,686	1,111,712
1991	1,105,380	170,692	1,276,072
1992	1,092,335	360,066	1,452,401
1993	1,344,865	455,502	1,800,367
1994	1,107,376	373,879	1,481,255
1995	777,758	176,624	954,382
Scenario I (Ha.)			
1996	653,797	131,091	784,888
1997	995,903	148,980	1,144,883
1998	1,208,559	160,031	1,368,590
1999	1,338,151	167,029	1,505,180
2000	1,353,082	171,293	1,524,375
2001	1,305,787	173,015	1,478,802
2002	1,237,073	173,941	1,411,014
2003	1,144,537	173,431	1,317,968
2004	1,030,204	172,306	1,202,510
2005	899,932	170,530	1,070,462

The Spanish production of sunflowerseed is expected to be at low levels for 1996[11], then to increase progressively during most of the projection period, and finally to decrease moderately at the end of the projection period.

According to the model specification of demand developed in this dissertation, the demand for sunflowerseed by the oil industry also tends to be affected by scenario changes, although more modestly than the production of sunflowerseed. In this case, Table 6.2 shows that when lower levels of domestic sunflowerseed production are attained, there is a moderation of the amounts of sunflowerseed crushed by the sunflowerseed oil industry.

Furthermore, the volume of trade in sunflowerseed tends to remain at substantially low levels, except for year 1996 in which a relatively low sunflowerseed production is expected due to a decrease in the sunflowerseed acreage (mainly motivated by the presence of MAPA's restrictions to the production of sunflowerseed in Spain).

The first scenario shows that Spain will also tend to import moderate quantities of sunflowerseed at the end of the projection period. Of course, unexpected bad harvests would tend to boost Spain's sunflowerseed imports in any given year of the projection interval.

Sunflowerseed oil and meal prices are projected using the price equations estimated in Chapter V and the sunflowerseed price and soybean meal price projections explained earlier in this chapter. Moreover, the projection of the prices of sunflowerseed oil and sunflowerseed meal are the same under the five different scenarios.

As noted previously, the sunflowerseed oil and sunflowerseed meal internal disappearance figures that are shown in Table 6.3 and Table 6.4 are also identical under the five alternative scenarios; these figures reflect a relatively stable domestic consumption of sunflowerseed oil that tends to increase moderately during the 1997-2005 period, and a

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[11]As noted, all the projections for 1996 are identical for the five scenarios.

Table 6.2. Sunflowerseed Balance Sheet Projections in the Baseline Scenario (1996-2005).

Year	Production	Seed Crushed	Other Uses	Net Exports
Historical data (MT).				
1986	872,046	851,046	29,700	-8,700
1987	1,005,721	850,521	26,800	+52,600
1988	1,135,629	1,158,816	24,600	+22,713
1989	926,752	965,252	28,100	-63,000
1990	1,312,326	1,204,526	33,200	+76,300
1991	1,025,500	992,200	34,000	-700
1992	1,343,100	1,319,278	13,000	+10,822
1993	1,214,500	1,279,594	27,418	-92,512
1994	986,900	1,099,758	17,142	-130,000
1995	680,400	939,126	10,000	-268,726
Scenario I (MT).				
1996	706,850	858,757	18,600	-170,507
1997	998,338	1,068,398	23,140	-93,200
1998	1,191,738	1,215,890	26,335	-50,487
1999	1,317,418	1,312,596	28,430	-23,608
2000	1,356,399	1,343,730	29,104	-16,435
2001	1,344,324	1,335,585	28,920	-20,189
2002	1,313,722	1,313,216	28,443	-27,937
2003	1,264,527	1,276,566	27,649	-39,688
2004	1,191,078	1,221,993	26,467	-57,382
2005	1,100,535	1,154,156	24,998	-78,619

consumption of sunflowerseed meal that is projected to expand more importantly over these same years.

On the other hand, the figures on sunflowerseed oil stock variation tend to vary among scenarios; this is because they are significantly affected by the different projections on sunflowerseed oil production obtained under the different scenarios.

Table 6.3 shows that, for the first scenario, the production of sunflowerseed oil also tends to increase significantly, especially under the years of the 1998-2002 period.

As a consequence, Spain should export substantial amounts of sunflowerseed oil during most of the projection period or, otherwise, considerable quantities of sunflowerseed oil will have to be accumulated into stocks.

In any case, the figures on sunflowerseed oil net exports suggested by this first scenario are within reasonable limits, and could be possibly achieved by the Spanish oil industry because they are somehow similar to the levels of sunflowerseed oil exports that prevailed during the late 1980s.

Moreover, there are significant sunflowerseed oil stocks releases at the beginning of the projection period, possibly motivated by the relatively low amounts of sunflowerseed oil produced in 1995[12], and by the also relatively small sunflowerseed oil production projected for 1996, as well as by the relatively large amounts of sunflowerseed ending stocks that were available in 1995.

Under the first scenario, and during the rest of the projection interval, sunflowerseed oil stocks tend to increase moderately, although there are also some releases at the end of the period.

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[12]As noted, the amounts of sunflowerseed oil and meal produced in 1995 are assumed to be consumed in 1996. Therefore, the figures on sunflowerseed oil and meal production for the 1995-1996 agricultural year reflect the actual oil and meal production in 1995 and, consequently, are identical for the five scenarios. Furthermore, since the different projections for 1996 do not vary among scenarios, the sunflowerseed oil and meal productions projected for the 1996-1997 agricultural year are also the same for the five scenarios.

Table 6.3. Sunflowerseed Oil Balance Sheet Projections in the Baseline Scenario (1996-2005).

Year	Production	Bottled Consumption	Other Consumption	Stock Variation	Net Exports
Historical data (MT).					
1985-1986	374,141	267,644	55,943	+58,000	-7,446
1986-1987	358,312	263,123	54,389	+25,000	+15,800
1987-1988	375,075	290,335	33,740	-70,000	+121,000
1988-1989	499,310	299,335	64,981	-24,000	+159,000
1989-1990	410,065	293,676	42,789	+19,000	+54,600
1990-1991	514,833	318,978	64,855	-25,000	+156,000
1991-1992	416,723	311,700	61,823	+39,000	+4,200
1992-1993	554,097	308,713	55,000	+125,513	+64,871
1993-1994	543,984	304,140	60,000	-4,000	+183,844
1994-1995	454,874	334,554	65,000	0	+55,320
Scenario I (MT).					
1995-1996	388,434*	357,787	68,150	-69,850	+32,347
1996-1997	360,071	347,503	66,191	-52,397	-1,226
1997-1998	449,463	348,750	66,429	-1,424	+35,708
1998-1999	512,355	350,386	66,740	+22,142	+73,087
1999-2000	553,591	351,988	67,045	+29,571	+104,987
2000-2001	566,867	352,933	67,225	+24,200	+122,509
2001-2002	563,394	353,667	67,365	+14,391	+127,971
2002-2003	553,856	354,183	67,463	+5,691	+126,519
2003-2004	538,228	355,094	67,637	-2,559	+118,056
2004-2005	514,957	355,677	67,748	-10,774	+102,306

* Historical figures

Table 6.4. Sunflowerseed Meal Balance Sheet Projections in the Baseline Scenario (1996-2005).

Year	Production	Consumption	Net Exports
Historical data (MT)			
1985-1986	424,546	426,246	-1,700
1986-1987	395,112	430,512	-35,400
1987-1988	387,074	422,174	-35,100
1988-1989	517,600	578,800	-61,200
1989-1990	444,016	505,816	-61,800
1990-1991	554,082	554,482	-400
1991-1992	456,412	511,112	-54,700
1992-1993	612,863	677,863	-65,000
1993-1994	563,272	618,272	-55,000
1994-1995	505,889	565,889	-60,000
Scenario I (MT)			
1995-1996	436,600*	630,264	-193,664
1996-1997	397,060	648,705	-251,645
1997-1998	490,791	667,501	-176,710
1998-1999	556,734	686,219	-129,485
1999-2000	599,972	705,166	-105,194
2000-2001	613,891	723,933	-110,042
2001-2002	610,250	742,428	-132,178
2002-2003	600,249	760,950	-160,701
2003-2004	583,862	779,122	-195,260
2004-2005	559,463	797,190	-237,727

*Historical figures

The ending stocks under the first scenario should reach around 198,000 metric tons of sunflowerseed oil in 2005, which is below the sunflowerseed oil stocks available in Spain at the end of 1995. This level of stocks could be regarded as relatively consistent with the projected sunflowerseed oil production and consumption levels.

As noted, Table 6.4 shows that the domestic disappearance of sunflowerseed meal is projected to increase significantly during the 1996-2005 projection period; on the other hand the Spanish production of sunflowerseed meal is to reach more moderate levels under this first scenario.

Consequently, it is projected that Spain will be a net importer of sunflowerseed meal during all the years of the projection period. Sunflowerseed meal imports will reach especially substantial levels toward the end of the projection period. Given Spain's structural dependence on livestock feeds imports, this is not a surprising result.

