

Agricultural trade liberalization in Morocco:

The case of oilseeds sector

by

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CHAPTER 1.

INTRODUCTION

Economic Conditions in Morocco before the
Structural Adjustment Program

Since 1976, the Moroccan budget deficit and current account deficit have expanded simultaneously. In 1974, the price of phosphate tripled, and the Moroccan government seized the opportunity to finance spending programs, such as pay raises for government employees and food price subsidies, through phosphate revenues. One explanation for the increased revenue is that public investment expenditures were financed through foreign loans. But in 1976, phosphate prices began to decline, and soon 47 percent of the commodity sold for only its 1975 price (Morrison 1991, p. 1633). In 1978, the government attempted to introduce stabilization measures such as public investment reductions, wage freezes, increased taxes, and credit reductions, but was forced to abandon these measures in 1979 after a drought and the second oil shock.

Consequently, during 1978-80, the budget deficit grew from 9.7 percent to 12.4 percent of Gross Domestic Product (GDP), and the foreign debt from \$5.1 to \$7.9 billion (Morrison 1991, p. 1634). In October 1980 the Moroccan government entered into a second stabilization agreement with the International Monetary Fund (IMF). But a 50 percent decrease in subsidies, increases in the prices of staples, further decreases in the phosphate price, increases in the value of the dollar, and high interest rates forced the government to abandon this program as well.

In the context of these different agreements, the oilseed sector has been characterized by government intervention at different levels throughout the sector, by a monopoly crushing firm (SEPO), by lack of sector efficiency, by lack of improvement in arbitrage ability of different agents in the network, and by the high level of government expenditures on the consumption subsidy of vegetable oil. Therefore, the next structural adjustment program involving stabilization and liberalization measures for the whole economy has also targeted the liberalization of agricultural and food products pricing and marketing such as oilseeds and their products, and the reduction of food subsidies, which is the major concern of the government.

The Agricultural Sector before the Structural Adjustment Program

The growth of the Moroccan agricultural sector in the 1970s could not be sustained throughout the next decade. In fact, rapid population growth (2.6 percent), urbanization, and decreases in the real prices of staples (flour, sugar, and vegetable oils) together stimulated a growth in food demand that food production could not match. Stagnating agricultural export crops also led to an annual agricultural trade deficit ranging from \$200 to \$250 million (Bouanani and Tyner 1991, p. IS-III B-2).

Virtually all forms of government intervention to offset the negative impact of macroeconomic policies on the agricultural sector such as price supports for major agricultural commodities and subsidies on basic products like flour, sugar, and vegetable oil have had negative

repercussions on public finance and have caused distortions in production and exchange.

The Moroccan Structural Adjustment Program

From 1981-83, Morocco's budget and balance of payments deficits worsened. And in 1983, the government was obliged to negotiate loans with both the IMF and the World Bank in the context of a structural adjustment program. This program involved stabilization and liberalization for the purposes of reducing aggregate demand and of increasing aggregate supply, through structural reforms.

Adjustment program measures in Morocco include the following:

Stabilization Measures

- reduced food subsidies
- slowed growth of domestic credit (14.8 percent instead of 20.1 percent)
- devaluation (7 percent between February and April 1984)
- greatly reduced investment expenditures
- slowed growth of public sector employment

Structural Adjustment Measures

- fiscal reform, including introduction of a value-added tax in April 1986
- lowered agricultural subsidies
- raised agricultural production prices
- breakup of the state monopoly on fertilizer and seed sales
- abolition of price controls on 60 categories of manufactured products
- elimination of export duties
- breakup of the state monopoly on agricultural exports
- dismantling of the system of quantitative import restrictions
- lowered import taxes
- improved temporary admission scheme for exporters
- simplified customs procedures
- raised interest rates (Morrison 1991, p. 1634).

Major Components of the Agricultural Adjustment Program

The major components of the Agricultural Adjustment Program (AAP) are liberalized agricultural and food product pricing and marketing, restructured priorities for the public investment program, streamlined and/or privatized government support services, improved management of natural resources, and strengthened policy analysis of the Ministry of Agriculture (World Bank 1987, pp. 9-18).

