AN ECONOMIC STUDY OF A REGULATED SUBSECTOR: SUGAR IN SPAIN

by

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Objectives

The objectives of this paper are five-fold. First it represents an attempt to describe the problems, issues and policies related to the Spanish sugar subsector, and, to put together and organize some facts about its functioning. Hopefully, this will provide a basis for the doctoral thesis which will be undertaken in the near future.

Secondly, this study will be aimed at finding sugar demand and supply relationships at the provincial and regional level respectively. This will serve the double purpose of providing some basis for making short-run predictions and, also, to use the estimated demand relationships in a more complicated spatial equilibrium model to be undertaken in the subsequent research for the doctoral thesis.

Third, and in addition to the previous demand and supply relationships, some extrapolations of past trends in sugar consumption and sugar-beet production will be made in order to project long run levels to 1980 and 1985. With this, future needs in regional processing capacities will be calculated and, from them, which beet producing areas will necessitate authorization by the government to install additional capacity, and, which will need to retire some of the existing facilities.

A fourth objective of this paper is to find the area, or areas, which may be considered as the "main consuming areas" or places with "the largest sugar deficit" from which to compute the "threshold", "variable levies" and at-the-port-differentiated prices in an economically efficient way. These could be applied by the government to sugar imports once they are released from the

State trading status and are allocated to domestic private distributors.

In this context, most deficit area is defined as that region or area for which the contour of spatially differentiated presents the highest peak. Or, alternatively, the area to which the highest sugar transportation cost structure applies.

One might think that densely populated locations or provinces could be singled out by close observation of actual cross-country sugar retail prices. However, only a single price, the regulated maximum price is quoted in published statistics, precluding this approach to the analysis. Thus, one thrust of this paper consists in providing a possible criterium or rationale to select the "most deficit area", and, also, to indicate an approximation to the optimal patern of differentiated prices which should be applied to sugar imports at the ports of entry for an efficient trading in the spatial dimension.

The last, and fifth, objective is to find whether there is any regional comparative advantage in terms of transportation costs. Since uniform prices are regulated by the government and no variation exists as to location, one might expect that some particular provinces and regions are benefited, both, by their proximity to consuming centers and by the public policies which regulate the sugar market in Spain. A somewhat related topic of this study consists, also, in finding whether the same thing applies to the propietary structure of the sugar subsector. At present, three corporations monopolize sugar processing and wholesale distribution, except for some minor cooperative firms.

This fifth objective is related to the previous one in that the same economic rationale and research methods are used.

Methodology

Demand

Often policy decisions require estimates of demand interrelationships and estimates of the probable level of consumer demand in the future. Recent contributions in the area of economic theory and statistical methods of estimation and testing hypothesis have made it possible to improve procedures used in estimating demand relationships.

A demand relationship obtained as a result of maximizing consumer's satisfaction subject to a budget restraint is usually expressed as a function of prices of the commodity for which the demand relationship is sought, the prices of substitute and complementary commodities, and consumer income.

Procedures to estimate economic factors such as price and income elasticities often make use of cross-section data. On the other hand, those which are intended mainly for prediction purposes almost all ways use time series data.

To analyze the effects of prices and income on the quantity consumed, it is necessary to isolate the effects of other non-economic elements such as psychological sociological, cultural and regional factors that determine the level of consumption of a given commodity.

Generally, prices remain unchanged during a short period of time and, therefore, data obtained from cross-section surveys provide a basis for obtaining the effects of income on consumption free from price effects. However, within a

cross section, it is difficult to keep the psycho-socio-cultural factors constant and, therefore, the effects of these factors on the income coefficient have to be determined before deciding on the reliability of the income coefficient obtained from cross-section data. Unfortunately it is often difficult to quantify the effects of many economic factors.

Since one objective of this study is to predict future levels of per-capita sugar consumption and only published secondary data referred to the last decade are available, time-series analysis will be the method to be used.

Theoretically, the following model might be specified as a first approximation of a demand function:

$$qit = fi(pit, Zit, Yt, Uit)$$

where

qit = per-capita consumption of ith commodity

pit = price of the ith commodity

Zit = other factors affecting demand (assumed exogenous)

Yt = per-capita disposable income

Uit = a random disturbance

A number of problems might arise from the estimation of the desired parameters:

Error specification. Estimation by ordinary least squares requires that the error term is not correlated with prices and income, the absence of autocorrelation, constant variance over time, and, in addition, sufficient observations

in relation to the number of parameters to be estimated. When these conditions are not met, more complex formulations are required, as is discussed in texts on econometrics such as Johnston (1963), Goldberger (1964) or Malinvaud (1966), Kmenta (1971).

Multicollinearity. Often prices and income move together over time, resulting in problems of multicollinearity which, in the extreme case, results in a singular matrix. In the case of income and prices, writers have suggested combining time-series data with income slopes or elasticities, estimated from cross-section data. High multicollinearity among prices increases variance among estimated coefficients and which raises questions as to their significante.

Relevant variables. In the more general models, quantity consumed is related to all commodity prices and income which, represents is an impossible measurement task, when time-series data are used. The concepts of separable utility functions provide guides for meaningful methods to simplify the estimation procedures.

Mathematical form of the equation. No a priori guideline exists for the functional form of the relationship among quantity, prices, and income that is appropriate in all cases. Time-series data provide only samples from a limited range of observations. Some of the commonly used functions belong to one of the following:

Linear:

$q = a + by + cp + u,$

Semi-logarithmic:

$q = a + b \log y + c \log p + u,$

Double-lorarithmic:

$\log q = a + b \log y + c \log p + u,$ or

Inverse-logarithmic:

$\log q = a + by + cp + u$

Where:

a,b,c, are coefficients

y = income

p = price

u = random disturbance or error.

Strict linear relationships sometimes do not lead to good predictions and hence logarithmical relationships are used. Semilogarithmic relationships allow for variations in the elasticities from zero to infinity. Double-logarithmic functions give constant demand elasticities. Inverse logarithmic functions are called also exponential functions since they can be rewitten as $Y_t = 10^{a+by+cp}$, a notable feature of it being that the ratio of two consecutive values (which could be two consecutive years in time-series analysis) is equal to the same constant.

When a single equation is formulated for a commodity to estimate the direct price and a few other cross-price elasticities, the effect of all other omitted variables is implied to be zero. The choice of other prices to be included is often based on subjective judgements of researchers. Also, the number of parameters to be included in each equation depends upon the required number of degrees of freedom which

can be increased either through increasing the number of observations or through decreasing the number of parameters in the equation. The number of observations can be increased by extending the period of observation or reducing the interval between successive observations in the case of time-series data, and enlarging the sample space in the case of cross-section data. In general, the effect of using enlarged time-series and cross-section data is to increase the variability in the data and it may be important to test whether any structural change or heterogeneity has occurred in the process of enlargment. The number of parameters in the model can be reduced by defining composite commodities. Although the estimation problem can be solved by aggregating commodities, this procedure introduces a number of "aggregation problems." Also, for policy analysis, often information on individual commodities is required and an aggregate derived from heterogenous items may not relfect the characteristics of individual commodities belonging to the set. This has been the case in this particular study when differentiated types of sugar sold using different packages and at different prices were aggregated as if we were dealing only with one undifferentiated commodity.

If supply and demand were simultaneously determining price there would be an identification problem. 1/ However, price in the case of this study might safely assumed as exogenous as a result of government regulation. In effect,

1/ Unless demand and supply shifters exist and used in the regression equations.

the government does not allow the market to clear with just domestic supply but either export or import substantial volumes.

Transportation Model

It is theoretical framework. Location of economic activity is a special field of inquiry which can be traced to 1826, when Von Thunen (1826) wrote of the location of agricultural activities around a population center. Except for Weber (1909) the field received little attention until the work of Hoover (1937) and later with works of Losch (1944), Bressler (1952), Mighell and Black (1951), but it was not until the 1950's that spatial economics as an applied field became a major area for economic research.

Important theoretical studies were published by Koopmans (1949), Enke (1951) and Samuelson (1952), Fox (1953) which provided the basis for the numerous studies conducted since the early fifties. Because reviews of these studies and an evaluation of the present state of knowledge can be found in Bawden (1963)[1], the present study emphasizes only the specific model developed for the Spanish sugar industry with some reference to some, more comprehensive, models.

There are in essence three distinct models for location of economic activity. Short-run ex-post transportation model, short-run ex-ante model and long-run ex-ante model. These

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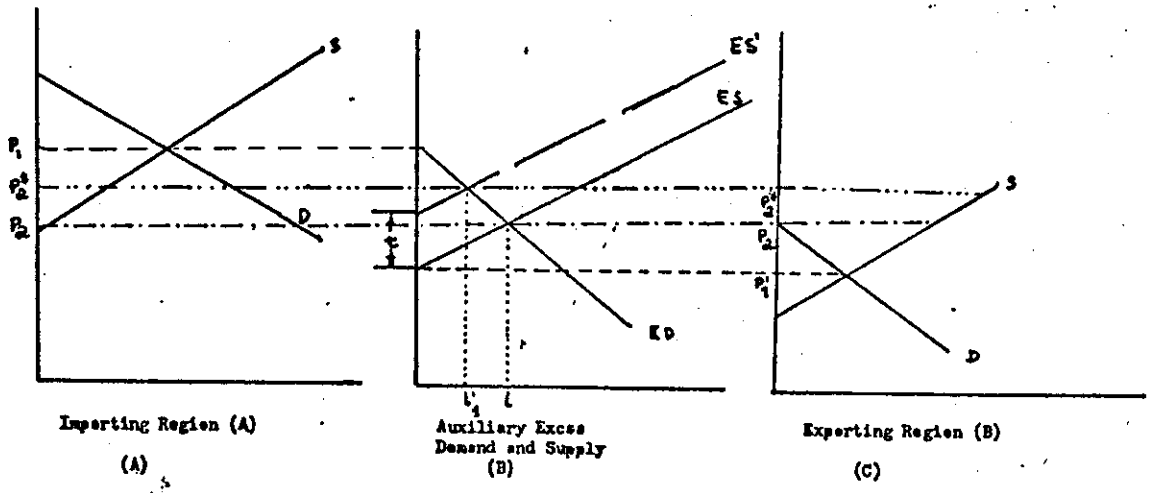
[1] Bawden, D. L. et al. "An evaluation of alternative spatial models". A.J.A.E., 46 (5): 1372-79.

last two are usually encompassed with the term "spatial equilibrium analysis". The three models differ principally in assumptions made concerning production and consuming activities and the time dimension. However, all three models assume: (1) competitive shipping activities, (2) single product, (3) spatially separated markets with no foreign imports or exports and (4) constant storage levels. One point is designated in each producing and consuming region to represent all activity within each region, thus all models assume homogeneity throughout each region.

The "short run ex-post model", the simplest of the spatial models is the one used here for the purposes of this study. Given regional quantities produced and consumed in some time period, a shipping pattern is specified which minimizes total transportation costs and satisfies all regional surpluses and deficits. With this shipping pattern, relative regional prices can then be derived assuming a perfectly competitive shipping activity. That is, the price differential between two areas engaging in trade is equal to the transfer cost between them, and is less than their common transfer cost if no trades takes place. However, if prices and trade of the commodity is regulated by government intervention, making trade compulsory at constant prices, and these are equal across producing and consuming regions, some cross-subsidization, both among regions and the processing and distributing firms, is forced to occur.

Finding price differentials--the usually sought objective of empirical research using the short-run ex-post model is often depicted using the following diagram:

Fig. 1 SPATIAL EQUILIBRIUM MODEL.



In fig. 1, the fact that region B has a lower domestic equilbrium price than A establishes B as the exporter and B as the importer. Indeed, pretrade price in A is P_1 while that of B is P^1_i. From the exporting region the expost-supply or excess-supply curve is derived and from the importing region the import-demand or excess-demand curve, both plotted in Fig. 1,B.

Now suppose that trade opens up. Post-trade equilibrium in the absence of transport, storage costs and artifical barriers of trade require that there be a common price in the two regions and that the quantity exported by one region be equal to the quantity exported by the other. Both conditions are met at price P_2 which is established by the

intersection of the export-supply and import demand curves. Price in the exporting region rises while that in the importing region decline following opening of trade. Production expands in the exporting region and contracts in the importing region, but the contraction stops short of complete specialization. The importing region continue to produce some of the product.

The free-trade position might then be modified by the introduction of transfer costs. Since the vertical axis denotes price, the transfer costs can be measured as a "t" segment on that scale. Drawing an additional excess supply ES' line to which the "t" segment has been vertically added and finding the intersection with the excess demand line we get price P_2^* and level of trade "i" different from the free-trade level "i_1".

Ideally, a transportation model might, in addition, serve three other different purposes:

(1) To measure the efficiency of distribution of a commodity from processor to consumer during a specified period.

(2) To predict, given relatively constant regional production and consumption the direction of changes in shipping routes and traffic loads which might take place in the very near future as a consequence of rationalization by the economic participants of the distribution of the commodity in question.

(3) To evaluate the effects on shipments of changes in forces, such as a change in the transportation rate structure.

The first purpose of the model--that is, the investigation of efficient price differentials--raises several questions many of them related to the original assumptions of the model and the simplifications made necessary by the task and data which the researcher has at hand.

Due to expository reasons, a more complete treatment and evaluation of this usually sought purpose of the short-run transportation model is here delayed until the last section of this study. The reader is referred to it for further explanations.

The second purpose of the model--as an indicator of distributional efficiency--raises certain questions. A comparison of quantity shipped or number of shipments over similar routes, or of area prices can be misleading. The model does not allow to make transportation costs vary depending on volume or weight-shipped. Perhaps the best measure of distributional efficiency in the sense of transfer cost minimization is a comparison of the total transfer cost incurred by actual shipments with the total shipping cost of the optimun solution. Industry or government policy makers might use the potential savings from an improved shipment pattern to determine the advisability of improved market information or of new shipping regulations. A more extreme

use might be in assessing the value of a centralized control mechanism for use in war time. Of course, these uses assume that complete data on actual shipments are avaiable as a basis for comparison with the optimum pattern.

The third purpose of the model assumes that there is a strong tendency in the short-run for a shift from the actual toward the optimum shipping pattern. That is, shippers attempting to maximize profits would tend to revise their shipments toward the optimum pattern as dictated by relative area prices and transfer costs.

The last, and fourth, purpose of the transportation model could be achieved effectively only if the actual shipping pattern closely approximated the optimum pattern. It will be only then when changes in the shipping pattern in response to induced stimuli such as changes in transportation costs should be a fairly accurate description of reality.