II.b. Second Scenario.

The second scenario assumes that the reference amounts for sunflowerseed and for idle land will increase, during all the 1997-2005 period, at the average rates at which the reference amounts for sunflowerseed and for idle land have increased during the 1992-1996 period.

Therefore, the second scenario presumes that the compensatory payment granted to the land planted with sunflowerseed will grow at a 9.3% annual rate during all the years of the 1997-2005 period. This will affect equally the compensatory payments received for rain fed and irrigated sunflowerseed base hectares.

Similarly, this second scenario assumes that, for the 1997-2005 period, the reference amount established for the compensatory payments for idle land will increases at a 19% annual rate; this will affect identically all the compensatory payments received for the rain fed and irrigated sunflowerseed base hectares, and for the rain fed wheat base hectare.

Moreover, the second scenario also assumes that, for the 1997-2005 projection period, the reference amount for wheat (and hence the deficiency payments for rain fed wheat) will grow at the average rate of increase of the 1993-1996 period, that is the average growth rate experienced since the year in which the system of compensatory payments for wheat was first put into practice.

As noted, the growth rate in the reference amounts for wheat has been, so far, significantly higher than for sunflowerseed; thus, during the 1993-1996 period, the reference amount for wheat has increased at an average annual rate of 29.8%. This can be explained because the initial reference amounts granted when the reform of the CAP started in the arable crops sector, were at much lower levels for wheat than for sunflowerseed.

In any case, the projection results obtained for the sunflowerseed irrigated and rain fed acreages, under the assumptions adopted in this second scenario, can provide insights about the potential effects on the sunflowerseed sector of the present trends in agricultural policy; it could also provide some background for policy recommendations on the future growth rates of the different compensatory payments.

The results of the acreage projections under the second scenario are summarized in Table 6.5. As in the first and all the other scenarios, the acreage projections are constructed under the assumption that MAPA's legal restrictions to plant sunflowerseed are not in effect during the 1997-2005 projection period.

The sunflowerseed areas projected under the second scenario tend to be smaller than under the first scenario. In fact, under the first scenario, from year 2003 onwards compensatory payments will begin to be significantly higher in the production of rain fed wheat than in the production of rain fed sunflowerseed; consequently, expected gross margins will tend also to be larger in the production of rain fed wheat.

Thus, the rain fed sunflowerseed acreage, and hence the total sunflowerseed area should suffer important decreases since year 2003. The positive aspect of this situation is that, under this second scenario, the

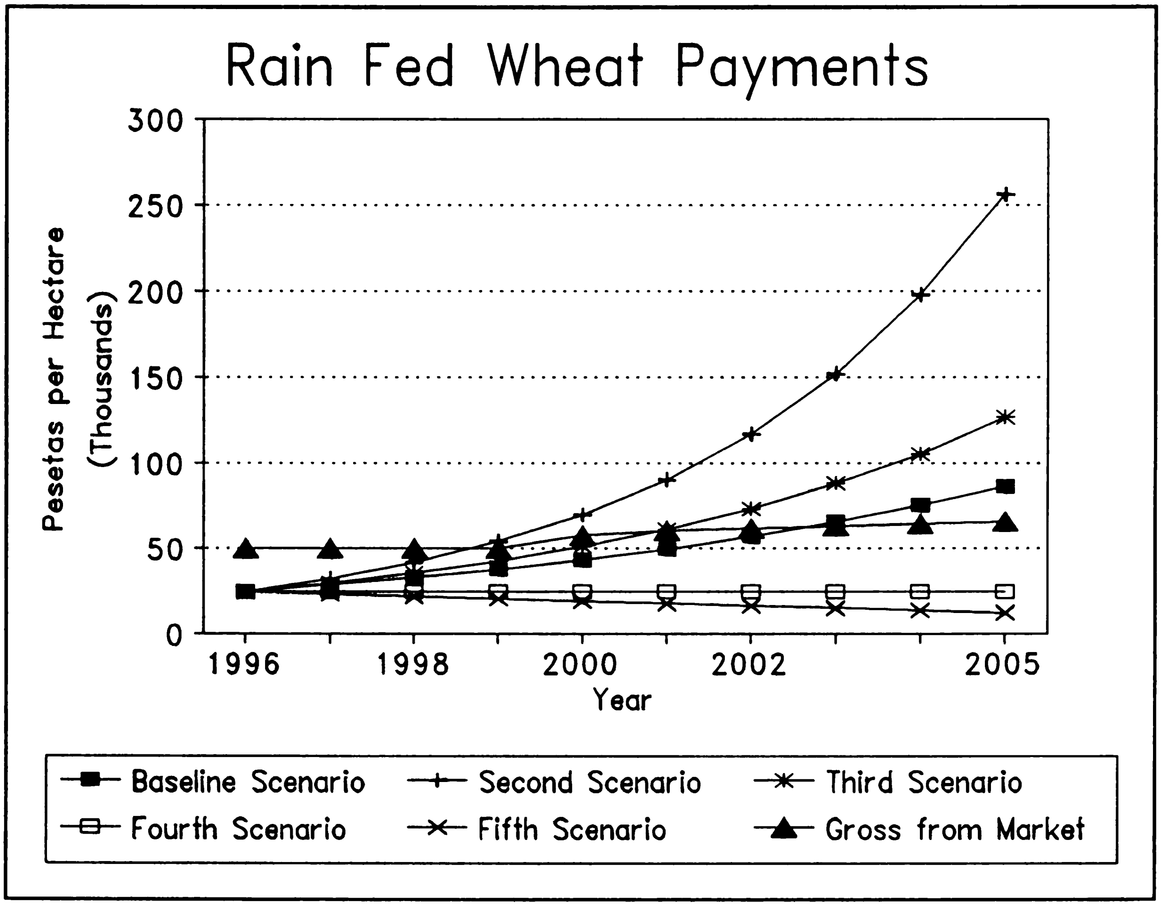

Figure 6.2. Projected Average Compensatory Payments for Rain Fed Wheat, under the Different Scenarios, (1996-2005).

Spanish sunflowerseed producers are very unlikely to be penalized at the end of the projection period.

Therefore, the relatively large wheat compensatory payments levels projected under the second scenario lead to a significant moderation on the Spanish sunflowerseed acreage, especially toward the end of the projection period. In any case, the recommendation of maintaining MAPA's restrictions during the early years of the projection period, stills holds in this second scenario.

The Spanish production and utilization of sunflowerseed under the second scenario is presented in Table 6.6. In this case, the Spanish production of sunflowerseed is also expected to decrease at the end of the projection period, although much more moderately than the sunflowerseed acreage. This last result can be explained because the decrease in the rain fed sunflowerseed area is partly compensated with increases in the irrigated sunflowerseed acreage, which implies higher average yields per hectare.

Furthermore, the volume of trade in sunflowerseed tends to remain at low levels also under the second scenario, just as in the first scenario. However, in the second scenario Spain is expected to import slightly higher quantities of sunflowerseed at the end of the projection period.

Table 6.7 shows that, under the second scenario, there is a slight moderation in the amounts of sunflowerseed oil produced, although Spain is still expected to remain a net sunflowerseed oil exporter during all the projection period.

There is less accumulation of sunflowerseed oil stocks under the second scenario; consequently, the sunflowerseed oil ending stocks reach more modest levels, and are projected to be around 134,000 metric tons in year 2005.

Finally, the balance sheets projections for sunflowerseed meal are summarized in Table 6.8, and also indicate a moderation in the projections for sunflowerseed meal domestic production, as well as an increase in the amounts imported of sunflowerseed meal.

II.c. Third Scenario.

The third scenario assumes moderate increases in the sunflowerseed and idle land reference amounts. On the other hand, this scenario still presumes relatively substantial increases in the wheat reference amounts, which is plausible given the present low compensatory payment levels currently granted in the production of rain fed wheat, and the expected future decrease in the nominal value of wheat intervention prices.

More specifically, this third scenario assumes that the sunflowerseed and idle land reference amounts will grow at a 5% rate, while the wheat reference amount will grow at a 20% rate, during all the years of the 1997-2005 projection period.

The results of the acreage projections under the third scenario are summarized again in Table 6.5. The sunflowerseed areas projected under the third scenario tend to be below the acreage projections under the first scenario and above the area projections for the second scenario; however, the decrease in the rain fed area and the increase in the irrigated acreage that occur at the end of the projection period tend to be more moderate than in the second scenario; hence, the third scenario leads to more equilibrated results at the end of the projection period than the second scenario.

Obviously, the recommendation of maintaining MAPA's restrictions, during at least some of the years of the 1998-2002 period, also holds in the third scenario. Moreover, the comparison of the acreage projections under the first, the second, and the third scenarios indicates that a moderation in the growth rate of the wheat reference amounts should be accompanied by very low growth rates in the sunflowerseed reference amounts.

Otherwise, the compensatory payments and gross margins received in the production of rain fed sunflowerseed would be very attractive if compared with the gross margins obtained in the production of rain fed wheat, even if both decrease in absolute levels; this could lead to

Table 6.5. Projections of Sunflowerseed Area in Scenarios II and III (1996-2005).