Price and Marketing Policies within the AAP for the Oilseed Sector

One aim of the AAP was to decontrol prices and to deregulate domestic and international marketing of oilseeds and their products. The agreements called for using world market prices instead of domestic production costs to establish domestic support prices for oilseeds and meals. A safety clause stipulated that domestic support price would not fall below the 1986 real support price in the event of a decline in world market prices (Bouanani and Tyner 1991, p. IS-III B-2). In fact, this revised price policy for oilseeds has been in effect since 1989.

Morocco's Commitments in the Oilseed Sector by the End of 1992

The Moroccan government still must set a new price policy for meals and for refined oil. This policy must involve dismantling of regulations throughout the sector, at both domestic and international levels. In addition to decontrolling prices and deregulating domestic and international marketing of oilseed products, the government is considering

entering into a free trade agreement with the European Community (EC) by the end of 1992.

Before its accession to the General Agreement on Tariffs and Trade (GATT) in 1977, Morocco had concluded bilateral trade agreements with many of its trading partners. With respect to its principal trading partner, the EC, with whom it conducted 54.2 percent of its total trade in 1988 (up from 42 percent in 1985) (GATT 1990, p. 46), Morocco enjoys preferential treatment. Economic relations are governed by the Cooperation Agreement of 1979, which replaced the Association Agreement of 1969 (GATT 1990, pp. 19-20). Nearly 70 percent of 1986 imports from Morocco entered the EC under preferential treatment. In 1984, Morocco applied for membership in the EC, and as a first step towards full membership the government is aiming for free trade with the Community by the end of 1992.

Study Objectives

This study analyzes the effects of the Moroccan internal-external liberalization of pricing and marketing policies on the controversial Moroccan oilseed sector. In a broad sense, the oilseed sector is characterized by the coexistence of two major distortions: government intervention and a national crushing firm monopoly, SEPO, which has exclusive rights to produce and sell domestic crude oil and meal within the country.

The oilseed sector, which includes the major agents, oilseed growers, a single oilseed crushing firm (SEPO), crude oil refineries, and feed blending companies (meal users), is closely regulated by the government. Government intervention is primarily the setting of the

oilseed production prices, the consumer price of refined oil, the domestic price of meals, and the margins, throughout the sector. The government also regulates the foreign trade of this sector and establishes the refined oil consumption program from which crude oil needs are derived and submitted to SEPO.

Second, Morocco's only crushing firm, SEPO, is the cornerstone of this network. It monopolizes the crushing industry and second it is the exclusive buyer of domestic oilseeds. In short, it is the exclusive producer and seller of domestic crude oil to local refineries and of domestic meals to competitive feed blending companies.

Many problems in the Moroccan oilseed sector have been identified by a national study of prices and incentives in the Moroccan agricultural sector. Protection of oilseed production, taxation of meal consumption, lack of sector efficiency, and lack of improvement in arbitrage ability of different agents in the network have all been scrutinized (AIRD 1990b, pp. 161-162).

Consequently, the present study, which focuses on the aforementioned two distortions, will take into account the following aspects of liberalization, demonstrating their effects on the Moroccan oilseed sector: liberalization of oil and meal pricing at internal and external levels, and removal of vegetable oil consumption subsidies, which are of major concern to the government.

Government intervention in sector margins (crushing, refining, wholesales, retailer margins) will not be taken into account as a component of liberalization in this study. Because information about the

potential new marketing process in the oilseed sector is lacking, it is assumed that the Moroccan government will continue fixing margins. This study addresses the effects of liberalization on both supplies of crude and refined oils, on the country's refined oil trading pattern, and social welfare.

Study Organization

This study determines the effects of liberalization on the Moroccan oilseed sector and presents policy recommendations, as outlined here. The second chapter examines pricing and marketing policies in the Moroccan oilseed sector, presents the corresponding formal model, and describes the database used for analysis. The third chapter discusses econometric estimation and results before and after the free trade agreement, and the fourth chapter focuses on results and suggestions for sector policy options.