Finally some mention should be made of the two other spatial equilibrium models which are cited here. The short-run ex-ante model is often designated to predict short-run market behavior. The model is descriptive (behavioral) in nature with emphasis in both quantity and location through time. Equilibrium area production, consumption, relative and absolute prices, and shipments are determined by minimized transfer costs. The model is dynamic in the sense that it determines a series of interdependent solutions through time

in a recursive way. Bawden[2] in 1966 empirically tested this model, originally suggested by Fox[3] (pp. 547-66) in 1966.

The long-run ex-ante model is often intended to predict absolute production advantages among areas under long-run conditions. This model represents a logical extension on the supply side of the asumptions in the previous two models. While in the short-run ex-post model, factors and supply by region are fixed--i.e. supply was perfectly inelastic--and in the short-run ex-ante model the supply function is positively sloped, representing the fact that some factors are fixed and other variable; in the long-run model all factors are variable and the supply function is assumed to be perfectly elastic at the level of production costs.

The long-run ex-ante model is thus similar to the short-run ex-post model except that: (1) unit production costs in each area are given, (2) regional supply is assumed to be perfectly elastic, with the amount of production endogenous to the model, (3) the demand function in each region is negatively sloped rather than perfectly inelastic at a fixed amount, and (4) both production and transportation costs are minimized by the solution.

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2 Bawden, D.L. et. al. "Interregional Competition in the U.S. Turkey Industry" Hilgardia, Vol. 37, No. 13, 1966.

3 Fox, K.A. "Spatial Equilibrium Models of the Livestock-Feed Economy" A.E.R., 45(4): 584-608.

A transportation model can be solved using several algorithms. In this study, a simple, linear programming model was utilized with the help of the computer facilities available at Michigan State University. In essence the mathematical problem is to find xij for all i and j (shipping pattern) auch as

$$\text{Min} \sum_{i=1}^{n} \sum_{j=1}^{m} cij\ Xij$$

Subject to

$$Q_i^S = \sum_{j=1}^{m} Xij$$

$$Q_j^D = \sum_{i=1}^{n} Xij$$

$$Q_i^S = Q_j^D$$

$$Xij \geq 0$$

where:

Xij = quantity shipped from area i to area j

cij = shipment costs from origin i to destination j

Q_i^S = total quantity available at exporting region i

Q_j^D = total quantity available at importing region j

II

THE SPANISH SUGAR SUBSECTOR

Background and General Information

Uses of Sweeteners. Product Definition.

Sugar or its equivalent sucrose in the technical parlance is a member of a large class of carbohydrates-saccharides, highly valued for their sweetening properties. The main commercially important sources of sucrose are the roots of the sugar beet and the stalks of the sugar cane. The refined product resulting from the extraction of sugar of any of these two sources is undistinguishable for the human senses unless complicated exhaustive laboratory analyses are conducted on the residual impurities which can differentiate the two.

Dextrose and glucose, primarily derived from corn starch, are the other sweetening agents. Also, certain orther organic compounds have been found to have similar sweetening properties. Of these, saccharin and certain cyclamates are the most common examples. Organic compounds substitute for saccharides in dietary uses since they have no caloric value, but a relatively large sweetening power.

Users of sweeteners in Spain are households, the institutional markets, and the food and pharmaceutical industries. Households use sugar with coffee and tea usually in crystalline form. Brown sugars composed of fine crystals of sucrose, and syrups derived from cane refining are used

in minor amounts since the Spanish cuisine prefers fruits to pastry.

The soft drink industry, some alcoholic drink industries such as sugar cane rum, and the canning industry are also users of sugar. Non-caloric sweeteners as of the present are also used by these industries although in relatively little amounts. Low-calorie soft drink sales have not developed much as compared with other countries. The baking industry consumes sugar also as a substrate for yeast growth for leavening. Non-yeast goods such as soft cakes, pies, and doughnuts use sugar as an ingredient too.

History of Sugar Production in Spain

Sugar cane, the only raw product for sugar extraction existing in the world until the early 1800's was introduced in Spain sometime before the 10th century by the arabs. Cultivation of sugar cane during the period of arab domination was concentrated in the eastern provinces of Valencia, Murcia and Granada. Centuries later, Spaniards brought it to tropical America where a more suitable climate favored its expansion.

From the 1600's to the mid-1800's, in which beets the alternative source of sugar, were successfully investigated and found in central Europe, Spain heavily relied on colonial sources for her sugar supplies. In 1878 the first beet processing plant was installed. Sugar cane remained concentrated in the aforementioned eastern regions throughout that

period and some sugar beet cultivation was started in the interior of the Iberian peninsula.

After important technological breakthroughs occurred, the sugar beet remained as the most important raw material, but as a consequence of its anarchic expansion, which resulted in huge oversupplies and heavy losses for some economic participants of the subsector during the decade of the 1930's, the government enacted the first Sugar Act in 1935. The Act regulated the installation, amplification and operations of plant refineries, along with the assignment of production quotas at the farm level.

Since the 1943-44 campaign, State intervention has been broadened to also cover the regulation of minimum raw product prices and the norms to be followed on the relationships and contracted arrangements binding raw product producers and processors, as well as maximum margins to be charged throughout the marketing process, i.e., from sugar beet processing to the retailer.

Economic Importance

The combined total value of sugar beet and sugar cane for the latest campaigns are as indicated in Table 1.

The average of the five year period represents about 2.6 percent of the total value of agricultural production of the country. Raw product sources of sugar rank twelve in the classification of agricultural products according to their money value.

Table 1.

VALUE OF SUGAR CANE AND SUGAR BEET PRODUCTION

Campaign	Million PTA
69/70	7,971
70/71	8,851
71/72	10,505
72/73	9,110
73/74	9,150
Average	9,120

Source: Comercializacion de Azucar. Subdireccion de Mercados en Origen. Ministerio de Agricultura. Spain.

In 1973, cultivated lands with sugar beets occupied 200.375 Has., of which about 55 percent were on multicrop irrigated areas and 45 percent on single crop, non-irrigated areas. The number of farmers engaged in its production was about 100,000, and money wages paid to hired labor surpassed 3.6 billion PTA.

The 39 sugar beet and sugar cane processing plants existing in 1972 paid out 1.2 billion PTA in wages and had 1.7 billion PTA in invested capital.

Total land devoted to sugar cane production for 1972 was 4.9 thousand Has., all of them on irrigated land which produced 580 million PTA. This represents 6 percent of the equivalent sugar beet value. In this study, sugar cane will not be dealt with because of its minor significance in sugar production.

A major goal of Spain, with respect to sugar, is to maintain a high degree of self-sufficiency. Table 2, gives an account of the performance of the sugar subsector in achieving this goal. The table refers only to the mainland part of the country and the Balearic Islands. The remaining peninsular consumption and that of the Canary Islands have been met by importations.

Table 2.

SUGAR SELFSUSTAINING DEGREE FOR MAINLAND SPAIN AND BALEARIC ISLANDS

Campaign	Total Production of Sugar (Ton)	Consumption (Thousand Ton)	Self-supply Percent
1,963/64	375,314	584.9	68.0
1,964/65	482,404	590.8	81.6
1,965/66	518,186	644.6	80.4
1,966/67	567,465	691.8	82.0
1,967/68	578,384	736.2	78.6
1,968/69	681,618	774.6	88.0
1,969/70	732.345	789.7	92.7
1,970/71	731,734	815.5	89.7
1,971/72	971,562	879.2	110.5
1,972/73	764,512	936.3	81.6
1,973/74	751,053	1,046	71.6
1,974/75 (1)	552,000	1,026	53.6

(1) estimation

Source: Plan de Ordenacion y Desarrollo del Sector Agro-Industrial del Azucar. Ministerio de Agricultura. Ministerio de Industria. Spain

Sugar imports, mainly from Cuba, meant an average outlay of 2.15 billion PTA per year during the 1962/73 decade. In the 1973/74 campaign sugar imports surpassed 10 billion PTA. During the first four months of year 1975 the foreign currency outlay to make up for imports of this commodity amounted to 6 billion PTA. For the next three years, starting in 1975, Spain has signed a bilateral agreement with Cuba which commits the latter to buy, an the former to sell, as much sugar as needed either at world prices or at prices paid to domestic suppliers if the international value fall below them.

The sugar subsector is also a net income transfer recipient from the public. About 1.7 billion PTA were given annually to farmers in the late 1960's. For the 1974-75 campaign, the Spanish Administration has made available a credit fund of 8.0 billion PTA for the improvement of the productive structure at the farm level. In addition, during the last months of 1974 and first of 1975 sugar consumption was subsidized to make for the prices of the imported product which was consistantly over the domestic ones by more than 100 percent.

ECONOMIC CHARACTERISTICS OF THE SUGAR SUBSECTOR

Sugar Production and Supply

Sugar beets are grown in almost all regions of the country. Total land under beet cultivation in Spain has widely fluctuated from year to year. From 110,762 Ha. in the 1963/64 campaign to 191,124 Ha. in 1973/74 the highest figure was reached in the 1970/71 campaign in which 205,265 Ha. were cultivated. In 1974/75 it is estimated that only 143,360 Ha. have been seeded. Table 3, gives an account of the total land under beet cultivation for the last ten years and for each of the production regions.

A superficial inspection of the figures in the table refering to the 1966/74 period, will indicate that there has been an important slump in the Ebro Region, a somewhat stable situation for the Duero Region, and an important increase in the Sur Region.

Sugar beet production in the Duero Region is mainly on irrigated lands. Only about 8 percent is on non-irrigated lands. This contrasts with the situation in the Sur Region, of which approximately 86 percent is on non-irrigated, dry lands.

The Ebro-Centro Region can be further subdivided into two zones. In the Ebro subzone, where 76% of sugar-beet cultivation is on irrigated land, the combined number of Has. has been greatly reduced in the last

decade. However, the Centro Region where almost all beet production is on irrigated land, production has been stabilized for the same period.

Sugar beet production grew at increased rates in the 1964/72 period, reaching a peak of 6.42 million Tons in the 71-72 campaign. On the other hand, production has also decreased since then, declining to the 5.0 million Tons level in 1974, having been estimated 4.1 million for 1975. Wild oscillations have occurred in this period as it was the case in previous years.

Table 3

NUMBER OF HAS BY SUGAR ZONES. (1)

	CAMPAIGNS										
ZONES	1963/64	1964/65	1965/66	1966/67	1967/68	1968/69	1969/70	1970/71	1971/72	1972/73	1973/74
DUERO	60,170	70,770	73,713	85,603	88,247	81,780	84,428	86,553	84,151	86,000	82,300
EBRO-CENTRO	36,415	44,318	38,640	42,488	45,095	36,022	30,031	31,528	30,530	28,920	20,180
SUR	14,177	27,040	33,460	29,926	38,680	46,590	72,063	87,184	86,490	85,455	88,644
TOTAL	110,762	142,128	145,993	158,017	172,022	164,392	186,512	205,265	201,171	200,375	191,124

(1) Estimated

Source: Plan de Ordeneción y Desarrollo del Sector Agro-Industrial del Azúcar. Ministerio de Agricultura. Ministerio de Industria. Spain (Dec 1974.)

Table 4 SUGAR BEET PRODUCTION BY ZONES (TONS) (1)

	CAMPAIGNS										
Zones	1963/64	1964/65	1965/66	1966/67	1967/68	1968/69	1969/70	1970/71	1971/72	1972/73	1973/74
DUERO	1,454,800	1,633,300	1,835,800	2,007,500	2,127,200	2,250,300	2,435,155	2,243,252	2,913,655	2,830,700	2,422,567
DUERO-CENTRO	837,300	976,900	1,086,000	1,269,800	1,129,100	1,011,200	906,510	877,982	985,544	737,300	602,502
SUR	437,400	705,800	743,100	721,900	1,034,800	1,308,900	1,654,078	2,281,582	2,521,822	1,630,400	2,501,261
TOTAL	2,729,500	3,316,000	3,664,900	3,999,200	4,291,100	4,570,400	4,995,763	5,402,816	6,421,021	5,198,600	5,501,000

(1) Estimated

Source: Plan de Ordeneciony Dessarrollo del Sector Agro-Industrial del Azúcar. Ministerio de Agricultura Ministerio de Industria. Spain.

An analysis of Table 4 and Appendix 1 leads to the following conclusions:

a) While beet production is relatively stable for the DueroRegion,there is a declining tendency for the Palencia, Burgos, Soria and Segovia provinces.

b) In the Ebro-Centro Region, the Ebro Subregion production has declined very quickly. A more stable trend, however, occurred in Teruel and Alava provinces. In the Centro Subregion, on the other hand, Ciudad Real and Albacete tended to increase their production.

c) There are great oscillations in the Cordoba, Cadiz and Sevilla provinces of the Sur Region. This is understandable because of the higher meteorological influence on non-irrigated crops. In the Granada and Malaga provinces, production is decreasing. The Badajoz and Caceres provinces have maintained their production despite the promotion action of the new, highly-advanced processing factory existing in the former province.

Sugar beet yield averages oscillated for the 1963/74 period of reference from 23.9 to 31.6 tons per Ha. The 1963/67 average being 27 tons/Ha. while the 1968/73 amounted to 28.5 tons/Ha. These figures refer to irrigated and dry lands jointly. At the national level, average yields on dry lands are approximately 16.8 tons/Ha. vs. 32.05 on irrigated lands.

Among regions oscillations are also great. While the Duero Region yields are increasing from year to year, the Sur Region sugar beet yields on dry cultivation vary very widely.

Spanish sugar beet yields, compared with those of the EEC countries, are significantly low. Two major factors in explaining this outcome are: the relatively less-advanced agricultural technology used in Spain and the unfavorable climatic conditions of the 45 percent of total beet production which is cultivated on non-irrigated lands. In Table 5, a comparison among some European countries is depicted.

Table 5.

SUGAR BEET YIELD AVERAGES, 1973/74 CAMPAIGN

Country	Ton/Ha
Germany	43
Belgium	42
Denmark	40
France	40
United Kingdom	32
Ireland	40
Italy	39
Holland	44
Spain	30

An additional factor worth mentioning is the decreasing trend of the sucrose content of sugar beets in Spain. This might be produced by a number of factors. Some experts of the industry are of the opinion that some marginal lands are being brought under beet cultivation as a consequence of the prevailing non-discriminating subsidization given to growers during the last few years. On the other hand, the sucrose content, 13.7 percent as an average, is similar to most other western European countries.