Year	Rain Fed Area	Irrigated Area	Total Area
Scenario II (Ha.)			
1996	653,797	131,091	784,888
1997	992,692	154,154	1,146,846
1998	1,191,430	174,492	1,365,922
1999	1,288,534	194,165	1,482,699
2000	1,243,405	214,016	1,457,421
2001	1,099,506	234,120	1,333,626
2002	885,272	255,874	1,141,146
2003	582,849	278,543	861,392
2004	200,000	302,930	477,790
2005	200,000	329,045	529,045
Scenario III (Ha.)			
1996	653,797	131,091	784,888
1997	996,807	150,989	1,147,795
1998	1,208,660	165,545	1,374,205
1999	1,333,467	177,178	1,510,645
2000	1,337,465	186,948	1,524,413
2001	1,271,466	194,526	1,465,992
2002	1,173,923	201,845	1,375,768
2003	1,039,941	208,148	1,248,089
2004	868,701	214,171	1,082,872
2005	662,761	219,816	882,577

excessively large sunflowerseed acreages and to more probable penalizations to the Spanish sunflowerseed farmers.

A second implication, from a longer term perspective, is that the reference amounts granted for wheat and sunflowerseed should grow at similar rates once similar gross margins levels are achieved in the production of rain fed sunflowerseed and rain fed wheat, as occurs in the first scenario around year 2004.

The Spanish production and utilization of sunflowerseed under the third scenario are again presented in Table 6.6. In this case, the production of sunflowerseed tends to be at almost the same the levels that were attained under the first scenario, probably because a higher proportion of the sunflowerseed acreage is cultivated under irrigation. There is also a low volume of trade in sunflowerseed, as in the other scenarios.

Table 6.7 shows that the quantities of sunflowerseed oil produced are similar under the first and the third scenario. The final ending sunflowerseed oil stocks are projected to be around 196,000 tons in year 2005. Moreover, under the third scenario the Spanish oil industry is also supposed to export significant amounts of sunflowerseed oil during most years of the projection period. The balance sheets projections for sunflowerseed meal are also presented in Table 6.8 and indicate that, as in the other scenarios, Spain will also be dependent on sunflowerseed meal imports under the third scenario.

II.d. Fourth Scenario.

The fourth scenario presumes that the levels of institutional subsidies that EAGGF guarantees to arable crops producers will remain during the 1996-2005 period at constant nominal levels. Therefore, the fourth scenario assumes that, during the years of the 1997-2005 projection period, all the compensatory payments will remain at the same levels that EAGGF has announced for 1996.

In this case, it is a subject of interest to consider the consequences of gradual declines in the real value of the actual

Table 6.6. Sunflowerseed Balance Sheet Projections in Scenarios II and III (1996-2005).

Year	Production	Seed Crushed	Other Uses	Net Exports
Scenario II (MT).				
1996	706,850	858,757	18,600	-170,507
1997	1,006,378	1,074,475	23,272	-91,369
1998	1,208,979	1,228,923	26,617	-46,561
1999	1,337,927	1,328,100	28,765	-18,938
2000	1,366,596	1,351,437	29,272	-14,113
2001	1,323,320	1,319,708	28,584	-24,972
2002	1,229,912	1,249,862	27,072	-47,022
2003	1,072,827	1,131,656	24,511	-83,340
2004	830,496	949,421	20,564	-139,489
2005	924,369	1,020,988	22,114	-118,733
Scenario III (MT).				
1996	706,850	858,757	18,600	-170,507
1997	1,002,976	1,071,904	23,217	-92,145
1998	1,203,061	1,224,449	26,521	-47,909
1999	1,335,144	1,325,996	28,720	-19,572
2000	1,378,165	1,360,183	29,460	-11,478
2001	1,365,377	1,351,500	29,272	-15,395
2002	1,327,780	1,323,843	28,673	-24,736
2003	1,262,970	1,275,389	27,624	-40,043
2004	1,162,485	1,200,378	25,999	-63,892
2005	1,030,505	1,101,219	23,851	-94,565

Table 6.7. Sunflowerseed Oil Balance Sheet Projections in Scenarios II and III (1996-2005).

Year	Production	Bottled Consumption	Other Consumption	Stock Variation	Net Exports
Scenario II (MT).					
1995-1996	388,434*	357,787	68,150	-69,850	+32,347
1996-1997	360,071	347,503	66,191	-52,397	-1,266
1997-1998	452,054	348,750	66,429	-443	+37,318
1998-1999	517,912	350,386	66,740	+23,916	+76,870
1999-2000	560,202	351,988	67,045	+31,146	+110,023
2000-2001	570,154	352,933	67,225	+23,984	+126,012
2001-2002	556,624	353,667	67,365	+10,439	+125,153
2002-2003	526,841	354,183	67,463	-4,597	+109,792
2003-2004	476,437	355,094	67,637	-22,550	+76,256
2004-2005	398,731	355,677	67,748	-44,642	+19,948
Scenario III (MT).					
1995-1996	388,434*	357,787	68,150	-69,850	+32,347
1996-1997	360,071	347,503	66,191	-52,397	-1,266
1997-1998	450,958	348,750	66,429	-858	+36,637
1998-1999	516,005	350,386	66,740	+23,333	+75,544
1999-2000	559,305	351,988	67,045	+31,143	+109,129
2000-2001	573,883	352,933	67,225	+25,735	+127,990
2001-2002	570,180	353,667	67,365	+15,321	+133,828
2002-2003	558,387	354,183	67,463	+5,454	+131,287
2003-2004	537,726	355,094	67,637	-4,623	+119,618
2004-2005	505,741	355,677	67,748	-15,443	+97,759

* Historical figures

Table 6.8. Sunflowerseed Meal Balance Sheet Projections in Scenarios II and III (1996-2005).

Year	Production	Consumption	Net Exports
Scenario II (MT.)			
1995-1996	436,600*	630,264	-193,664
1996-1997	397,060	648,705	-251,645
1997-1998	493,507	667,501	-173,994
1998-1999	562,561	686,219	-123,658
1999-2000	606,903	705,166	-98,263
2000-2001	617,338	723,933	-106,595
2001-2002	603,151	742,428	-139,277
2002-2003	571,923	760,950	-189,027
2003-2004	519,073	779,122	-260,049
2004-2005	437,596	797,190	-359,594
Scenario III (MT.)			
1995-1996	436,600*	630,264	-193,664
1996-1997	397,060	648,705	-251,645
1997-1998	492,358	667,501	-175,143
1998-1999	560,561	686,219	-125,658
1999-2000	605,963	705,166	-99,203
2000-2001	621,248	723,933	-102,685
2001-2002	617,366	742,428	-102,062
2002-2003	605,000	760,950	-155,950
2003-2004	583,336	779,122	-195,786
2004-2005	549,799	797,190	-247,391

*Historical figures

agricultural subsides, especially in a context where the internal pressures to reduce the relative, and even absolute, importance of the EU agricultural budget, could possibly be intensified in the future.

Hence, this fourth scenario assumes constant nominal sunflowerseed and wheat compensatory payments during all the projection period, while the fifth scenario presumes nominal decreases in the different compensatory payments during the projection years. Although there is no clear evidence of a decrease in the real value of EAGGF's compensatory payments in the immediate future, the analysis performed under the fourth and fifth scenarios can provide insights on the potential effects of such a policy orientation, as well as on the relative importance of these effects.

According to the fourth scenario, the sunflowerseed reference amount should be 167.75 ECU/MT for all the years of the 1996-2005 period. Similarly, the reference amount for wheat should be 54.34 ECU/MT for all the years of the 1996-2005 period. The reference amount for the land that is left idle to fulfill the set-aside requirements is also assumed to remain constant, at 68.83 ECU/MT, during all the 1996-2005 period.

The sunflowerseed acreages projected under the fourth scenario are summarized in Table 6.9. As it can be seen, the acreage projections under this fourth scenario are higher than the sunflowerseed areas projected under any other scenario, even with much lower real compensatory payments in the fourth scenario than in the first three scenarios.

The explanation of this result is that, although the real value of the compensatory payments granted in the production of rain fed and irrigated sunflowerseed decreases significantly, the real value of the compensatory payments for rain fed wheat remains at even lower levels: in fact, according to the fourth scenario, the average Spanish sunflowerseed producer should expect to obtain small negative gross margins in the production of rain fed wheat during the years of the projection period; as a consequence, land that otherwise would have been cultivated with wheat and, possibly, other cereals goes into the production of sunflowerseed.

Moreover, this result certainly stresses the important effects that the agricultural policy measures focused on the cereal sector have on the rain fed sunflowerseed acreage. This confirms that, perhaps, the most effective policy measure that EAGGF could adopt to contain the growth in the rain fed sunflowerseed acreage, and hence in the total sunflowerseed area in Spain, are relatively large growth rates in the wheat reference amounts, in order to equilibrate the compensatory payments in the production of rain fed wheat and rain fed sunflowerseed.