The number or beet-producing farms have declined very rapidly in the past decade. While in the 1965/66 campaign there were 124,000 beet-producing farms, in 1970/71 there were 94,000 and only 62,000 in 1974/75. The average number of Has. per farm has almost doubled in the same 1965/75 ten-year period from 1.17 to 2.31 Has. However, these average figures are only a rough approximation to reality if attention is paid to particular regions and provinces. While in the Duero Region the initial average of 1.25 Ha. per farm led to 1.60, the Sur Region changed from 1.66 to 7.80 Has. Moreover, it is important to note that: while in some provinces in the Duero Region, such as Leon where only 9 percent of the growers cultivate more than 2 Has, in Cadiz, located deep in the South of the Sur Region, 73 percent of the growers cultivated more than 50 Has. of sugar-beet.

In addition to constraints such as the size of farms as

mentioned above, there are other structural limitations. Monogerm seeds are seldom used. Only about 1,700 Ha, which represents 10 percent of the total land devoted to sugar beets, used monogerm varieties in 1972. This ratio is very low in comparision with that of ECC countries in which 80 percent is seeded with beets using these improved varieties. Furthermore, levels of mechanization and utilization of capital-intensive inputs are rather low, but it is expected that in the near future, increased wages will make the replacement of labor-intensive services necessary.

Prices paid to farmers for their sales of sugar beets increased 33 percent from 1963/64 to 1972/73, that is, in 8 years. The production response to this price increment being 137 percent. This represents an average price-supply elasticity coefficient of 4.1 for the period under consideration. However, for the following two years in which prices increased 5 percent, beet production declined about 6 percent. This indicates a strong influence of other factors affecting supply. Besides, for the present campaign 1974/75 in which sugar prices were raised 27 percent above that of the previous year, it has been estimated that only 4,100 Thousand Tons will be produced. Underlying the events of these last three years are the substantial increased prices paid by farmers in the purchase of their inputs as a result of the high level of inflation existing in the country and the energy crisis. Table 6 indicates the production and prices occurred in the period.

Table 6.

SUGAR BEET PRICES AND PRODUCTION

Campaign	PTA/Ton	Subsidy (PTA/Ton)	Total (PTA/Ton)	Production Thousand Ton
1963/64	1,150	----	1,150	2,703
1964/65	1,245	----	1,245	3,328
1965/66	1,245	100	1,345	3,664
1966/67	1.245	100	1,345	4,000
1967/68	1,345	----	1,345	4,282
1968/69	1,400	80	1,480	4,553
1969/70	1,400	115	1,515	4,980
1970/71	1,400	125	1,525	5,416
1971/72	1,400	125	1,525	6,412
1972/73	1,440	125	1,565	5,214
1973/74	1,480	125	1,605	5,501
1974/75	1,750	296	2,046	4,100
1975/76	2,800	200	3,000	-----

Source: Plan de Ordenacion y Desarrollo del Sector Agro-Industrial del Azucar. Ministerio de Agricultura. Ministerio de Industria. Spain, 1974.

It is worth noting that for the 1975/76 campaign, beet prices will reach 3.000 PTA/Ton which represents an 87 percent increase just in the last two years. With this the Spanish Administration expects that higher production levels will be obtained in the present and subsequent years. In fact, this high price even surpasses EEC prices as can be seen by looking at Table 7. Such a change in level of prices represents a turnaround in the history of the Spanish Sugar Policy. In the

past, beet prices in Spain were kept abreast with those existing in the EEC.

Table 7

SUGAR BEET PRICES IN EEC AND SPAIN (PTA/Ha)

Items	1974/75		1975/76	
	EEC	Spain	EEC (1)	Spain
Beets	1600	1750	1840	2800
Transport Premium	200	200	200	200
Pulp	100	----	100	----
Subsidy	----	96	----	----
Total	1900	2046	2140	3000

(1) Estimate

Sugar Consumption and Demand

Sugar consumption in Spain has substantially grown during the past decade. Table 8 gives total consumption (1), per capita consumption ratios, annual increments and the percentage it represents over the previous year's per capita consumption.

Table 8

SUGAR CONSUMPTION IN MAINLAND SPAIN AND BALEARIC ISLANDS

Campaign	Consumption(1) Thousand Tons	Per Capita Comsumption Kgs./person	Increment	Percentage
1963/64	584.9	19.36	----	---
1964/65	590.8	19.37	0.01	.05
1965/66	644.6	20.91	1.54	7.9
1966/67	691.8	22.21	1.30	6.2
1967/68	736.2	23.37	1.16	5.2
1968/69	774.6	24.32	0.95	4.0
1969/70	789.7	24.52	0.20	0.8
1970/71	815.5	25.02	0.50	2.0
1071/72	879.2	26.62	1.60	6.3
1972/73	936.3	28.08	1.46	5.4
1973/74	1,046	30.88	2.80	9.9

Source: Grupo Azucar. Ministerio de Agricultura Spain. 1970 and Plan de Ordenacion y Desarrollo del Sector Agroindus trial del Azucar. Ibid.

(1) Consumption figures in this table represent total dissappearance from processing plants as it is reported to the Spanish Government. They are not actual consumption figures in the usual meaning of the term.

By inspection of Table 8, one may also infer that apparent consumption increased 80 percent in the 1964/74 ten-year period taking the 1963/64 campaign as a base, and also that per capita comsumption rose almost 60 percent for the same period or what is the same a 4.8 percent annual income. These figures are, however, somewhat distorted by the events that occurred in the 1973/74 campaign. During that year, speculation

occurred when intermediaries, and perhaps consumers, knew at least one month in advance that the Government had the intention of raising sugar prices in the middle of the campaign. Elimination of this effect would result in a less-pronounced increment for the period. In addition it should be noted that the figures represented in Table 8 refer to consumption in the mainland and the Balearic Islands. To find the total consumption for Spain, about 70,000 Tons for the 1973/74 must be added, and around a 6 to 7 percent to the remaining years of the decade.

Per capita sugar consumption in Spain compares quite unfavorably with that of other western European countries.

Table 9.

SUGAR PER-CAPITA CONSUMPTION FOR THE E.E.C. COUNTRIES & SPAIN

Country	Kgs. Per-capita and Year (1971/72 Campaign)
Germany	34
France	37
Italy	28
Holland	46
Belgium and Luxenburg	36
United Kingdom	45
Ireland	52
Denmark	48
C.E.E.	36.6
Spain	26.6

Table 9 illustrates the facts. The EEC average for 1971/72 was 36.6 Kgs. per-capita with only 26.6 for Spain. However, this latter figure was increased to 30.9 in 1973/74. Italy, on the other hand, had only 28 Kgs. per-capita in 1972/73 ranking last in the EEC group. Yet, it should be kept in mind that fruits and sweet products are good substitutes for the Spanish and Italian tastes which, coincidentaly, are the two countries that produce more fruits in the area.

There are several factors which have likely influenced the increase in total sugar consumption. The most relevant ones being: population, per-capita income, and level of prices. Population increased to 3.5 million persons during the 1964/1974 ten-year period here considered, which represents almost a 1.1 percent net population growth ratio. Disposable income per capita in real terms also increased for the same period and so did sugar prices in absolute terms. Table 10 gives yearly sugar prices both in absolute terms and deflated to the 1963/64 campaign.

Table 10

SUGAR RETAIL PRICES
(2 KGS. BAGS OF SUGAR GRADE "BLANQUILLA")

Campaign	PTA/Kg.	(1963/64) PTA/Kg.(1)
1963/64	15.50	15.50
1964/65	15.50	14.07
1965/66	15.50	12.85
1966/67	15.50	12.08
1967/68	15.50	11.44
1968/69	15.50	11.05
1969/70	15.50	10.63
1970/71	16.00	10.25
1971/72	16.00	9.46
1972/73	17.00	9.05
1973/74	18.50/22.00(2)	9.45/9.71(3)
1974/75	22.00/32.50(4)	9.71/12.56(3)

(1) Prices deflated to 1963/64
(2) There was an increase in February 1974 to 22 PTA/kg.
(3) Estimation
(4) Prices increased in March 1975 to 32.5 PTA/kg.

Sugar carryover kept in mainland Spain has been around 20 percent over the predicted consumption of most years in the 1964/74 decade. However, these stocks were reduced to a 4 and 8 percent level in the last two campaigns. This reveals a critical situation in sugar supplies for this two-year period. Table 11 shows the evolution of carryover amounts and imported amounts for each year.

Table 11.

SUGAR STOCKS IN MAINLAND SPAIN (TONS)

Campaign	Carryover on July 1st	Percent over Consumption	Imports Thousand Tons
1963/64	83,200	17.0	224.
1964/65	94,549	16.0	185.8
1965/66	178,408	27.7	120.0
1966/67	170,437	24.6	89.2
1967/68	134,149	18.2	189.0
1968/69	164,672	21.3	117.5
1969/70	187,749	23.8	55.3
1970/71	184,860	22.7	56.0
1971/72	155,816	17.7	16.1
1972/73	263,844	28.2	-----
1973/74	42,661	4.0	340.0
1974/75	85,959	7.9	-----

Source: Plan de Ordenacion y Desarrollo del Sector Agro-Industrial el Azucar., Ibid.

Sugar consumption in Spain is distributed equally between industrial and domestic uses at the present time. Therefore it is expected, as international experience has shown, that in the future, increased amounts be directed toward industrial uses both for food and non-food products. The provincial distribution of total apparent consumption is shown in Table 25 which appears in page 65 of this study.

From the observation of this table, one can conclude that, in 1971, provincial consumption--in which both industrial and non-industrial uses are included--ranges from 75.34 Kgs.

per person in the Palencia province to 8.63 in Cuenca. The two most populated provinces, Madrid and Barcelona consuming 23.11 and 34.97 respectively. The national average consumption being 27.5 Kgs. per year and person for the 1970/71 year of reference.

Some months in advance of the sugar campaigns which start on July 1 st, and ends on June 30th of every year, the Spanish Government defines several standard classes of marketed sugar destined for different uses and at the same time assigns: maximum prices to be received by sugar plants, maximum margins of distribution, and consequently retail prices. Sugar standardization is based on sucrose content, whether it comes from cane or beet sugar, qualitative and sanitary conditions of the product, and the type of package used. Table 12, shows grades and standards, prices at retail processing levels, and the corresponding price spreads for the 1974/75 campaign.

Table 12

RETAIL AND PROCESSING PRICES AND MARGINS. PTA/KG.

Class	Retail Price	Price for Processors	Price Spread
"Blanquilla" in bulk Sugar	32.5	31.35	1.15
"Blanquilla" in bags of 1/2,1, or 2 Kgs.	34.5	32.865	1.635
"Blanquilla" in bags of 10 or 15 grms.	41.1	39.225	1.875
"Pile" Sugar	32.8	31.630	1.15
"Granulated Especial" Sugar	32.8	31.650	1.15
"Cortadillo" in bulk Sugar	36.1	34.765	1.375
"Cortadillo" box of 1 Kgs. or less	39.1	36.925	2.175
"Cortadillo" in packages	49.6	39.125	2.175
"Refinada" Sugar	36.6	35.275	1.375
"Glass" Sugar	39.6	37.075	2.525

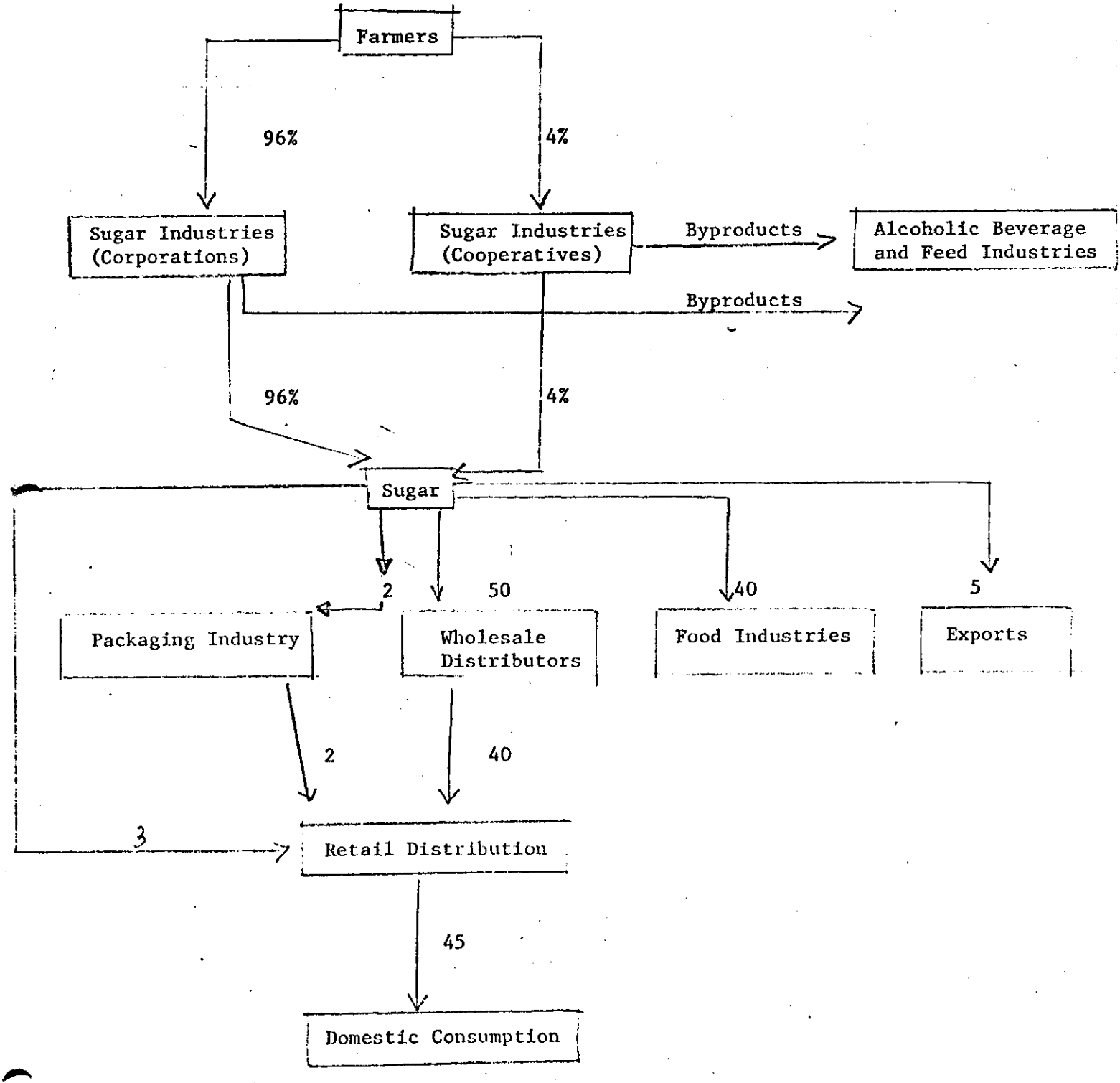
Source: Orden de Marzo 21,1975. B.O.E. No. 70, March 22,1975 Spain.

Channels and Methods of Distribution

The marketing channels for sugar from the raw product to consumption is summarized in Figure 1. Percent figures are referred to the 1969/70 campaign.

Figure 1.

MARKETING CHANNELS AND PERCENTUAL DISTRIBUTION



Source: Grupo Azucar. Ministerio de Agricultura. Spain 1970.

One interesting aspect of the functioning of the sugar marketing system, which clearly differentiates it from other subsectors, is the heavy public regulation to which it is subjected. Minimum raw product prices, maximum retail and wholesale prices, and margins for the different stages of distribution are dictated by the government every year. Furthermore, wholesalers and processing plants are required to send monthly situation reports refering to the sugar amounts they keep in storage, along with the names and the destination of their shipments. At the same time, processing plants should send monthly statements on the rythm of their processing activities.

Experts on the industry say that the marketing margins received by retail outlets are very inadequate. They also say that the only reason for shopkeepers and supermarkets to carry sugar is the capacity of this product to increase sales of other food products because of sugar's staple characteristics.

The Processing Industry

There exists a considerable degree of market concentration at the national level in the sugar processing industry. Three corporations own more than 80 percent of the processing plants and more than 87 percent of the aggregated processing capacity. Appendices 2,3, and 4 show the name, corporation that owns it, location, and daily processing capacity for the beet processing plants.

Moreover, agricultural cooperatives have scarcely engaged in processing activities. All but one of the 35 plants existing today belong to private corporations. The only existing cooperative firm possesses just one plant with 2,500 Tons of daily capacity which processes 350,000 Tons of beets a year. This represents slightly over 3 percent of the total sugar production of the country.

The figures presented in Appendix 5 show that the structure of the processing industry is fairly adequate for the beet production conditions of the country. There are 12 plants, out of the 35 existing today, with a capacity greater than 3,000 Tons/day. This particular capacity being the minimum authorized by the government for new installations. It is also worth mentioning that 7 plants process at least 4,000 Tons/day. Some studies have shown that substantial economies of size occur for capacities of about this dimension.

The average capacity of the sugar industry today is 2,470 Tons/day. This represents around 7,700,000 Tons of total capacity for each campaign. This total amount is distributed by regions as indicated in Table 13, in which average utilization ratios for the 1972/75 three campaigns and each production region are shown.

Further inspection of Table 13 shows that there is a rather low utilization of plant capacity of the Ebro-Centro Region and Sur Regions. This is a consequence of the disparities existing between the processing capabilities and actual

beet production for those two areas, which represents a misallocation of resources for the country.

Table 13

AVERAGE UTILIZATION RATIOS
FOR THE 1972/75 THREE CAMPAIGN

Region	Capacity Tons/Day	Campaign Duration (Days)	Annual Capacity (Tons)	Utilization Coefficient
Duero	29.850(1)	90	2,686,500	0.84
Ebro-Duero	15.500	80	1,240,000	0.42
Sur	41.200	90	3,708,000	0.57
Total	86.550	-----	7,634,500	0.64

(1) Including a new cooperative plant with 4,000 Tons/day that will start operating in the 1975/76 Campaign.

Source: Plan de Ordenacion y Desarrollo del Sector Agro-Industrial del Azucar. Ibid.

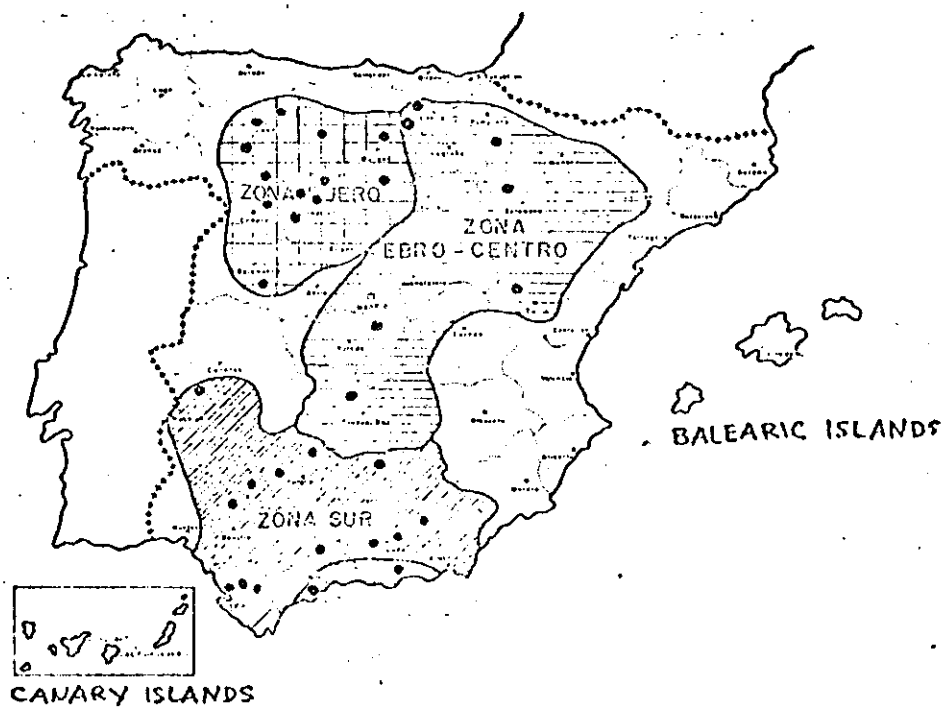
Insofar as the perspectives of the processing industry are concerned, experts of the industry believe, and government officials agree, that no authorization for the installation of new facilities should be granted for at least the next five years. Moreover, they say that the government should grant authorization for expansion to the existing plants as it becomes necessary because of the changes that surely will occur in the production of sugar beets. By doing so, they go on

saying, substantial economies for the 4,000 Tons/day size will be gained and the resulting cost savings shared by both the participants of the sugar subsector and consumers at large. It is for the preceding reasons that the location of the now-existing plants will be assumed to be unchanged from 1975 to 1980 for the purposes of this study.

The distribution of the processing capacity by zones is given in Appendix . Observation of the table on the appendix will indicate that the largest plants are concentrated in the Sur Zone. Figure 2 depicts the location of those plants.

Figure 2.

LOCATION OF SUGAR-BEET PROCESSING PLANTS
(1974/75 campaign)



Recent Developments and Problems of the Subsector

After the first processing facility was established in 1878, beet production areas and consequently processing plant locations have continually shifted around and across the country. This occurrence, which has also been the case in many other nations, has been explained by government officials and experts of the industry as being due to the following factors: first, because of the technological innovations achieved both at the raw-product and processing stages; second, because of the price and cost structure variations through time, sometimes owing to natural developments and sometimes to government intervention, as was the case when national minimim wage laws were established; third, due to the purposeful changes made in the Sugar Act since 1966, when prices paid to growers and accompanying premiums and discounts were related to the sugar content of the beets. Until that date, no differentiation was made other than on the density of the raw product.

In the production sphere, the Spanish Administration has in particular the problem of maintaining a politically-acceptable sugar retail price and, at the same time, supporting a high-enough price for the raw-product as to encourage domestic production in order to supply the amounts required by the internal demand. Needless to say, this difficult task is very seldom successfully accomplished. Consumption and production targets have been missed for most years, and huge amounts of

money have been paid to the subsector in the concept of subsidies and low-interest loans provided by public funds.

An additional problem which is present in the mind of the public regulators of the subsector has to do with equity considerations. Who should receive the economic incentives furnished by the government in the form of minimum prices, subsidies and low-interest loans? There is a great disparity in the net returns received by the cultivating farms of the Duero and Ebro-Centro Regions--basically of the family type--and the large commercial farms of the Sur Region in the South. While the southern productive structure is essentially land extensive and sometimes highly-mechanized, the other two regions use small farms and scattered cultivation plots as well as intensive labor. The consequence is that any policy directed to the subsector creates an equity problem because of the inflated share received by the large land owners of the South. This is turn adds to the discontent of the other participants of the sugar system--i.e. processors, distributors and consumers--who increase pressure on the regulators to try to tilt the balance toward their interests each year in which prices are modified.

Another source of trouble in the system, or subsector, are the frequent complaints and reactions of sugar distributors in relation to the margins they receive. Their complaint is based on the grounds that while they are more or less forced to carry sugar in their supplies because of the sensible

political importance of the product, they are mistreated in terms of the unfair margins they receive in relation to the services they perform and the costs which they incur. Wholesalers and retailers of sugar receive a 5% share of the price at retail, while farmers receive 65% and processors 30%. Their reactions are foreseeable. They reduce their inventories, and sugar shortages occur from time to time in different locations around the country.

This conduct of the distribution process in its storage function makes the performance of the system undersirable at least to three other participants of the system. Consumers need to keep sugar in their cupboards for periods longer than they would like. Processors are forced either to supply it on very short notices, or to maintain a costly storage and intelligence network. Third, the government officials of the C.A.T.--an agency charged with undertaking the functions of the private marketing sectors when problems arise--need to be equiped for the shortage eventuality with the facilities, personnel information systems, and necessary funds required to replace the traditional distribution channels.

In addition to the above, public regulation gives place to some repercussions and problems on the transportation activities to be performed by the system. One repercussion consists in the diversion of the transportation traffic of refined sugar, raw-products and the by-products derived from its processing from the publicly owned railroads to the truck-

ing industry, which increases gasoline consumption--a very scarce resource in Spain--and adds to the over-utilization of roads while railroads continue being under-utilized.

Before the payment based on sucrose content was established, sugar beets were delivered to train depots located at points near the production fields, from where they were brought to the plants. At the same time, refined sugar was carried to the consumer centers using the railroad since most plants were located close to railroad tracks. Today, because of the subsidy payments made to farmers to pay for transportation costs, they find it more convenient to carry their products directly to the processing plants where the sucrose content ought to be determined. At the same time, wholesale distributors trying to minimize their costs have moved their storage facilities away from train depots and nearer to the consuming centers. The result of all this is that processing plants find cheaper to move their refined sugar--job for which public subsidies are also paid--by trucks than by railroads.

III

PUBLIC POLICIES TOWARD SUGAR

The general norms that regulate the production and distribution of sugar, its raw-porduct and by-products are enacted in Sugar Acts by government decree every three years. Afterwards, and in each successive year, the national objective for sugar production is declared, taking into account projected consumption, the carryover of the preceding year and existing bilateral agreements with sugar exporting countries. From this figure, sugar beet and cane production is estimated and a miximum quota assigned for each of the cane-producing regions and the three beet-producing ones.

The decree--from now on to be called the Sugar Act--also establishes minimum prices to be received by the farmers and maximum retail prices to be charged for household consumption for different types and packages of sugar as described in Table 12 in section 2.2 of this study.

All sugar obtained within the limits imposed by the regional quotas can be destined to domestic consumption and receives a subsidy from FORPPA-an institution which is similar to FEOGA in the EEC, and is charged with the task of administering agricultural price and production policies. The subsidies are given to raw product processing plants to compensate the transport payments which they ought to pay to farmers according to their location in relation to the plant, and also, because of the costs incurred by the plant itself in

distributing refined sugar to wholesalers and major retail chains, which is a mandated task for them too.

The distribution of the subsidy between farmers and farm processors is established every year by interprofessional agrements between the national beet and cane producers and the processing associations.

Three major institutions collaborate in the enactment of the three-year Sugar Act: The Ministry of Agriculture, the Ministry of Trade and Commerce, and the FORPPA--a semi-autonomous body. The Ministry of Trade and Commerce establishes each year an indicative price for sugar consumption. This indicative price is determined according to a formula relating the consumer price index in Spain and sugar prices in the E.E.C. Afterwards, the FORPPA and the Ministry of Agriculture, in the month of July, fix the production target for the campaign to be initiated the first of July of the following year.

The Act also regulates contracts between farm producers and sugar processing plants. A prototype contract is published and its utilization mandated. The contractual obligations among interested parties are to be sanctioned by the government after the interprofessional associations bargaining meetings have taken place and the raw-product delivery dates, quality standards and other minor items have been agreed upon.

If a plant needs to shut down, the parent company, or any other agreed substitute, ought to continue contracting

with the customary growers. A processing plant cannot discontinue its services unless the quantity of raw product during three consecutive years decreased at least 65 percent below the average of the immediately preceding three-year period.

Beet production quotas for each region can be surpassed only by a ten percent of the regulated amount, but if this case occurs the excess is added to the production of the next year.

The Act also determines the payments to be made to raw-product growers according to the distance from their farms to the processing centers. Likewise, it regulates the premiums and discounts to be paid in relation to the sucrose content. These premiums are calculated by a formula which provides important economic incentives for raw products with high purity, saccharic content and quality. In addition, the farmer can obtain specified amounts of fresh and dry pulp--which are by-products of the processing activities--at no cost.

There are also provisions in the Sugar Acts specifying the maximum amounts of sucrose content that might be wasted in the form of molasses, which is another by-product of the sugar extracting process. Finally, the Act specifies the distribution of the retail price among the production and distribution agents. This is usually based on grade "blanquilla" sugar packaged in 2 Kgs bags. The distriubtion for the last five years was: 65 percent to farmers, 30 percent to processors not including value of by-products, 5 percent to retailers.

Spain uses an import-control program very similar to that of the E.E.C. In case of sugar, first, there is a "target" price from which other support prices are denied. This is fixed by the government in accordance with a complicated and varying criteria partially based on cost of living indicators and the sugar prices existing in the neighboring countries of Western Europe. There are then two "intervention" prices, a floor and a ceiling price, which are small deviations around the "target" price. They determine the minimum price at which the country buys refined sugar from foreign countries and the maximum prices at which sugar theoretically would be sold out of official stocks. The minimum price is aimed at maintaining a floor price which is thought to give support to prices of domestically produced sugar.

It is from the "intervention" price that the "threshold" price and "variable levies" are supposed to be calculated as sanctioned in the Spanish Agricultural Trade Policy. The "threshold price" is derived from the "minimum intervention" price by subtracting the cost of shipping sugar from the port of entry nearest to the main deficit area. This price is the minimum price that the country can tolerate if it is to maintain the minimum intervention price in the main consuming centers and avoid subsidizing foreign farmers.

The "variable levy" is thus a tax amounting to the difference between the c.i.f. import price and the "threshold" price, and it varies with any changes in these two prices. In other words,

changes in the internal price of sugar (which indirectly determines the "threshold" price) or in the world price immediately bring about changes in the "variable levy". It is, thus, an important device aimed at supporting internal prices and avoiding the vagaries of international prices.