Thus, lower sunflowerseed compensatory payments could result even in an increase of the sunflowerseed acreage, as long as these payments are more attractive than the compensatory payments granted in the wheat sector. The acreage projections of the fourth scenario also accentuate the recommendation of maintaining MAPA's restrictions, during at least some of the years of the projection period.

As shown in Table 6.10, large acreage projections also result in a very large domestic production of sunflowerseed under the fourth scenario. The volume of trade in sunflowerseed is still small, although, in this case, Spain tends to become a net sunflowerseed exporter during most of the projection period. Furthermore, Table 6.11 and 6.12 indicate large domestic sunflowerseed oil and sunflowerseed meal productions, as a consequence of the rise in the amounts of sunflowerseed produced.

The final sunflowerseed oil ending stocks are projected to be at very high levels (around 277,000 tons) in year 2005. Moreover, as a result of the sunflowerseed and sunflowerseed oil overproduction projected under this scenario, Spain would have to export substantially high quantities of sunflowerseed oil; otherwise, the Spanish oil industry would have to accumulate sunflowerseed oil stocks beyond reasonable levels, or moderate significantly its sunflowerseeds purchases from sunflowerseed farmers.

Hence, in such an extreme situation, and in the case that the oil industry failed to find external markets for its potential sunflowerseed oil surpluses, the Spanish sunflowerseed sector would have to become (if possible) a net exporter of significant amounts of sunflowerseed.

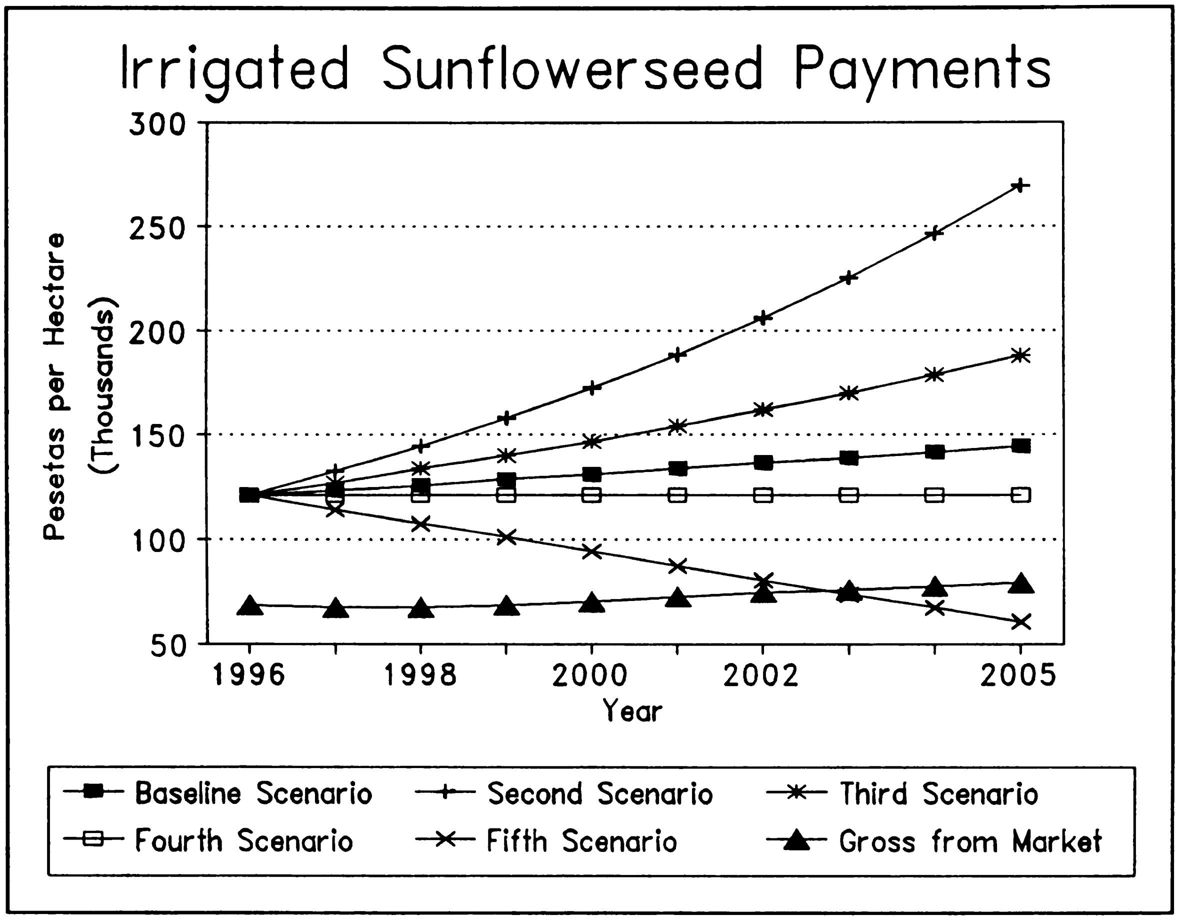

Figure 6.3. Projected Average Compensatory Payments for Irrigated Sunflowerseed, under the Different Scenarios, (1996-2005).

On the other hand, the balance sheet projections for sunflowerseed meal summarized in Table 6.12, show that, although Spain would still be a net importer of sunflowerseed meal, there would be a relevant moderation in this kind of imports, due to the large amounts of sunflowerseed meal produced domestically.

II.e. Fifth Scenario.

This last scenario assumes that all compensatory payments for wheat and sunflowerseed will be progressively reduced, over the 1997-2005 period, to half of their nominal values. Hence, in 2005 all the reference amounts will be at half of their announced nominal value for 1996. Thus, the fifth scenario assumes even more radical decreases in the levels of compensatory payments than the fourth scenario.

Such decreases are very unlikely to occur in the short term; nonetheless, from a longer term perspective, a hypothetical future accession of the Eastern Europe countries to the EU could stress the necessity of reducing radically agricultural expenses, due to the tremendous costs that could have the application of CAP to these potential new entrants.

In any case, the usefulness of this scenario relates to the comparative static nature of the study. Therefore, for comparison purposes, it is a subject of interest to analyze how the Spanish sunflowerseed sector could react, in the presence of sharp decreases in the current levels of compensatory payments related to the sunflowerseed sector.

In relation to the fifth scenario, the average Spanish rain fed sunflowerseed producer should still expect positive gross margins in the production of rain fed sunflowerseed, as well as negative gross margins in the production of rain fed wheat, during the years of the projection period.

Therefore, as can be noted in Table 6.9, the fifth scenario still results in very large sunflowerseed acreage projections; in fact, the projected sunflowerseed areas are only below the projections obtained

Table 6.9. Projections of Sunflowerseed Area in Scenarios IV and V (1996-2005).

Year	Rain Fed Area	Irrigated Area	Total Area
Scenario IV (Ha.)			
1996	653,797	131,091	784,888
1997	1,015,362	147,640	1,163,002
1998	1,263,067	156,419	1,419,486
1999	1,441,053	160,503	1,601,556
2000	1,516,052	161,419	1,678,071
2001	1,535,377	159,706	1,695,083
2002	1,544,717	157,021	1,701,738
2003	1,542,435	152,812	1,695,247
2004	1,531,125	147,963	1,679,088
2005	1,517,537	142,485	1,660,022
Scenario V (Ha.)			
1996	653,797	131,091	784,888
1997	1,007,319	143,919	1,151,238
1998	1,242,031	146,458	1,388,489
1999	1,404,105	142,641	1,546,746
2000	1,462,190	134,596	1,596,786
2001	1,465,917	123,837	1,589,754
2002	1,459,690	111,793	1,571,483
2003	1,441,790	98,157	1,539,947
2004	1,415,147	83,991	1,499,138
2005	1,386,731	69,429	1,456,160

under the fourth scenario. As in the fourth scenario, relatively low real sunflowerseed reference amounts result in a significant decrease in the irrigated sunflowerseed area; however, this decrease is more than compensated by a very important increase in the rain fed sunflowerseed area.

Again, this result is explained because the compensatory payments granted in the production of rain fed sunflowerseed remain at much higher levels than the compensatory payments for rain fed wheat, even if the former -as well as the later- decrease significantly in absolute terms. Therefore, this outcome still emphasizes the necessity of considering the interdependence of the effects caused by policy measures that are not focused exclusively on the sunflowerseed sector.

Table 6.10, Table 6.11 and Table 6.12 still suggest relatively large domestic sunflowerseed, sunflowerseed oil and sunflowerseed meal productions.

Consequently, Spain will have to export relatively substantial amounts of sunflowerseed oil, although below the amounts projected for the fourth scenario. In the fifth scenario the sunflowerseed oil ending stocks are projected to be around 216,000 metric tons in 2005. Finally, as in the other scenarios, Spain is also projected to remain a net importer of sunflowerseed meal.

To sum up, all the scenarios tend to project large sunflowerseed acreages in Spain during most years of the 1996-2005 period; therefore, it is very likely that, in the future, EAGGF will penalize the Spanish sunflowerseed producers if MAPA does not adopt restrictive measures to control the production of sunflowerseed.