However, in actual practice the methods followed in Spain have mainly consisted in either buying at the international price and applying tariff when the price was lower than the regulated maximum price in operation in the country for that particular year, or, in the case of dealings with Cuba, to pay c.i.f. prices equal to the above regulated price with no consideration as to which the deficit area is.

As stated in the section concerning to the objectives of this paper, apparently, one reason for it, is simply, that there is considerable uncertainty in the choice of the deficit area. An attempt will be made here in order to provide some help in choosing it.

Factors Affecting Sugar Supplies

Annual sugar supplies depend on two critical factors: the processing capacity of the sugar extracting and refining industry and the availability or production of the agricultural raw-product, which, in the case of Spain, is both sugar beets and canes, although the latter has become of minor importance since it is devoted mainly to the liquor industry, and the area on cane cultivation is declining very rapidly.

As explained in section 2.3 of this paper, the processing capacity has not represented a limiting factor in Spain for at least the last fifteen years. Moreover, no shortage capacity for the country as a whole is expected until at least the year 1980 because of the excess that exists at present, but some shortages might occur in some specific areas.

Sugar beet production has fluctuated very widely, as explained in Section 2.1, apparently due to changes in the government-regulated prices which are paid to beet growers and to shifts in production areas and techniques followed in their cultivation. Yields obtained in non-irrigated areas are considerably lower and more volatile than those obtained under irrigation methods.

According to a plan on the development and the organ-

ization of the sugar subsector made by both the Ministry of Agriculture and the Ministry of Industry in 1974,[1] no new areas other than the present three existing zones will be authorized to undertake sugar production until the year 1980. After that year, new processing industries will be authorized, unless previously-made technical studies show a fair degree of future success.

At present, there are three different sites on which agronomic studies have proven that beet production is technically and, to some extent, economically feasible; the new areas of beet cultivation being Caceres, Albacete and Murcia provinces. These areas are programmed to be the prime candidates for future expansion--or perhaps creation--of production zones in the 1980's.

Future production in the traditional three zones will surely depend, among other factors, on the profits procured by farmers in the cultivation of competing crops. In the Ebro-Centro Region, for example, where sugar beets are grown from April to December, corn and alfalfa have been identified by agricultural experts as the most important production substitutes.

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[1] Plan de Ordenacion y Desarrollo del Sector Agro-Industrial del Azucar. Direccion de la Produccion Agraria, Ministerio de Agricultural Direccion General de Industrias Alimenticias, Ministerio de Industria. Spain.

There are no well-identified competing crops for beets in the Duero Region. However, agricultural experts using some rules of thumb have indicated a number of them, the most important being alfalfa, potatoes and to some extent, corn and beans. Cultivation of beets and the aforementioned commodities is undertaken mostly on irrigated lands.

In the Sur Region, where sugar production takes place from October to June, mostly on non-irrigated lands, cotton and sunflower seeds are named as the most important production substitutes. In addition, some individuals believe that wheat and corn should be also included when labor costs get unexpectedly very high in comparison with beet prices.

Factors Affecting Sugar Consumption and Demand

For the purposes of this paper, demand is defined as the various quanlities of a particular commodity which a consumer is willing and able to buy as the price of the commodity varies, with all other factors such as income, tastes, price and availability of substitutes, etc., held constant. Demand relationships, thus, simply refers to the pure relationship between price and quantity purchased per unit of time, holding other factors constant.

Consumption, on the other hand refers to quantities actually consumed in a given period of time. Per capita income-consumption relationships for example, relate quantities consumed per year to annual per capita income. In this study

sugar consumption will be analyzed.

Demand for sugar is composed of demand for storage and for actual consumption. As previously discussed, inventories in the hands of wholesale and retail distributors have been consistently depressed to a minimum because of the low margins received by these participants of the subsector. In addition, mandated maximum prices prevent that large quantities be stored for speculative purposes except in those instances where regulated prices are expected to be raised in the short run.

Cross-section studies made by the International Sugar Council show that sugar prices and disposable real per capita income are the most important determining factor of sugar consumption. The study also showed that some differences are due to the particular habits in some regions of the world, the level of industrialization of the country, and whether it is a major producing region in the international context.

FAO, in a study made in 1956, also added as factors influencing consumption the marketing organization and climatology of the consuming country. Cold climates foster sugar consumption because of its caloric content. The study also discussed the inverse relationship between fresh fruit consumption and that of sugar, and the apparent influence of the type of basic cereal used in human consumption. While wheat consumption favorably affects the utilization of sugar, rice diminishes it.

There have been a number of sugar consumption studies in Spain with varying degrees of accuracy in as far as their predictions. (See for example: 4 & 5) From these studies some conclusions might be drawn. First, income, population and prices seem to be the major determinants as was to be expected in view of the results obtained in the international studies to which reference has been made. Besides, estimations made from the extrapolation of past trends did not result in good predictions of future per capita consumption rates. Third, some difficulty was encountered in determining what was apparent and what was actual consumption. The statistical tables of the country are refering to sugar disappearance. Forth, per capita consumption figures previous to 1960 were found not reliable since some rationning schemes were still in operational figures such as those used in industrial uses like soft beverages and bakery products were not available on a yearly basis.

In addition, some other studies undertaken on an international basis show that in countries of low per capita consumption--less than 12 Kgs. a year--most sugar is directly consumed in the household. As the consumption goes up, industrial uses increase. For consumption between 27 and 30 Kgs. per capita both uses are more or less equally distributed. Above these figures, industrial uses start to increase much more rapidly than those of the households.

[4]Nebot Rubio A. Un producto que fabrica la naturaleza: el azucar. Revista Sindical de Estadistica. 1973.

[5]Campillo M. El consumo de Azucar en Espana: Tendencias y Perspectivas. Revista de la Asociacion de Ingenieros de Espana. 1973.

Some studies mention that there might be a ceiling in per capita consumption. They show that in Holland during the 1957 to 1967 decade, sugar consumption for all uses was practically constant at the 42 Kgs. per capita level and that for countries such as Denmark, Great Britain and Sweden for example, for those years they consumed about 45 Kgs. per capita with plus or minus small changes around that figure for the same decade. In the U.S., the annual per capita consumption for that period was established at around 104 pounds raw-value equivalent to 97 pounds of refined sugar which represents about 45 Kgs. All those facts tend to emphasize the view that for high levels of income, sugar consumption increases at highly decreasing rates as income rises.

Finally, it should be noted that the use of synthetic sweetners and other saccharic substances[6] is rather insignificant in comparison with that of sugar. In 1967, only 6,400 tons of sweeteners vs. 187,081 tons of sugar were used. However, it might be said that with the now-existent sugar price structure--doubling the one existing in 1967--the previously mentioned proportion must have been altered very dramatically, at least in the recent years. Lumping together this estimate with the fact that, at present, per capita comsumption increases are mainly in the form commodities

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[6] Jaime Pulgar A. y Jesus Esteban A. Grupo de Trabajo Azucar. Ministerio de Agricultura. Madrid, 1974. Spain.

originated in the food processing and pharmaceutical industries, one can reliably assume that per capita sugar consumption will increase, but at ever declining rates.

SPECIFICATION, ASSUMPTIONS AND RESULTS OF THE SUGAR DEMAND AND SUGAR-BEET SUPPLY MODELS

Sugar Consumption and Demand

Two different types of equations (log-log and semi-log) were tested for the purpose of predicting short run sugar consumption levels and finding demand related parameters.

By using specifications of the log-log type, the following equations were estimated[1]:

$$\lg(PCSC) = 1.96 + 0.062 \log(DPCDI) - 0.64 \log(DPS) + 0.05\ DUMMY$$

s:	(0.56)	(0.24)	(0.19)	(0.008)
t:	(3.5)	(0.25)	(-3.35)	(6.4)

$R^2 = 0.9810$, $\bar{R}^2 = 0.9739$, dw = 1.773, n=11, S.E.E.=.103

$$\lg(PCSC) = 2.1 - 0.69 \lg(DPS) + 0.05\ DUMMY$$

s:	(0.035)	(0.033)	(0.007)
t:	(59.5)	(-20.9)	(6.82)

$R^2 = 0.9808$, $\bar{R}^2 = 0.9766$, dw = 1.8, n=11, S.E.E.=.0097

$$\lg(PCSC) = 0.09 + 0.87 \lg(DPCDI) + 0.05\ DUMMY$$

s:	(0.096)	(0.065)	(0.018)
t:	(0.97)	(13.3)	(4.7)

$R^2 = 0.9542$, $\bar{R}^2 = 0.944$, dw = 1.34, n=11, S.E.E.=.0151

where PCSC = Per-capita sugar consumption[2] (Kgs.)
DPCDI= Deflated per-capita disposable income (Thousand PTA)
DPS = Deflated price of sugar (PTA)
DUMMY= 1 if price increases where known in advance;
DUMMY=0, if otherwise.

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1 Prices and quantities of synthetic substitutes of sugar were not entered in the demand equations since their importance was negligible for the time period of consideration.

2 Per-capita sugar consumption figures are based on sugar dissapearance from sugar processing industries. It encompasses sugar kept in storage and for speculation purposes by the sugar using industries.

These equations might be transformed as follows:

$$\Delta(PCSC) = 0.062\ \Delta(DPCDI) - 0.64\ \Delta(DPS) \quad (4)$$

$$\Delta(PCSC) = 0.87\ \Delta(DPCDI) \quad (5)$$

$$\Delta(PCSC) = -0.69\ \Delta(DSP) \quad (6)$$

Where: Δ = Annual percentage increase.

The following equations were found using semi-logs:

$$PCSC = 46.95 + 7.53 \log(DPCDI)_t - 32.22 \log(DPS) + 3.24\ (DUMMY)_t \quad (7)$$

s: (26.84) (9.71) (8.34)
t: (0.6443) (-3.533)

$$R^2 = 0.9859,\ \bar{R}^2 = 0.9806,\ \text{d.w.}=2.11,\ n=11,\ \text{S.E.E.}=.496 \quad (8)$$

$$PCSC_t = -47.214 + 48.21 \log(DPCDI)_t + 3.4(DUMMY)_t$$

s; (4.73) (3.22) (0.58)
t:

$$R^2 = 0.964,\ \bar{R}^2 = 0.956,\ \text{dw} = 1.57,\ n=11,\ \text{S.E.E.}=.748 \quad (9)$$

$$PCSC_t = 64.16 - 38 \log(DPS)_t + 3.21\ (DUMMY)_t$$

s: (1.73) (1.6) (.37)
t: (37.) (-23.) (8.)

$$R^2 = 0.9852,\quad \bar{R}^2 = 0.9819,\ \text{d.w.}=1.12,\ n=11,\ \text{S.E.E.}=.479$$

Where: PCSC= Per-capita sugar consumption (Kgs.)
DPCDI = Deflated per-capita disposable income (Thousand PTA)
DPS = Deflated price of sugar (PTA)
DUMMY= 1, if price increases were known in advance;
DUMMY=0, if otherwise.

By doing so, it is possible to keep the coefficient of the logarithm of deflated prices of sugar of the previous equation. This equational form will be needed in other more complicated spatial-intertemporal equilibrium models to be undertaken in the future.

Sugar demand elasticities can be directly derived from equations (2) and (3) once the value of the dummy variable is known, that is, whether there was speculation or not in face of the price increases enacted by the government.

Equation (2) indicates that sugar demand is price inelastic (elasticity less than one) for the whole twelve year period under consideration. Equation (1) and (3) indicates also that income elasticity of sugar consumption is less than 1 and low enough as to indicate that the commodity is a "necessity".

However, for prediction purposes equation (7) is preferred. This equation was selected because prices and incomes, were included in the equation and their coefficients came out showing the rights signs, it predicts turning points reasonably well, the estimated income coefficient is more significant than that of the similar log-log- equation (1), serial correlation does not represent much of a problem, and the coefficients of determination R^2 and $\bar{R}^2$ are greater than 0.98.

TABLE 25. PROVINCIAL PERCAPITA CONSUMPTION AND INTERCEPT OF PROVINCIAL DEMAND EQUATIONS

Province	Kgs/Person	Intercept	Province	Kgs./person	Intercept
Palencia	75.54	113.41	Zamora	22.62	60.49
Baleares	66.33	104.2	Orense	22.39	60.26
Santander	61.15	160.19	Toledo	21.86	59.72
Logrono	51.39	89.26	Vizcaya	21.76	59.62
Lerida	48.43	86.3	Burgos	21.19	59.05
Guipuzcoa	46.65	84.52	Soria	19.39	57.25
Alicante	40.16	78.03	Granada	18.83	56.69
Oviedo	39.16	77.03	Salamanca	18.49	56.35
Murcia	38.13	113.87	Coruna	17.02	54.88
Alava	37.20	75.07	Albacete	15.77	53.63
Zaragoza	36.76	74.63	Badajoz	14.97	52.83
Cordoba	35.55	73.42	Teruel	13.55	51.41
Gerona	35.52	73.39	Jaen	12.91	50.77
Barcelona	34.97	72.84	Caceres	12.55	50.41
Tarragona	33.01	70.88	Guadajalara	12.40	50.26
Palmas	32.19	70.52	Ciudad Real	12.26	50.12
Valladolid	31.65	69.52	Castellon	12.22	50.08
Sta. Cruz Tene.	29.61	67.48	Huesca	11.66	49.52
Pontevedra	29.58	67.45	Avila	10.66	48.52
Leon	28.18	66.05	Almeria	10.43	48.29
Valencia	27.68	65.55	Huelva	9.77	47.63
Navarra	25.17	63.04	Lugo	9.44	47.3
Segovia	25.03	62.9	Cuenca	8.63	46.49
Malaga	23.97	61.84			
Cadiz	23.14	61.01			
Madrid	23.11	60.98			
Sevilla	22.66	60.53			

The dummy variable in all the forementioned equations refers to years in which price increases were known in advance of the announcement by the government. As it was expected the signs appeared to be positive in all equations. This indicates that, in effect, deviations and abnormalities in the sugar consumption trends occur because of speculative withholding of stocks by the part of the sugar using industries.

Data consisted of time series related to the 1962/1963 to the 1973/74 campaigns. Although data for previous years and campaigns were available they were not utilized because some rationing schemes were in operation by the time. Using them would reduce the homogeneity of the period of analysis.

By looking at the equation signs, the levels of significance, how well they approximated the turning points which occurred in the period under consideration and the coefficients of determination, the semilog equation (PCSD) = 64.16 - 38 lg (DPS) = 3.21 (DUMMY) was chosen as the one on which to base the derivation of the provincial demand equation. Table 25 shows the constant (or intercept) for each of the provincial equations and the level of sugar consumption in the year 1971.

Sugar Supply

In order to estimate regional sugar supplies various specifications were used. The following is the general model on which the different equations were based:

$$ASB_{t,i} = f\ (EGRSB_{t,i},\ APSU^{1}_{i,t-1},\ APSU^{2}_{i,t-2}, DUMMY_{t}),$$

$$QSBt,i = (YIELD)t,i\ *(ASB)t,i$$

$$QSBt,i = (SRR)t,i\ *(QSB)t,i$$

where:

$ASB_{t,i}$=Sugar-beet Areas in i-region, year "t", (Has)

$EGRSB_{t,i}$= Sugar-beets Expected Gross Returns in i-region,, and year "t" (PTA/Ha)

$APSU^{1}_{t,i}$ and $APSU^{2}_{t,i}$=Actual Gross-Returns per-hectare of substitute crop 1 or 2, in i-region and year "t". (PTA/Ha)

$QSBt,i$=Sugar-beet production in i-region year "t". (QM)

$YIELD_{t,i}$= Sugar-beet yields in i-region, year "t". (QM/Ha)

$QSS_{t,i}$= Quantity of sugar produced by i-region in year "t". (QM)

$SSR_{t,i}$= Sucrose Recovery Rate in i-region, year "t".

Using time series data the following equations were estimated for sugar-beet acreages. For the "Sur" Region:

$$(ASUR)_{t} = 28815{,}4 + 27.5\ (EXPROB)_{t} - 31.3\ (AGRCOT)_{t-1} 80.3(AGRSUN)_{t-1}$$

s:(87770.9) (273.7) (251.1) (562.4)

t:(.3283) (.1003) (-.1245) (-.1428)

.....+46695.5(DUMMY)

(17073)

(2.723)

R^2= .6558, $\bar{R}^2$= 4264, n=11 , S.E.E.= 20178.76

Where:

$(ASUR)_t$ = Sugar-beets Area of "Sur" Region, (Has)

$(EXPGRB)_t$ = Per-hectare Expected Gross Returns of Sugar Beets. (PTA/HA)

$(AGRCOT)_t$ = Per-hectare Actual Cotton Gross Returns, (PTA/Ha)

$(AGRSUN)_t$ = Per-hectare Actual Sunflower Gross Returns, (PTA/HA)

$(DUMMY)_t$ = 0 for years before 1967 campaign
1 otherwise.

And:

$$(EXPROB)_t = \frac{(PSB)_t * (YB)_{t-1}}{CPI_{t-1}}$$

$$(APCOT)_t = \frac{(PC)_{t-1} * (YC)_{t-1}}{CPI_{t-1}}$$

$$(APSUN)_{t-1} = \frac{(PS)_{t-1} * (YSN)_{t-1}}{CPI_{t-1}}$$

Where:

PSB_t = Prices of Sugar-beets in "t" year, (PTA/QM)

YB_{t-1} = "Sugar-beet yields in year "t-1" (QM/HA)

PC_{t-1} = Cotton prices in year "t-1", (PTA/QM)

YC_{t-1} = Cotton yields in year "t-1" (QM/Ha)

PS_{t-1} = Sunflower prices in year "t-1", (PTA/QM)

YS_{t-1} = Sunflower yields in year "t-1, (QM/Ha)

CPI_{t-1} = Consumer price index in year "t-1"

For the Ebro-Centro Region:

$$(AEBCT)_t = 33123.53 + 76.53\ (EGRCTB^*)_t - 1.1\ (GRCRN)_{t-1}$$

s: (15357.2) (47.13) (.2618)

t: (2.1569) (1.624) (-4.2)

$R^2 = 0.804$, $\bar{R}^2 = 0.7720$, n=11 , S.E.E. = 3610.4

Where:

$ABCT_t$ = Sugar-beet Acreage of "Ebro-Centro" Region in "t" year, (Has).

$(EGRCTB^*)_t$ = Per-hectare Expected Sugar-beet Gross Returns in "t" year, (PTA/HA)

$(GRCRN)_{t-1}$ = Per-hectare Actual Corn Gross Returns in year "t-1", (PTA/HA)

And

$$(EGRCTB)_t = (PCRN)_{t-1} * (YCORN)_{t-1}$$

$$(GRCRN)_t = (PB)_t * (YBEBCT)_{t-1} / CPI_t$$

Where:

$(PCRN)_{t-1}$ = Corn Prices in year "t-1", (PTA/QM)

$(YCRN)_{t-1}$ = Corn Yields year "t-1", (QM/Ha)

$(AB)_t$ = Sugar-beet Prices, years "t", (PTA/QM)

$(YBECT)_{t-1}$ = Sugar-beet yields in the "Ebro-Centro" Region for year "t-1", (QM/HA)

$(CPI)_t$ = Consumer Price Index.

Within the "Ebro-Centro" Region the "Ebro" Sub-region presents some peculiarities of its own. Subar-beet cultivation has been declining since the mid sixties. It is for this reason that a separate equation has been estimated for this area:

$$(AEBRO)_t = 39547.4 + 48.13\ (EGREB)_t - .001(AGR)_{t-1} - 1.37(CORNGR)_{t-1}$$

s: (15194.8) (47.63) (0.104) (0.256)

t: (2.6) (1.0) (-0.01) (-5.4)

$R^2 = .8797$, $\bar{R}^2 = .8281$, n=11, S.E.E.= 3422.17

Where:

$(AEBRO)_t$ + Sugar-beet Area in "Ebro" Region, year "t". (Has)

$(EGREB)_t$ = Per-hectare Expected Sugar-beet Gross Returns in year "t" (PTA/HA)

$(AGR)_{t-1}$ = Per-hectare Actual Alfalfa Gross Returns in year "t-1" (PTA/Ha)

$(CORNGR)_{t-1}$ = Per-hectare Actual Corn Gross Returns in year "t-1" (PTA/HA)

And:

$$(EGREB)_t = (PB)_t\ *(YBEBRO)_{t-1} / (CPI)_t$$

$$(AGR)_{t-1} = (PA)_{t-1} * (YA)_{t-1}$$

$$(CORNGR)_{t-1} = (PC)_{t-1} *(YC)_{t-1}$$

Where:

$(YBERRO)_{t-1}$ = Beet. Yields in "Ebro" Region year "t-1" (QM/Ha).

$(PB)_t$ = Beet Prices in year "t" (PTA/QM)

$(YA)_{t-1}$ = Alfalfa yields in year "t-1" (QM/Ha)

$(PA)_{t-1}$ = Alfalfa Prices in year "t-1" (PTA/QM)

$(YC)_{t-1}$ = Corn Yields in year "t-1" (QM/Ha)

$(PC)_{t-1}$ = Corn Prices in year "t-1" (QM/Ha)

For the "Duero" Region about 12 different equations were tried with no success. Loans granted to sugar-beet growers in some particular years and the support and subsidies given to those new cooperatives which could vertically integrate producing and processing functions, have surely affected the number and the scheduling of farms entering sugar beet production to such an extent as to reduce the importance of other economic factors.

Nonetheless, the following equation was finally chosen as the most reliable.

$$(ADUERO)_t = 62299.7 + 0.332(HPBNA) + 9042.1\ (DUMMY)_t$$

s: (14552.7) (.45) (5987.5)

t: (4.2) (.72) (1.5)

$R^2 = .5430$, $\bar{R}^2 = .7369$, n=11, S.E.E. = 6503.23

Where:

$(ADUERO)_t$: Sugar-beet Acreace in "Duero" Region and year "t"

$(HPBNA)_t$: Per-hectare Sugar-beet Prices National Average in year "T"

$(DUMMY)_t$ = 0 { Year previous to 1967
1 { Otherwise.

SPECIFICATION, ASSUMPTIONS AND RESULTS FROM THE TRANSPORTATION MODEL

The Linear Program

Linear programming techniques were used to solve the transportation problem of this study. An Apex 1 subroutine for the Control Data 6500 computer, available at M.S.U., was utilized to make its resolution feasible. The linear program consisted of (15x32) equal to 480 columns and 15 rows for the year 1971, and (14x33) equal to 462 columns and 14 rows for the year 1968. There were, therefore, 480 and 462 activities respectively, all of which might enter the optimal solution of the transportation problem.

Data on sugar surpluss and deficit quantities of the Spanish provinces were derived from secondary information and from them percentage figures were calculated in order to make the resolution of the linear program operational.

For the year 1968 it was assumed that of the sugar consumed in the Balearic Islands, 60 percent was provided by the province of Valencia and 40 percent by the province of Barcelona. It was assumed, also, that sugar consumption in the Canary Islands was met by foreign imports.

For the year 1971 nearly all the assumptions for 1968 were maintained except for the more exacting assumptions that all sugar consumption was met by national production and, therefore, sugar quantities demanded by the Canary Islands were subtracted from sugar supplies available in Cadiz the nearest producing province with port facilities. In addition, production in percentage terms available at the producing provinces was hypotherized to be at the

highest possible level according to the maximum utilization of the processing capacity available in the 1970-71 campaign.

The rationale for making the last two assumptions was to find the optimal distribution pattern of sugar for the most unfavorable situation in order to compare it with the optimal solution of the year 1968.

The Transportation Cost Matrix

Estimates of charges to shippers for transporting sugar from each of the 14 producing provinces to each of the 33 consuming provinces in operation in 1968, and 15 producing provinces to 32 consuming provinces in 1971, were obtained by extrapolating some figures provided by officials of the Ministry of Agriculture of Spain.

A combination of two transfer cost functions plus direct estimates of transport costs by sea were utilized. The functions were:

From 1 to 300 Km.

$$cij = 1.25\ aij - \frac{(a_{ij})^2}{1200}$$

From 300 to 1050 Km.

$$cij = 1.4\ aij - \frac{(aij)^2}{1400}$$

More than 1050 Km. No land transport. Ships are used instead. Regular rates do not apply.

If consuming center has port facilities, ships are preferred to trucks or railway. If production center is located close to port facilities, ships are preferred to trucks or railway.

Where:

cij= Land transportation costs in PTA/kg.

aij= Distances in Km. using main highways.

Transport costs were assumed independent of the size or weight of shipment.

The flows of sugar supplies from areas with surplus to areas with deficit which minimize the transportation costs are depicted in Figs. 3 and 4 for the years 1968 and 1971 respectively.

Since the figures utilized in the model do not correspond to actual quantities but to percentages and, furthermore, for the year 1971 surplus figures represent amounts which might be potentially shipped to locations with sugar deficits, the amounts indicated by the model do not have opperative meaning. However, they might serve for other purposes.

In this study they have been used to compute the optimal transportation cost structure, and from it to derive the deficit area with the highest optimal transportation costs. Likewise, the optimal cost structure have been used to find which producing areas benefited from the lowest transportation costs to the consuming centers and, to establish a comparison among the producing regions determined by the Spanish Sugar Act as described before in this paper.