As noted in Chapter II and Chapter IV, the restrictions that MAPA has imposed in 1994 and 1995, and which will be applied also in 1996, have proven very effective in controlling the growth of the area planted with sunflowerseed in Spain: hence, in the near future, MAPA will still have to impose some restrictions on the production of sunflowerseed, probably similar to the limitations already in effect.

Table 6.10. Sunflowerseed Balance Sheet Projections in Scenarios IV and V (1996-2005).

Year	Production	Seed Crushed	Other Uses	Net Exports
Scenario IV (MT).				
1996	706,850	858,757	18,600	-170,507
1997	1,009,382	1,076,746	23,321	-90,685
1998	1,223,394	1,239,819	26,853	-43,278
1999	1,378,417	1,358,707	29,428	-9,781
2000	1,455,465	1,418,616	30,726	+6,123
2001	1,486,066	1,492,731	31,248	+12,087
2002	1,507,712	1,459,857	31,619	+16,236
2003	1,521,717	1,470,981	31,860	+18,876
2004	1,521,987	1,472,133	31,885	+17,969
2005	1,517,076	1,469,028	31,818	+16,230
Scenario V (MT).				
1996	706,850	858,757	18,600	-170,507
1997	996,306	1,066,862	23,107	-93,663
1998	1,188,011	1,213,072	26,274	-51,335
1999	1,314,468	1,310,367	28,381	-24,280
2000	1,358,575	1,345,375	29,140	-15,940
2001	1,356,856	1,345,059	29,133	-17,335
2002	1,344,037	1,336,132	28,939	-21,034
2003	1,321,681	1,319,770	28,585	-26,674
2004	1,285,564	1,293,417	28,014	-35,866
2005	1,244,411	1,262,914	27,354	-45,857

Table 6.11. Sunflowerseed Oil Balance Sheet Projections in Scenarios IV and V (1996-2005).

Year	Production	Bottled Consumption	Other Consumption	Stock Variation	Net Exports
Scenario IV (MT).					
1995-1996	388,434*	357,787	68,150	-69,850	+32,347
1996-1997	360,071	347,503	66,191	-52,397	-1,266
1997-1998	453,023	348,750	66,429	-76	+37,920
1998-1999	522,558	350,386	66,740	+25,552	+79,880
1999-2000	573,253	351,988	67,045	+35,414	+118,805
2000-2001	598,799	352,933	67,225	+32,720	+145,921
2001-2002	609,082	353,667	67,365	+25,248	+162,802
2002-2003	616,385	354,183	67,463	+19,266	+175,473
2003-2004	621,128	355,094	67,637	+14,153	+184,244
2004-2005	621,619	355,677	67,748	+9,303	+188,891
Scenario V (MT).					
1995-1996	388,434*	357,787	68,150	-69,850	+32,347
1996-1997	360,071	347,503	66,191	-52,397	-1,266
1997-1998	448,808	348,750	66,429	-1,672	+35,302
1998-1999	511,154	350,386	66,740	+21,770	+72,257
1999-2000	552,641	351,988	67,045	+29,420	+104,187
2000-2001	567,568	352,933	67,225	+24,726	+122,684
2001-2002	567,434	353,667	67,365	+16,004	+130,398
2002-2003	563,627	354,183	67,463	+8,931	+133,049
2003-2004	556,650	355,094	67,637	+2,865	+131,054
2004-2005	545,413	355,677	67,748	-2,621	+124,609

* Historical figures

Table 6.12. Sunflowerseed Meal Balance Sheet Projections in Scenarios IV and V (1996-2005).

Year	Production	Consumption	Net Exports
Scenario IV (MT.)			
1995-1996	436,600*	630,264	-193,664
1996-1997	397,060	648,705	-251,645
1997-1998	494,523	667,501	-172,978
1998-1999	567,433	686,219	-118,786
1999-2000	620,588	705,166	-84,578
2000-2001	647,373	723,933	-76,560
2001-2002	658,155	742,428	-84,273
2002-2003	665,812	760,950	-95,138
2003-2004	670,786	779,122	-108,336
2004-2005	671,301	797,190	-125,889
Scenario V (MT.)			
1995-1996	436,600*	630,264	-193,664
1996-1997	397,060	648,705	-251,645
1997-1998	490,104	667,501	-177,397
1998-1999	555,475	686,219	-130,744
1999-2000	598,975	705,166	-106,191
2000-2001	614,627	723,933	-109,306
2001-2002	614,486	742,428	-127,942
2002-2003	610,494	760,950	-150,456
2003-2004	603,179	779,122	-175,943
2004-2005	591,397	797,190	-205,793

*Historical figures

Comparing the different scenarios provides greater insight into the impacts of potential future evolutions of the CAP in the arable crops sector than simply examining the magnitudes of the predictions. The acreage projections in the different scenarios indicate that a moderation in the sunflowerseed reference amounts leads to lower irrigated sunflowerseed areas but not necessarily to lower rain fed sunflowerseed acreages: as it is shown in the last two scenarios, even low sunflowerseed reference amounts could result in large total sunflowerseed areas, as long as the compensatory payments for rain fed sunflowerseed are significantly above the compensatory payments for rain fed wheat.

Currently, the compensatory payments granted in the production of rain fed sunflowerseed are at notably higher levels than the compensatory payments granted in the production of rain fed wheat. The results obtained in the first three scenarios suggest that the reference amounts for wheat will still have to grow at relatively high rates; otherwise, Spanish farmers are likely to plant excessively large sunflowerseed acreages and, very possibly, would be subjected to penalizations if no restrictive measures are adopted.

At the same time, it is not necessary to maintain the actual rates of growth for the sunflowerseed reference amounts; hence, it is possible to have a moderation in the growth of the compensatory payments granted in the production of sunflowerseed. Once the compensatory payments for rain fed wheat reach levels similar to the compensatory payments received in the production of rain fed sunflowerseed, it could be advisable to moderate the growth rates of the wheat compensatory payments also.

Consequently, the reference amounts granted for wheat and sunflowerseed should grow at relatively parallel rates, once similar gross margins levels are achieved in the production of rain fed sunflowerseed and rain fed wheat. These growth rates could even be at moderate levels, as long as they grant reasonable and positive gross margins in the production of rain fed and irrigated sunflowerseed and in the production of rain fed wheat.

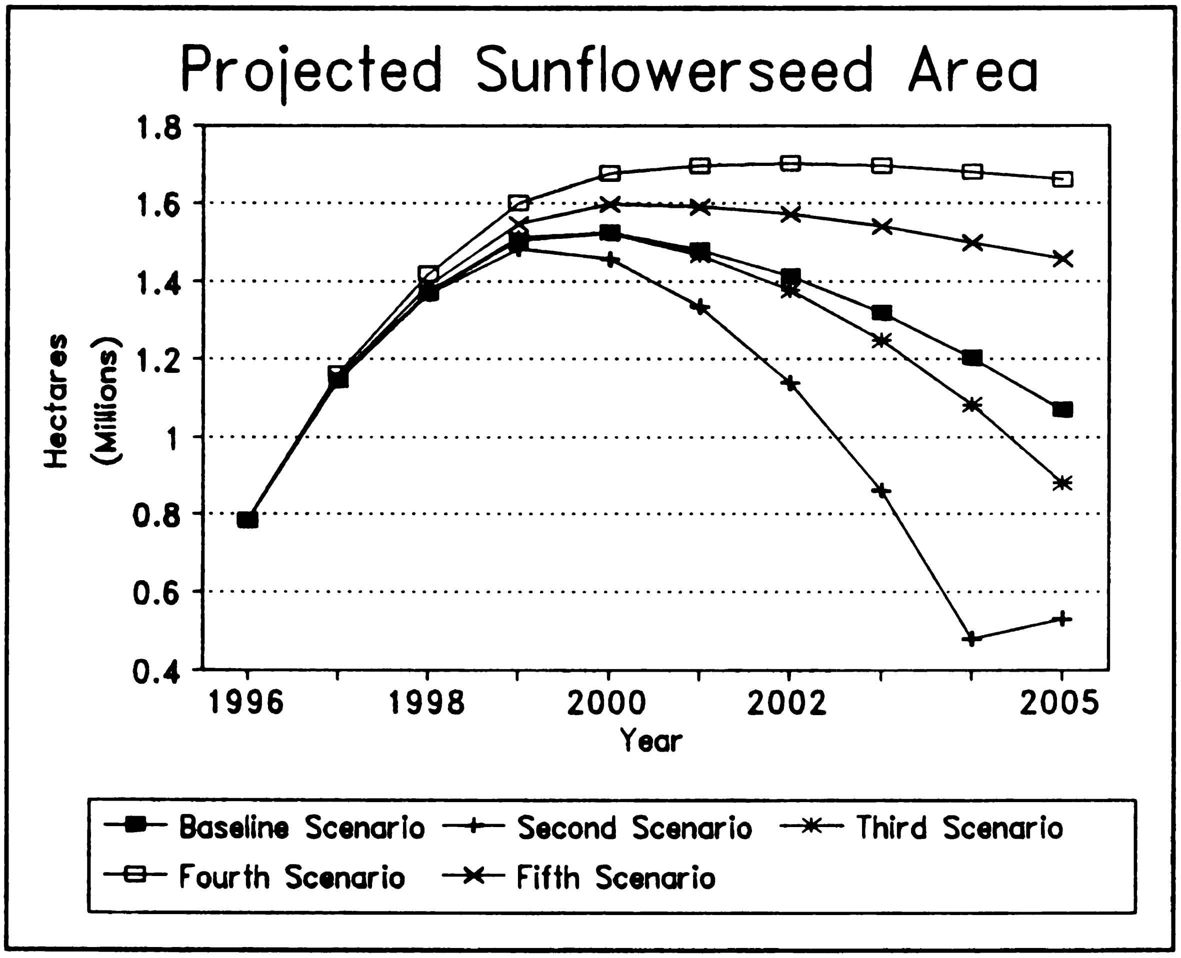

Figure 6.4. Projected Sunflowerseed Acreages under the Different Scenarios, (1996-2005).

Moreover, if wheat and sunflowerseed gross margins reach similar levels at the end of the projection period, a moderation of the growth rate for the rain fed wheat payments could help to control increases in the EU agricultural budget and, besides, to avoid excessive decreases in the Spanish rain fed sunflowerseed area. In fact very large decreases in the sunflowerseed acreage should be avoided also, in order maintain an equilibrium -necessary from an agronomic point of view- among the rain fed sunflowerseed and wheat areas in the main sunflowerseed producer zones of Spain.

Furthermore, all the scenarios indicate that, during the projection period, Spain will tend to remain self-sufficient in sunflowerseed, and that there will be a small volume of trade in sunflowerseed in all the 1997-2005 interval, unless an unexpected bad harvest, in any given year, makes it necessary to import sunflowerseed.

Finally, the different scenarios suggest that Spain is expected to export sunflowerseed oil and to remain a net importer of sunflowerseed meal during all the 1996-2005 period, although the volume of trade in these commodities varies among scenarios.

CHAPTER VII

SUMMARY AND CONCLUSIONS

In 1992, the CAP mechanisms regulating the EU oilseeds sector experienced a radical reform that eliminated intervention prices in the oilseeds markets. As a consequence of that reform, the Spanish sunflowerseed prices declined abruptly, and EAGGF remunerated sunflowerseed producers establishing a compensatory system that grants substantial payments per sunflowerseed hectare.

In 1993, the reform of the CAP was also applied to the cereal and other arable crops sectors. However, in this case, the reform has been much more gradual: intervention prices have not been fully eliminated, although, during the 1993-1996 interval, decreased in real terms; at the same time, in the 1993-1996 period, the compensatory payments per hectare granted in the cereal sector were at significantly lower levels than the compensatory payments granted in the production of oilseeds. Nonetheless, during that period, the reference amounts granted in the production of cereals also grew at higher rates than the reference amounts for oilseeds.

This dissertation has tried to assess the impacts that potential future developments in the compensatory payments levels granted by EAGGF could have on the Spanish sunflowerseed sector. Accordingly, the study develops econometric models that simulate the Spanish supply and demand in the sunflowerseed sector during the 1970s, the 1980s and the first half of the 1990s.

The analysis of supply at the agricultural level focuses on the estimation of sunflowerseed acreage and yield equations. Moreover, the study of the Spanish rain fed sunflowerseed supply is carried out independently of the analysis of the irrigated supply.

Wheat is identified as the most important crop competing with the production of rain fed sunflowerseed in the main sunflowerseed producer regions; however, the analysis of the irrigated sunflowerseed supply does not take into account any competing crop, mainly because of the large number of possible alternatives that are available in this case.

Furthermore, farmers' expectations about gross margins, in the production of rain fed and irrigated sunflowerseed, and in the production of rain fed wheat, are used as the main variables explaining the evolution of the sunflowerseed acreage in Spain. The utilization of gross margins allows the concentration of information on variable costs and gross revenues obtained from several variables -as for example, the compensatory payments granted by EAGGF-, and thereby conserves on degrees of freedom.

Besides, in the particular case of the reform of the CAP in the sunflowerseed sector, the use of gross margins is especially justified: first, because, due to the reform of the CAP, the evolution of the Spanish sunflowerseed acreage cannot be explained with the use of sunflowerseed prices alone; second, because a lack of degrees of freedom prevents the analysis of the sunflowerseed area only in terms of the compensatory payments per hectare that are being granted since 1992; and third, because farmers have been able to reduce significantly their variable costs per hectare in the production of sunflowerseed in response to the decrease in sunflowerseed prices.

The main difficulty that this study has encountered, for incorporating gross margins in the simulation of the Spanish sunflowerseed acreage, is the lack of official sources of data in Spain, providing representative variable costs in the production of sunflowerseed, or of any other crop. Therefore, part of this dissertation is devoted to construct variable costs, gross revenues and gross margins series for the production of rain fed and irrigated sunflowerseed, as well as for the production of rain fed wheat in Spain.

Specifically, the variable costs series are constructed extrapolating information on variable costs provided by several case

studies that were available for years 1976, 1982, 1986, 1989, 1990 and 1994. Then gross margins series were computed utilizing the variable cost series thus constructed.

The accuracy of the modelling results could be affected, somehow, by the quality of the data on costs of production here utilized. Inaccurate or unrepresentative data on variable costs of production could decrease, to some extent, the validity of the conclusions obtained in the econometric analysis of supply.

The case studies utilized here are assumed to provide an accurate representation of the agricultural practices of the average sunflowerseed producer in Spain. Unfortunately, it is very difficult to determine their exact level of representativeness since they are based on individual farm studies and not in aggregated data.

Therefore, in the future, it would be very desirable to have official sources of data providing detailed and up-to-date data on costs of production at the farm level; these data should be based on representative surveys for the entire nation. An immediate advantage of having official sources of data on representative costs of production would be to support and to facilitate studies as the one presented here.

As noted, the variable cost series constructed in this study detected a significant decrease in the variable cost per hectare in the production of rain fed and irrigated sunflowerseed after 1992. This decrease has taken place abruptly in response to the radical decrease in sunflowerseed prices caused by the reform of the CAP.

On the other hand, there is no evidence of appreciable decreases in rain fed wheat variable costs after CAP reform. Nonetheless, some decline in the rain fed wheat variable costs is possible in the future, due to the expected decline in the wheat real intervention and market prices. The potential extent and magnitude of such a decline is still unknown. Hence, the inspection of future studies relating rain fed wheat production practices to the evolution of wheat prices, during the 1996-2005 period, could be a subject of interest and a source of future research.

The econometric analysis of the sunflowerseed area confirms that the consideration of farmers' expectations about gross margins in the production of sunflowerseed and alternative crops can explain significantly the historical evolution of the Spanish sunflowerseed acreage. The specific analysis of the rain fed sunflowerseed area corroborates that rain fed wheat is an important alternative to rain fed sunflowerseed: consequently, farmers' expectations about gross margins in the production of rain fed wheat do influence significantly the Spanish sunflowerseed acreage.

Moreover, different models were tested to account for the formation of farmers' expectations about gross margins. The estimation and validation results in the analysis of the sunflowerseed area suggest that farmers follow the same expectation model in the rain fed and in the irrigated production of sunflowerseed.

Specifically, the econometric analysis of the rain fed and of the irrigated sunflowerseed acreage indicates that farmers form their expectations about gross margins according to the same rational expectation model; rain fed and irrigated producers form their planting decisions taking into account all the relevant information available at the moment: present institutional prices and subsidies, present variable costs and present information about past yields.

Thus, the selected rain fed and irrigated acreage models suggest that sunflowerseed producers take MAPA announcements about institutional prices and subsidies as valid, and that farmers form their expectations in relation to these announcements, instead of basing their expectations in past patterns of real gross margins.

Furthermore, the econometric analysis of the rain fed and irrigated sunflowerseed acreage indicates that the legal restrictions that MAPA imposed in 1994 and 1995 moderated significantly the growth of the sunflowerseed area. Besides, the irrigated sunflowerseed area equation denotes that shortages in the availability of irrigation water tend to induce increases in the Spanish irrigated sunflowerseed acreage.

The econometric analysis of the Spanish sunflowerseed yields corroborates that the decline in sunflowerseed prices has influenced importantly rain fed and irrigated sunflowerseed yields. Other significant factors influencing sunflowerseed yields are weather and technological change.

The analysis of the Spanish consumption of sunflowerseed oil confirms that bottled sunflowerseed oil and bottled olive oil are substitute products. Moreover, the estimation results show inelastic own price, cross price and income elasticities for the demand for bottled sunflowerseed oil.