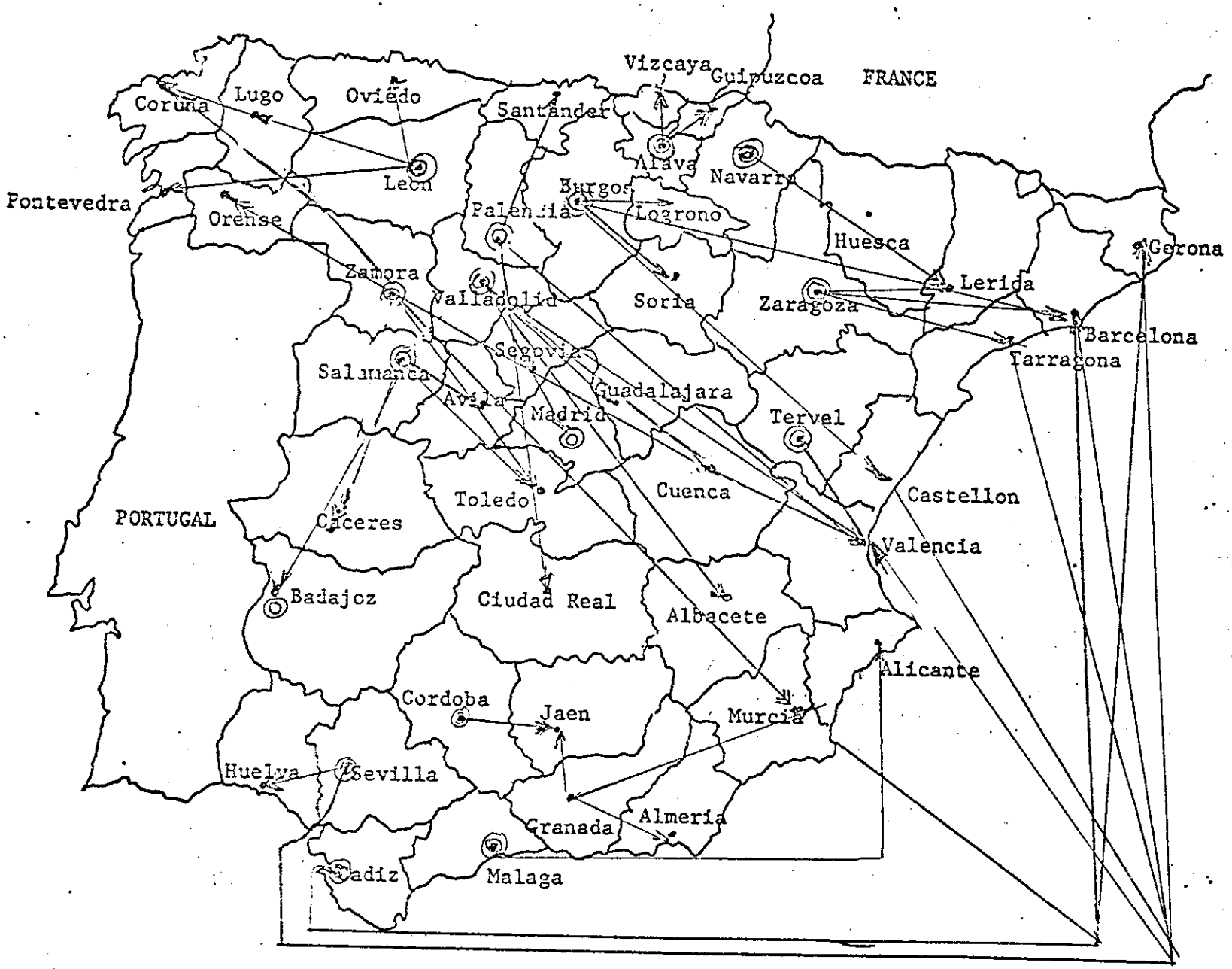

Figure 4. OPTIMAL FLOWS. YEAR 1971

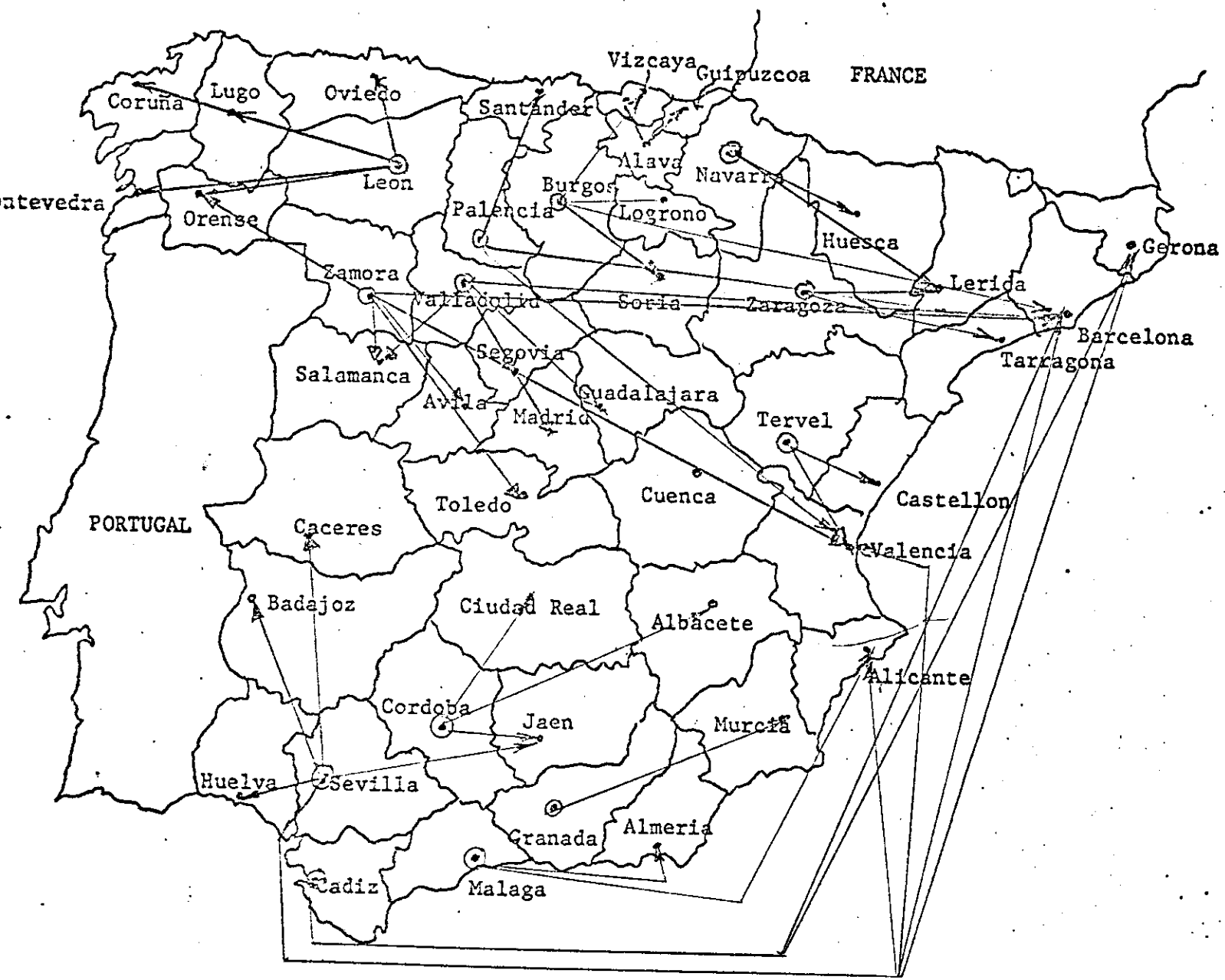

Figure 3. OPTIMAL FLOWS. YEAR 1968.

The province of Barcelona was found the province with the largest deficit in both the 1968 and 1971 runs of the transportation model. Using the optimal distribution indicated by those two runs this province requires supplies from locations for which high transportation costs apply. Ranking second in both models is the province of Valencia with an optimal transportation cost structure closer to that of Barcelona for the 1971 case in which more exacting assumptions were imposed on the specification of the model.

With respect to the optimal transportation costs which apply to different producing and surplus regions the results of the two models roughly indicate that the cost structure approximates the following distribution.

Table 22. COMPARISON OF LEAST TRANSPORTATION COST STRUCTURES

Region	Index
"Ebro" Region	1.5
"Centro Sur" Region	0.5
"Duero" Region	3.7
"Sur" Region	1.6

The index used in the above table was constructed for each distinctive producing region from the following formula:

$$\text{Index}_i = \frac{1}{100} \frac{\sum_{j=1}^{k} aijtj}{\sum_{j=1}^{k} aij}$$

Where: aij = Sugar quantities shipped by the producing region "i"
to consuming region j as indicated by the least cost conbination given by the transportation model.

tij = Transportation costs from producing region "i" to consuming region "j"

Then the index is a weighted average of transportation costs from each producing region to the consuming locations using the least cost conbination for the nation on a whole.

Thus, the "Duero" Region finds itself in comparative disadvantage with respect to the transportation costs derived from its particular location in relationship to the location of the consuming centers. The "Ebro" and "Sur" Regions, in the optimal, are in relative equal position with each other and have considerable advantage over the Duero Region. The "Centro Sur" Region because of its geographical proximity to Madrid - a large consuming center-is the region with most advantage.

SPECIFICATION, ASSUMPTIONS AND RESULTS OF THE SUGAR DEMAND AND SUGAR SUPPLY PROJECTION MODELS.

Consumption Projection

Projections related to sugar consumption in Spain were based on three different assumptions as to sugar consumption growth rates. As indicated in Table 14 three-declining rates were considered for the eleven year 1973/74-1984/85 period. The reasons for selecting these three rates were derived from the following considerations: First, the consumption figures of the 1963/64 to 1973/74 eleven year period given in Table 8 indicate that per-capita consumption grew at a 4.3 percent compound rate. Second, recent trends in the E.E.C. neighboring countries, with tastes similar to those of Spain, suggests that growth rates are going to be much lower than the figure cited above. 1/ Third, population growth has assumed to be at present levels or even lower. Fourth, income growth was supposed to behave in a manner similar to the last five years. However, since sugar income elasticity is expected to continue being as low as in the last ten years, as it was indicated by the short-run prediction models of this study, the income effect was considered negligible. Fifth, the deflated sugar prices appearing in Table 8 of this study are not likely to be repeated in the future . Government officials have given numerous public statements at this respect.

1/ During the 1967 to 1974 period sugar consumption increased from 31.4 Kgs to 37 Kgs per capita, which means a 2.4 percent annual compound rate. Spain in 1973/74 consumed 30.9 Kgs, this figure being quite similar to that of 31.4 in the E.E.C. in 1967.

Table 14 below gives consumption figures projected to the next decade.

Table 14. SUGAR CONSUMPTION PROJECTIONS

Campaign	Mainland (Thousand Tons)	Islands and Territories (Thousand Tons)	Total (Thousand Tons)	Total (Kgs/Capita)
73/74	1046	70	1116.00	30.88
74/75	1080	72.24	1152.24	31.87
75/76	1114	74.55	1188.55	32.89
76/77	1149	76.94	1225.94	33.94
77/78	1186	79.40	1265.40	35.02
78/79	1224	81.94	1305.94	36.14
79/80	1264	84.56	1348.56	37.30
80/81	1301	87.10	1388.10	38.42
81/82	1341	89.71	1430.71	39.57
82/83	1378	92.23	1470.23	40.68
83/84	1417	94.81	1511.81	41.82
84/85	1456	97.46	1553.46	42.99

Assumptions: 1973/74 to 1979/80 - 3.2%

1980/81 to 1981/82 - 3.0%

1983/84 to 1984/85 - 2.8%

From previous Table 14 , assuming that 92% of total consumption is required to be produced by domestic supplies as it is presently avowed by the Government and that 13.6 percent is the national average for the sugar recovery rate (this represents and slight improvement over today's rates); the following Table 15 is derived:

Table 15. SUGAR AND SUGAR-BEETS PROJECTED NEEDS

Campaign	Sugar (Thousand Tons)	Sugar Beets (Thousand Tons)
73/74	1026.00	7544
74/75	1060.06	7799
75/76	1093.47	8040
76/77	1127.86	8293
77/78	1164.17	8559
78/79	1200.60	8828
79/80	1240.67	9122
80/81	1277.05	9390
81/82	1316.25	9678
83/84	1352.61	9946
84/85	1390.86	10227
85/86	1429.18	10508

Sugar-beet Supply Projections

To establish sugar-beet projections into the future it is necessary, first of all to break down the producing zone in two; the traditional old producing zone and the new zones for which agronomical feasibility studies have indicated high potential. However, the concern in this study will exclusively be with the old producing regions since enough reliable information does not exist for the new ones.

In addition, and in order to make realistic long-run supply projections, several assumptions have been made in this paper. Table 16 , below states those assumptions.

Table 16. ASSUMPTIONS FOR LONG-RUN PROJECTIONS

	Low estimate	High estimate
Sugar-beet prices	High enough as to provide an adequate profits to producers.	Same
Contract terms and norms related to the collection and analysis of sugar beets in the processing facilities.	Similar to those existing today.	Different from present. Better rationalization in the timing and operation of cropping, harvesting and collection processes.
Productive inputs.	Utilization of high yield varieties.	Same
Harvesting, transport and delivery to the processing facilities.	Similar to those existing today.	Undertaken not by farmers but by the processing firms themselves and/or new firms created for this purpose.

Besides, three additional assumptions have been made: 1)cultivation on irrigation lands will be more intensive in the future, 2) New irrigation lands are actually put in cultivation as specified in the government development five-year plans, 3) About 370,000 hectare on dry land will enter production, of which 300,000 are located in the Gudalquivir Valley of the "Sugar" Region. (Agronomical feasibility studies have recently indicated a remarkable potential for the aforementioned areas), 4) Processing capacity is not a limiting factor.

Once all the assumptions were specified long run sugar-beet supplies were derived as presented in Table 19.

Future Needs

A comparison of both projections, i.e., projected demands and supplies to the years 1980 and 1985 indicate the conclusions given in Tables 17 and 18 below.

Table 17. PROJECTED SUGAR-BEET SURPLUSES AND DEFICITS

Campaign	(Thousand Tons) Production needs to cover 92% of domestic demand	(Thousand Tons) Projected Production			(Thousand Tons) Deficit and Surplus		
		Low	High	Average	Low	High	Average
1979	9122	7330	9150	8240	-1793	+28	-882
1985	10508	8670	11640	10640	-1838	+1132	+132

Table 18. PROJECTED SUGAR SURPLUSES AND DEFICITS

Campaign	(Thousand Tons) Domestic Production needs to cover 92% of demand	(Thousand Tons) Projected Production			(Thousand Tons) Surplus and Deficit		
		Low	High	Average	Low	High	Average
1979/80	1240.7	996.8	1244.4	1120.6	-243.9	+3.7	-120.1
1985/86	1429.2	1179.1	1583.0	1447.0	-250.1	153.8	-17.8

TABLE 19 LONG-RUN SUGAR-BEET SUPPLY IN TRADITIONAL ZONES

REGION		1975 / 76			1979 / 80			1985 / 86		
		LOW	HIGH	AVERAGE	LOW	HIGH	AVERAGE	LOW	HIGH	AVEAGE
DUERO	DRY LAND (HAS)	3,380	4,980	4,180	3,880	4,830	4,355	3,880	4,680	4,280
	IRRIGATED (HAS)	73,500	86,100	79,800	93,700	109,600	101,650	108,700	129,900	119,300
	TOTAL (TONS)	3,000,000	3,500,000	3,250,000	3,840,000	4,500,000	4,170,000	4,440,000	5,308,000	4,874,000
EBRO-CENTRO	DRY LAND (HAS)	5,000	8,850	6,925	5,050	9,150	7,100	5,050	9,250	7,150
	IRRIGATED (HAS)	10,850	14,600	12,725	16,250	24,000	20,125	20,900	35,800	28,350
	TOTAL (TONS)	554,000	796,000	675,000	771,000	1,179,000	975,000	957,000	1,654,000	1,305,500
SUR	DRY LAND (HAS)	72,400	82,000	77,200	79,500	99,300	89,400	87,000	121,500	104,250
	IRRIGATED (HAS)	11,400	14,700	13,500	16,600	20,900	18,750	20,800	27,800	24,300
	TOTAL (TONS)	2,194,000	2,556,000	2,375,000	2,572,000	3,220,000	2,896,000	2,920,000	4,028,000	3,474,000
TOTAL (HAS)	DRY LAND (HAS)	86,780	95,830	91,305	88,430	113,280	108,550	95,930	135,430	115,800
	IRRIGATED (HAS)	95,750	115,400	105,575	126,550	154,500	140,525	150,400	193,500	171,950
	TOTAL (HAS)	182,530	211,230	196,880	214,980	267,780	241,380	246,330	328,930	287,630
TOTAL PRODUCTION (TONS)		5,748,000	6,852,000	6,300,000	7,183,000	8,899,000	8,041,000	8,317,000	10,990,000	9,653,500

Also, from Table 19, and assuming 90 days as the maximum length of the processing campaign, the derived Table 20 below indicates surpluses and deficits in the processing capacity for the years 1980 and 1985.

Table 20. PROJECTED DEFICITS AND SURPLUSES IN PROCESSING
(Processing Capacity in Tons/24 Hr. of sugar-beets)

Campaign	Needed capacity			Today's Authorized	Deficits and Surpluses for projected capacity		
	Low	High	Average		Low	High	Average
1980/81	79,811	98,878	89,344	90.900	+11,089	-7,977	+1556
1985/86	92,411	122,111	107,261	112.250	+19,839	-14,850	+4989

Finally, the processing capacities which will be needed for 1980 and 1985 years in each region are indicated in Table 21. (Assuming 90 days as the maximum length operations).

Table 21. LONG-RUN PROCESSING CAPACITY NEEDS IN TRADIONAL ZONES

REGION	Capacity in Thousand Tons					
	1980/81			1981/82		
	Low	High	Average	Low	High	Average
Dueron Region	42,667	50,000	46,333	49,333	58,978	54,155
Ebro Region	8,567	13,100	10,833	10,633	18,377	14,500
Sur Region	28,577	35,778	32,177	32,444	44,756	38,600
Total	798,111	98,878	89,344	92,411	122,111	107,261

If average capacities are, then, compared with todays existing capacity in each region the folllowing conclusions might be drawn.