The analysis of the Spanish sunflowerseed oil demand was made with the use of single equation techniques. A field for further research could be the application of demand systems to the simultaneous analysis of sunflowerseed oil consumption and olive oil consumption: thus, the demand system approach could provide insights not only on the consumption of sunflowerseed oil but also on consumption issues related to the Spanish olive oil sector.

The econometric analysis of the sunflowerseed oil stock variation suggests that sunflowerseed oil stocks are the result of sunflowerseed oil overproduction rather than of producers' speculative behavior; according to the analysis, the accumulation of sunflowerseed oil stocks is positively correlated to sunflowerseed oil surpluses, and negatively correlated to existing sunflowerseed oil ending stocks.

The analysis of the demand for sunflowerseed meal insinuates that the Spanish sunflowerseed meal consumption is well explained by sunflowerseed meal and soybean meal prices, and confirms that sunflowerseed meal and soybean meal are substitute products in the livestock feed market.

An increasing trend in sunflowerseed meal consumption is also detected; if that trend continues, annual increases in the domestic consumption of sunflowerseed meal can be expected during the 1996-2005 period.

Moreover, the modelling of the sunflowerseed demand by the oil industry indicates that the amounts of sunflowerseed crushed by the industry are highly influenced by the domestic production of sunflowerseed, and by the Spanish sunflowerseed oil internal disappearance.

Finally, the supply and demand models estimated in this dissertation are utilized to generate projections of the Spanish sunflowerseed acreage, and of the Spanish production, consumption and net trade of sunflowerseed, sunflowerseed oil and sunflowerseed meal for the 1996-2005 period. Net trade projections are deduced residually from the production and consumption projections.

The projection process is done according to five alternative scenarios. The compensatory payments that could be paid per irrigated or rain fed sunflowerseed hectare and per rain fed wheat hectare, during the 1997-2005 period, are the only exogenous variables that are changed among the different scenarios. The 1996-2005 projections of all the other exogenous variables are identical under the five scenarios.

Thus, alternative assumptions about the future compensatory payments levels granted in the sunflowerseed and wheat sectors result in different sets of projected sunflowerseed acreages, and of projected sunflowerseed, sunflowerseed oil and sunflowerseed meal productions; on the other hand the demand models' projections are relatively unaffected by the different scenarios.

In any case, too many unanticipated events may develop during the 1996-2005 period; therefore, the projection results obtained under the different scenarios only intend to provide insights into potential inter-scenario changes and their relative importance, instead of their exact magnitude.

The projection results confirm that sunflowerseed and wheat compete for rain fed land in Spain; thus, the compensatory payments levels that EAGGF grants in the production of wheat have a very significant influence

on the projected total Spanish sunflowerseed area, and specifically on the projected Spanish rain fed sunflowerseed acreage.

The explosive increment that the sunflowerseed area has experienced in Spain during the 1992-1995 period can be very much explained because sunflowerseed reference amounts have been at much higher level than cereal reference amounts. Moreover, the forecast results indicate that there will still be large sunflowerseed acreages in Spain, as long as compensatory payments, and hence expected gross margins, are at significantly higher levels for sunflowerseed than for wheat.

In this context, the policy of the European Commission of establishing, during the 1993-1996 period, significantly higher growth rates for the cereal reference amounts than for the oilseeds reference amounts must be regarded as appropriate. Moreover, the projection results obtained in this dissertation suggest that it will still be necessary to maintain relatively high growth rates in the wheat compensatory payments, at least until expected gross margins in the production of rain fed wheat and rain fed sunflowerseed begin to reach similar levels, probably toward the early 2000s.

Besides, the sunflowerseed acreage projections indicate that a moderation in the growth rate of the wheat reference amounts is not advisable unless it is accompanied by very low growth rates in the sunflowerseed reference amounts. Otherwise, the compensatory payments and gross margins received in the production of rain fed sunflowerseed would be very attractive if compared with the gross margins obtained in the production of rain fed wheat.

In any case, it would not be advisable, either, to have compensatory payments levels at significantly higher levels for cereals than for sunflowerseed, because this could induce monocultive practices that are not recommended from an agronomic point of view.

Furthermore, the projections obtained under the different scenarios suggest that Spain will tend to remain self sufficient in sunflowerseed during the projection interval. A low volume of trade in sunflowerseed and

significant sunflowerseed oil exports are expected during the 1996-2005 period; on the other hand, Spain is expected to remain a net importer of sunflowerseed meal during that same period.

All the projections developed in this dissertation, are made upon the assumption that the legal restrictions that MAPA has imposed on the Spanish production of sunflowerseed during the 1994-1996 period, will not be in effect during the years of the 1997-2005 interval; under such an assumption, large acreage projections are obtained in the five different scenarios.

Thus, the projected sunflowerseed areas under alternative scenarios suggest that the Spanish sunflowerseed producers are very likely to be subjected to EAGGF's penalizations, especially during the late 1990s and early 2000s. Therefore, the re-imposition of MAPA's restrictions to the production of sunflowerseed in Spain seems to be an advisable agricultural policy orientation, at least during part of the projection period (especially in the years in which sunflowerseed reference amounts are at significantly higher rates than the cereal reference amounts).

In any case, from 1995 onwards the maximum guaranteed area for oilseeds is established jointly for all the EU countries. Therefore, the acreage projections presented in this dissertation can only provide rough approximations on the likelihood of future EAGGF's penalizations on the Spanish sunflowerseed farmers.

Hence, it is not possible to determine exactly if the Spanish and other EU oilseeds producers would be penalized, in relation to the sunflowerseed areas projected for Spain in this study; in fact, the prospects of future penalizations for violations of the maximum guaranteed area for oilseeds would also depend on how oilseeds producers in other EU countries react to the compensatory payments levels that EAGGF will announce in the future.

Therefore, a field for further research could be the application of the techniques developed in this dissertation to the analysis of the oilseeds supply in other EU countries. Of special interest could be the inclusion of expectations about gross margins in the study of the supply of rapeseed in Germany, France and the UK, of the supply of sunflowerseed in France, and of the soybeans supply in Italy, due to the large impact that these countries have on the total EU oilseeds acreage.

It is also worth noting that, in the EU, cereals and protein crops are converging to the market regime that is now prevailing in the oilseeds sector. Therefore, the application of the gross margins approach utilized in this dissertation to the analysis of the supply of different cereals and protein crops in the EU countries may be warranted.

In the case of Spain, it would be of great interest to incorporate expectations about gross margins to the specific analysis of the supply of cereals, and especially to the supply of wheat and barley due to the large proportion of the Spanish rain fed acreage that is planted with these two crops. In particular, the variable cost series developed in this dissertation should facilitate the utilization of gross margins for the study of the rain fed wheat area in Spain.

Finally, from the results of the present study it could be concluded that the future evolution of the compensatory payments levels, granted in the EU's arable crops sector, is going to have a highly significant impact on the Spanish sunflowerseed sector. The sunflowerseed sector is of great importance to the Spanish agriculture, and the issues suggested by the conclusions of this study could be utilized in the future orientation of the Spanish agricultural policy.

LIST OF REFERENCES

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ABC. Daily periodical. Madrid. Various issues.

Actualidad Agraria. Weekly periodical. Madrid. Various issues.

AFOEX. Estadísticas de Ventas de Aceites Vegetales. Asociación Nacional de Industriales Envasadores y Refinadores de Aceites Comestibles. Madrid. Various years.

Alba Ordóñez, F. El Cultivo del Girasol. Madrid. 1990.

Albiac Murillo, J. The Spanish Hog Market: The Effects of the EC Enlargement. Ph.D. dissertation. University of Illinois. 1991.

Almon, S. "The Distributed Lag Between Capital Appropriations and Expenditures." Econometrica, 33. 1965

Ballesteros Aguiló, L. Evolución de Superficies, Rendimientos y Producciones del Girasol en La Mancha. Dirección Provincial del MAPA. Unpublished notes. Cuenca. 1980.

____. Evolución del Cultivo del Girasol en España. Dirección Provincial del MAPA. Unpublished notes. Cuenca. 1980.

Baquero Franco, J. Extracción de Aceite de Semillas Oleaginosas. Madrid. 1988.

Bazán Navarro, M. Estudio de la Rentabilidad por Hectárea en el Cultivo del Girasol y de la Remolacha Azucarera en la Campiña Jerezana. Unpublished notes. Azucarera Española. Jerez (Cádiz). 1994.

BCA. La Industria Agroalimentaria en España. Banco de Crédito Agrícola. Madrid. 1983.

Breusch, T. "Testing for Autocorrelation in Dynamic Linear Models". Australian Economic Papers, 17. 1978.

Briz Escribano, J and S. Mili. Investigación del Mercado al Nivel de la Demanda y de los Precios de Aceites de Oliva en España. ETSIA. Universidad Politécnica de Madrid. Madrid. September 1990.

Caldentey P. and A. Titos. "La respuesta de Oferta de Ganado Porcino en España". Revista de Economía Política. 1979.

Cámara Agraria de Sevilla. Costes de Producción Agraria en la Provincia de Sevilla. Diputación de Sevilla. Sevilla. 1978.

____. Estudio de Costes Agrarios en la Provincia de Sevilla. Diputación de Sevilla. Sevilla. 1990.

Camilleri, A. La Agricultura Española ante la CEE. Instituto de Estudios Económicos. Madrid. 1984.

Campo Andaluz. Monthly periodical. Seville. Various issues.

Cañas Madueño, J. A. "Estudio del Cultivo del Girasol en Andalucía". Agricultura. Madrid. 1977

Cejudo Fernández, J. "Algunos Aspectos Agro-industriales del Desarrolo del Girasol en España". IX Conferencia Internacional del Girasol. Tomo II. Málaga. 1980.

Commission of the European Communities. The Agricultural Situation in the Community. Brussels. Various years.

____. Diario Oficial de las Comunidades Europeas. Brussels. Various issues.

____. Reglamentos del Consejo de las Comunidades Europeas. Brussels. Various issues.

Deaton, A. and J. Muellbauer. "An Almost Ideal Demand System". American Economic Review. 1980.

____. Economics and Consumer Behavior. Cambridge University Press. 1980.

de la Rosa, J.R. "El Cultivo del Girasol en la Provincia de Cádiz". Agripesca. Delegación Provincial de Agricultura y Pesca. Cádiz. December 1992.

del Valle, L. El Cultivo Moderno del Girasol. Madrid. 1987.

Dios Palomares, R and J. A. Cañas Madueño. "El Enfoque Multiecuacional frente al Uniecuacional en Econometría: Aplicación al Mercado de Girasol". Economía y Sociología Agrarias. 1978.

El País. Daily periodical. Madrid. Various issues.

FAPRI. 1995 International Agricultural Outlook. Food and Agricultural Policy Research Institute. Iowa State University; University of Missouri-Columbia. 1995.

Ferris, J. et al. The Impact on U.S. Agricultural Trade of the Accession of the United Kingdom, Ireland, Denmark and Norway to the European Economic Community. Institute for International Agriculture. 1971.

____. Lecture Material for Commodity Market Analysis. Department of Agricultural Economics. Michigan State University. 1995.

FORPA. "Estudio del Mercado de Materias Grasas". Informes y Estudios del FORPA. Madrid. 1970.

Godfrey, L. "Testing Against General Autoregressive and Moving Average Error Models when the Regressors Include Lagged Dependent Variables". Econometrica, 46. 1978.

Gómez-Arnau, J. El Cultivo del Girasol. MAPA. Servicio de Extensión Agraria. Madrid. 1988.

Greene, W. H. Econometric Analysis. MacMillan. New York. 1990.

Guerrero García, A. Cultivos Herbáceos Extensivos. Madrid. Various editions.

Hatanaka, M. "An Efficient Estimator for the Dynamic Adjustment Model with Autocorrelated Errors". Journal of Econometrics, 2. 1974.

INC. Aceites Vegetales Comestibles. Instituto Nacional del Consumo. Madrid. 1985.

Josling, T. E. The United Kingdom Grains Agreement: An Economic Analysis. Ph. D. Dissertation. Michigan State University. 1967.

Junta de Andalucía. "Análisis del Sector del Girasol en Andalucía". Boletín de Información Agraria y Pesquera. Seville. July 1989.

____. La Agricultura y la Pesca en Andalucía en. Seville. Various years.

Kelch, D. R. Structural and Commodity Policies of the Spanish Agriculture. Foreign Agricultural Report Number 174. USDA. ERS. Washington, D. C. 1982.

Kalaitzis, V. C. An Econometric Analysis of the Feedgrain-Livestock Economy of Greece. Ph. D. Dissertation. Michigan State University. 1978.

Koipesol. El Cultivo del Girasol. Lunwerg Editores. Madrid. 1987.

Leuthold, R. "On the Use of Theil's Inequality Coefficients". American Journal of Agricultural Economics, 54. 1975.

MAPA. Adhesión de España a la CEE. Ministerio de Agricultura, Secretaría General Técnica. Madrid. 1987.

____. Anuario de Estadística Agraria. Ministerio de Agricultura, Secretaría General Técnica. Madrid. Various years.

____. Avances Estadísticos del MAPA. Ministerio de Agricultura, Secretaría General Técnica. Madrid. Various issues.

____. Boletín Mensual de Estadística Agraria. Ministerio de Agricultura, Secretaría General Técnica. Madrid. Various issues.

____. El Consumo Alimentario en España. Ministerio de Agricultura, Secretaría General Técnica. Madrid. Various years.

____. Encuesta sobre la Estructura de las Explotaciones Agrícolas Ministerio de Agricultura, Secretaría General Técnica. Madrid. 1989.

____. La Agricultura Española en. Ministerio de Agricultura, Secretaría General Técnica. Madrid. Various years.

____. Las Cuentas del Sector Agrario. Ministerio de Agricultura, Secretaría General Técnica. Madrid. Various years.

____. Manual de Estadística Agraria. Ministerio de Agricultura, Secretaría General Técnica. Madrid. Various years.

____. Memoria de Actividades del SENPA. Ministerio de Agricultura, Servicio Nacional de Productos Agrarios. Madrid. Various years.

____. Precios de Venta de Productos Agrarios y de Compra de Medios de Producción. Ministerio de Agricultura, Secretaría General Técnica. Madrid. 1988.

Ministerio de Economía y Hacienda. Precios al por Menor de Aceites de Oliva y de Girasol. Subdirección General de Comercio Interior. Unpublished notes. Various year.

Mataix Verdú, F. J. El Aceite de Oliva. Madrid. 1988.

McCallum, B.T. "Rational Expectations and the Estimation of Econometric Models: An Alternative Procedure". American Economic Review, 17, 1976.

Meilke, D.K. and H. de Gorter. "Impacts of the Common Agricultural Policy on International Wheat Prices". Journal of Agricultural Economics. 1988.

Meilke, D.K. and G.R. Griffith. "Incorporating Policy Variables in a Model of the World Soybean/Rapeseed Market".American Journal of Agricultural Economics. 1983.

Montero Laberti, F. and R. Moro Serrano. Actualidad Agroeconómica del Girasol en España. MAPA, Dirección General de la Producción Agraria. Madrid. 1988.

Nieto, M and R. Contreras. "Causas de la Expansión del Girasol en Andalucía". IX Conferencia Internacional del Girasol. Tomo II. Málaga. 1980.

OECD. Perspectivas Económicas. Organización para la Cooperación y el Desarrollo Económico. Paris. Various issues.

____. Spain. Organization for Economic Cooperation and Development Economic Surveys. Paris. Various years.

Pelach Paniker, A. Impacts on Selected Feedgrain and Livestock Enterprises of Spain's Accession to the European Economic Community. Dissertation for the degree of M.S. Michigan State University. 1981.

Peterson, E.W. Adjustment of the Spanish Feedgrain and Livestock Sectors Following Accession to the European Community. Ph.D. Dissertation. Michigan State University. 1981.

Pierani, P. and P. L. Rizzi. "An Econometric Analysis of the Olive Oil Market in Italy". European Review of Agricultural Economics. 1991.

Pindyck, R. and D. Rubinfeld. Econometric Models and Economic Forecasts. 3rd edition. 1991.

Salmon, K.G. The Modern Spanish Econmy. Pinter Publishers. New York. 1991.

Santana Ariona, R. La Agricultura Andaluza ante la CEE. Sector Aceite de Oliva. Seville. 1986.

____. La Agricultura Andaluza ante la CEE. Sector Semillas Oleaginosas. Seville. 1986.

Solbes Mira, P. La Adhesión de España a la CEE. Los Efectos sobre la Protección Exterior a la Agricultura. Monografías de Moneda y Crédito, no. 2. Madrid. 1979.

Tamames, R. Estructura Económica de España. 19th edition. Alianza Editorial. Madrid. 1990.

Theil, H. Economic Forecasts and Policy. 2nd edition. Amsterdam. 1965.

Tió, C. La Política de Aceites Comestibles en la España del Siglo XX. MAPA. Secretaría General Técnica. Madrid. 1983.

Tomek, W and K. Robinson. Agricultural Product Prices. Third edition. Cornell University Press. 1990.

Universidad de Córdoba. Estudios sobre Costes de Producción en el Cultivo del Girasol en Andalucía. Unpublished notes. Cátedra de Fitotecnia II de la ETSIAM. Córdoba. 1994.

USDA. Long-term Agricultural Baseline Projections, 1995-2005. Interagency Agricultural Projections Committee. USDA. 1995.

____. Oil Crops Situation and Outlook Report. USDA. ERS. Various issues.

____. Oil Crops Yearbook. USDA. ERS. Various years.

____. Selected Agricultural Statistics on Spain. 1965-1976. Statistical Bulletin 630. March. 1980.

____. The Basic Mechanisms of the EC Farm Policy. ERS. USDA. Miscellaneous publication, No 1485. 1990.

____. Wheat Situation and Outlook Report. USDA. ERS. Various issues.

____. Wheat Yearbook. USDA. ERS. Various years.