The Duero Region will need an additional daily processing capacity of about 16,383 Tons in the year 1980 and about 24,205 tons in 1985 over the 29850 Tons capacity available today.

Likewise, the Ebro-Centro Region will have to reduce its overall daily capacity about 4,.667 Thousand Tons in 1980 but only about 1,000 Tons in the year 1985. in order to keep pace with developments in sugar-beet production.

The "Sur" Region also will run excess capacity if the present level of 41,000 Tons per day is maintained. The excess capacity will amount to about 9,025 Tons in year 1980 and about 2,600 Tons in year 1985.

Conclusion

As indicated at the begining of the paper, this writing represents a start for future work on the Spanish Sugar Subsector. A more comprehensive treatment in the form of doctoral thesis will be undertaken in the near future.

The first objective, that of describing the functioning, issues and problems related to sugar in Spain have been covered in Section II. As stated in the second objective, sugar demand and supply relationships have been found using a number of regression equations. By inspecting the results of the demand equations given in section III one might state that sugar is price inelastic and that the income elasticity of sugar consumption is less than one and near to zero which indicates that the commodity might be called a "necessity" in economic parlance. Besides, and also from the sugar demand equations relating to the country as a whole, the demand equations of the fifty provinces which comprise the Spanish territory have been found. These equations will serve in the future for more complicated spatial equilibrium models.

In addition, regional sugar supply equations have been calculated and discussed in the second part of the section related to the short-run prediction models. From them one might conclude that in the Sur Region per-hectare cotton and sunflower prices lagged one year are important factors in determining sugar-beet production response together with per-hectare expected sugar-beet prices. However, also included in the equation is a dummy

which represents factors which were not accounted for in the specification of the different equations. One such factor could be the passing of time itself. As it came out, the dummy variable showed a significant regression coefficient. This gives an idea as to its importance as an explanatory variable of the sugar-beet production response. On the other hand, in the "Ebro-Centro" Region corn prices are more a determining factor. Corn prices affect very significantly the sugar-beet production response. Alfalfa has some importance also in the "Ebro" subregion of the cited region. Finally, in relationship with the "Duero" Region, no statistically significant equation was found which contained variables for crops competitive with sugar-beets for productive resources. The most reliable equation contained only a dummy variable of the type explained before in addition to sugar-beet prices. This could indicate that there might be important factors such as public loans, subsidies and favorable policies importantly affecting the production response.

The usefulness of all five regional equations should be sought in both short run predictions and in the government pricing of sugar beets. By using them, the Spanish legislator can inform their choice as to the response of their fixing of sugar beer prices in relationship to the unregulated existing prices of the substitute crops included in the equations.

The initially stated objective of projecting lon term sugar demand and supplies and finding whether installation of additional processing facilities will become necessary by the years 1980 and 1985, have been covered in a continuing part of section III of this study. As indicated in section III-3, only the Duero Region will surely have to augment its

processing capacity in order to keep pace with developments in sugar beet production. The region is likely to need an additional 16,338 Tons of daily processing capacity by 1980 and 29,850 Tons by 1985. However, the "Ebro_Centro" Region and the "Sur" Region will run excess capacity by 1980 and 1985 if the present availability is maintained.

The last objective, that of finding whether there is any regional comparative advantages in terms of location and related transportation costs, has been met by using a transportation model. The usefulness of this model has been tested in finding the most deficit consuming region (which has resulted to be Barcelona), and the production regions with most disadvantage in so gar as to the trasnportation costs to be paid by the processing firms, which cannot be reflected in wholesale prices as mandated by the Spanish Sugar policies. The region with comparatively more disadvantage, in the optimal or least costs configuration, was found to be the Duero Region, with the Sur Region and the Ebro Sub-Region positioned at approximately an equal level. The Centro Subregion showed substantial comparative advantage.

On the other hand, no significant advantages and disadvantages could be found from the results of the model in relationship with the proprietary structure of the particular location of processing facilities in the three regions of this study. The three corporations existing today, which control more than 87 percent of the aggregated processing capacity, have their sugar-beet processing enterprises dispersed

quite evenly across the country. However, this does not apply to the independent and comparatively smaller industries.

The only existing cooperative firms located in the province of Valladolid in the Duero Region and the continuing efforts to create and locate additional cooperatives with the backing of the government in that region are apt to fail if the processing-firms-pays policy is not changed, and, instead, it is the wholesaler, retailer or consumer who pays for the transportation cost.

Nonetheless these results should be taken with some caution since it is possible that the assumptions of the model exert considerable influence on the output. First, the transport cost structure specified in the model allows no adjustment for the discounts and differentiated rates which are likely applied depending on the volume and weight of shipments. Second, storage options and related costs are omitted in this particular model. Third, transportation costs may not be very accurate, particularly those related to sea-shipments. Fourth, the optimal flow structure, and in general the transportation model presupposes that decisions are taken by regions, not by firms as it is in the real world. A given corporation might find economies in transportation by using its own connections with the transport industry and the monopoly power allowed by its size and this would not be included in the model. Fifth, the optimal solution or least cost configuation of sugar transportation assume economic rationality by part of the participants.

Sixth, there are multiple aggregation problems. Consumption and production take place in scattered location and not at fixed sites or points as it is assumed in the model. Seventh, the model might be categorized as a short-run ex-port spatial equilibrium model. It assumes away the dynamic aspects of the economic activity.

APPENDIX I

Provincial Sugar-Beet Production

1.1 "Duero" Region

1.2 "Ebro-Centro" Region

1.3 "Sur" Region

APPENDIX 1.1

SUGAR-BEET PRODUCTION "EBRO-CENTRO" REGION (TONS)

C A M P A I G N S

PROVINCES	1968/69	1969/70	1970/71	1971/72	1972/73	1973/74	AVERAGE 1971/72-1972/73-1973/74
Alava	78,400	94,270	105,841	111,779	92,000	83,000	95,593
Logrono	111,400	150,531	113,455	171,638	134,100	78,000	127,912
Navarra	123,100	63,825	61,300	64,647	39,800	22,000	42,149
Zaragoza	296,200	196,191	223,834	210,520	125,200	71,800	135,840
Huesca	53,900	26,340	19,314	13,370	8,100	1,200	7,556
Lerida	18,500	10,048	7,557	732	-----	-----	244
Teruel	65,500	67,104	67,829	91,950	77,300	64,000	77,750
Burgos - Ebro	43,800	60,206	58,347	60,949	42,000	31,000	44,649
Soria - Ebro	17,700	21,166	18,725	17,283	14,000	-----	10,427
Madrid	40,900	38,818	26,632	31,127	16,000	5,000	17,375
Toledo	49,100	46,912	25,972	39,625	28,600	22,000	30,075
Ciudad Real	84,800	101,848	131,238	143,416	154,000	165,000	154,138
Cuenca	518	495	476	1,717	1500	1,000	1,072
Albacete	7,900	9,600	5,834	6,018	12,700	13,000	10,572
Guadalajara	20,000	20,151	11,904	20,743	10,600	12,000	14,447
TOTAL REGION	1,011,718	907,505	878,258	985,514	754,900	569,000	770,048

APPENDIX 1.2

SUGAR-BEETS PRODUCTION "DUERO" REGION (TONS)

PROVINCES	CAMPAIGNS 1968/69	1969/70	1970/71	1971/72	1972/73	1973/74	AVERAGE 1971/72-1972/73-1973/74
Leon	504,300	499,911	469,485	467,679	470,700	550,000	496,126
Zamora	254,500	229,506	214,191	322,392	344,000	339,000	335,130
Salamanca	150,600	164,562	162,006	215,781	237,400	230,000	227,727
Avila	124,000	175,860	174,850	254,471	250,100	224,000	242,857
Segovia	120,800	135,250	137,833	176,826	167,400	120,000	154,742
Valladolid	594,400	666,482	608,081	803,744	787,500	660,000	750,414
Palencia	165,400	207,755	216,870	306,903	267,000	275,000	282,967
Burgos - Duero	276,500	300,145	211,864	307,864	230,000	203,800	247,222
Soria - Duero	51,800	55,624	48,022	57,991	27,600	32,000	39,197
TOTAL REGION	2,242,300	2,435,095	2,243,202	2,913,654	2,781,700	2,633,800	2,776,384

APPENDIX 1.3

SUGAR-BEET PRODUCTION "SUR" REGION (TONS)

PROVINCES	CAMPAIGNS 1968/69	1969/70	1970/71	1971/72	1972/73	1973/74	AVERAGE 1971/72-1972/73-1973/74
Jaen	44,950	57,422	42,890	15,830	13,460	33,635	20,975
Cordoba	204,800	179,841	254,379	228,492	213,853	353,237	265,194
Sevilla	368,400	462,061	621,806	602,228	399,878	605,000	535,702
Huelva	9,200	12,500	25,900	13,400	25,000	21,000	19.800
Cadiz	498,100	672,294	1,078,265	1,473,787	813,977	1,359,215	1,215,659
Malaga	38,500	39,882	31,953	18,000	15,700	12,000	15,233
Granada	132,000	186,493	180,657	105,805	120,000	94,000	106,601
Almeria	-----	-----	-----	350	1,200	1,100	883
Murcia	1,700	3,000	3,300	2,690	4,900	600	2,720
Caceres	-----	-----	-----	1,027	1,600	-----	875
Badajoz	10,200	18,100	39,500	59,700	42,000	35,200	45,633
TOTAL REGION	1,308,050	1,631,593	2,278,650	2,521,309	1,651,568	2,514,987	2,229,288

APPENDIX 2

SUGAR-BEET PROCESSING PLANTS IN THE "DUERO" REGION

APPENDIX 2

SUGAR - BEET PROCESSING PLANTS IN THE "DUERO" REGION

Corporation	Name of Plant	Location	Province	Capacity(tons/24 hr)
Ebro Cia. Azucares y Alcoholes	Santa Elvira	Leon	Leon	3,000
" " " "	Duero	Toro	Zamora	3,000
" " " "	Santa Victoria	Valladolid	Valladolid	2,400
" " " "	Castilla	Venta de Banos	Palencia	2,800
" " " "	Penafiel	Penafiel	Valladolid	2,500
" " " "	S. Pascual	Gamonal	Burgos	850
Sdad. Gral. Azucarera de Espana	Leonesa	Veguellina	Leon	2,500
" " " "	Esla	Villanueva do Azoague	Zamora	900
" " " "	Carrion	Monzon de Campos	Palencia	2,500
Compania de Industrias Agricolas	La Baneza	LaBaneza	Leon	2,800
" " " "	Salamanca	Carbajosa	Salamanca	1,700
" " " "	Aranda de Duero	A. de Duero	Burgos	2,400
Cooperativa Onesimo Redondo	Onesimo Redondo	Valladolid	Valladolid	2,500
			TOTAL REGION	29,850

APPENDIX 3

SUGAR -BEET PROCESSING PLANTS IN THE "EBRO-CENTRO" REGION

APPENDIX 3

SUGAR - BEET PROCESSING PLANTS IN THE "EBRO - CENTRO" REGION (1)

(Campaign 1974/75)

Corporation	Name of Plant	Location	Province	Capacity (tons/24 hr.)
Ebro Gia. Azucares y Alcoholes	Leopoldo	M. de Ebro	Burgos	2,000
" " " "	Ebro	Luceni	Zaragoza	2,000
Sdad. Gral. Azucarera de Espana	Alavesa	Gobeo	Vitoria	3,000
" " " "	Concepcion	Marcilla	Navarra	1,800
" " " "	Aranjuez	Aranjuez	Madrid	2,500
Ebro-S.G.A.E. (joint venture)	C. Real	C. Real	C. Real	3,000
Compania Industrias Agricolas	Jiloca	Sta. Eulalia	Teruel	1,200
			Total Region	15,500

1

The following plants are not included due to temporary shutdowns:

Agricola Industrial de Navarra de Cia. located in Tudela (Navarra) capacity 2,000 ton/day

Azucarera de Terrer de Ebro located in Terrer (Zaragoza) capacity 1,600 ton/day

Azucarera de Alagon de S.G.A. located in Alagon (Zaragoza) capacity 940 ton/day

APPENDIX 4

SUGAR-BEET PROCESSING PLANTS IN THE "SUR"REGION

APPENDIX 4

SUGAR-BEET PROCESSING PLANTS IN THE "SUR" REGION

(Campaign 1974/75)

Corporation	Name of Plant	Location	Province	Capacity(tons/24 hr.)
Ebro Cia. Azucares y Alcoholes	San Rafael	Villarrubia	Cordoba	4,000
" " " "	San Fernando	Los Rosales	Sevilla	3,000
" " " "	Guadalcacin	Jerez	Cadiz	5,000
Sdad. Gral. Azucarera de Espana	Guadalete	Jerez	Cadiz	5,000
" " " "	Hispania (1)	Malaga	Malaga	1,000
Compania Industrias Agricolas	Guadalquivir	LaRinconada	Sevilla	4,000
" " " "	Jedula	Arcos de la F.	Cadiz	4,000
Ebro-Independientes	Guadiana	LaGarrovilla	Badajoz	1,200
Ebro-SGAE-CIA (participan las tres)	El Carpio	El Carpio	Cordoba	4,000
Azucareras Reunidas de Jaen	Sta. Catalina	Linares	Jaen	4,000
Azucarera Antequerana	Ingenio S. Jose	Antequera	Malaga	1,000
La Vega Azucarera Granadina	La Vega	Granada	Granada	1,000
Azucarera San Isidro	San Isidro	Granada	Granada	1,000
Agricola Ntra. Sra. del Carmen	Ntra. Sra. del Carmen	Benalua de Guadix	Granada	2,000
Ntra. Sra. del Rosario	Ntra. Sra. del Rosario(1)	Salobrena	Granada	1,000
			Total Region	41,200

1 Including Sugar Cane

Source: A.I.M.C.R.A. Zaragota. Spain

APPENDIX 5

EVOLUTION OF THE SUGAR INDUSTRY STRUCTURE

APPENDIX 5

EVOLUTION OF THE SUGAR INDUSTRY STRUCTURE

Sugar-beets (ton/24 hr.)	1961/62 No. of plants	%	1967/68 No. of plants	%	1974/75 No. of plants	%
<1,000	20	46.5	11	29.7	2	5.7
1,000-2,000	22	51.1	12	32.4	9	25.5
2,000-3,000	1	2.4	13	35.2	12	34.5
>3,000	---	---	1	2.7	12	34.3
	43	100	37	100	35	100

Total Capacity			
Total processing (Tons/ 24 hr.)	47,560	61,190	86,550
Total processing in Campaign (Tons/ 90 days)	4,280,400	5,507,100	7,789,500