CHAPTER 2.

OVERVIEW OF THE MOROCCAN OILSEED SECTOR AND A FORMAL MODEL

Any discussion of the Moroccan oilseed sector must take into account availability and uses of oilseed, responsibilities and relative importance of the four major economic agents, and internal and external prices and marketing policies undertaken by the government. Such information is essential for clarifying the workings not only of the sector, but also of the corresponding formal model.

Overview of the Moroccan Oilseed Sector

Oilseed availability and uses in Morocco

The Moroccan oilseed sector involves four kinds of oilseeds: the primary seeds, domestic sunflower and cotton, and the secondary, domestic and imported soybeans and rapeseed. From 1979 to 1991, domestic sunflower seeds, cottonseeds, soybeans, and rapeseed represented 58 percent, 38 percent, 3 percent, and 1 percent of annual average total of oilseed production.

Table 1 illustrates the evolution of domestic production of major oilseeds from 1979 to 1991. Although the shares of soybean and rapeseed in total production of oilseeds are quite small, their shares of total imports of oilseeds are quite large. Limited domestic production and great domestic demand creates the need to import seeds. The import license issued by the government is used exclusively by the one crushing firm in Morocco, SEPO. Table 2 presents import trends for soybean and rapeseed from 1979 to 1989.

Table 1. Domestic production of oilseeds in Morocco

Year	Sunflower	Cotton	Soybean	Rapeseed
(tons)				
1979	14517	7970	--	--
1980	3451	9940	--	--
1981	5698	14400	194	--
1982	5826	13300	115	110
1983	11870	13500	717	92
1984	19076	15900	310	183
1985	12484	9200	670	270
1986	32378	14790	1694	813
1987	45734	17350	4290	1164
1988	88540	22190	0	600
1989	103000	19078	0	1700
1990	155000	13650	6860	4000
1991	102000	14000	13000	1700

SOURCE: AIRD 1990b.

Table 2. Moroccan imports of soybean and rapeseed

Year	Soybean	Rapeseed
(tons)		
1979	29200	21000
1980	24400	14000
1981	10600	5200
1982	35000	7200
1983	15500	19250
1984	19200	11000
1985	22000	29100
1986	17000	0
1987	25200	13200
1988	10848	0
1989	21839	0

SOURCE: AIRD 1990b.

On the basis of fixed technical coefficients, presented in Table 3, both domestic and imported oilseeds are crushed by SEPO into crude oil and meals. The monopoly sells crude oil to the domestic refineries, which derive the edible oil, and it sells meal to the feed blending companies, which use it as a source of protein in animal feed. Domestic production of crude oil and meal from domestic oilseed is given in Table 4. Production of crude oil and meal from imported oilseeds may be found in Table 5. Despite the increasing production of crude oil from domestic and imported oilseeds, crude oil remains among the major imported staple food products. Cereals, sugar, and dairy products represent two-thirds of food imports (AIRD 1990a, p. 9). The residual supply to Moroccan refineries is imported crude oil, if domestic oil does not supply all the country's oil needs. Unlike the refineries, feed blending companies use mostly domestic products, which are more or less sufficient. Thus, meal imports are limited compared with those of crude oil. Table 6 presents data on the evolution of crude oil and meal imports.

Table 3. SEPO's technical coefficients used in the production of crude oil and meal in Morocco

	Crude oil	Meal
	(percent)	
Sunflower	0.42	0.40
Cotton	0.22	0.40
Soybean	0.18	0.75
Rapeseed	0.40	0.54

SOURCE: MARA/SEEMP 1992. Unless otherwise cited, all data are from MARA/SEEMP databases.

Table 4. Domestic production of crude oil and meal in Morocco from domestic oilseeds

Year	Sunflower		Cotton		Soybean		Rapeseed	
	Crude oil	Meal	Crude oil	Meal	Crude oil	Meal	Crude oil	Meal
(tons)								
1979	6097	5807	1753	3188	0	0	0	0
1980	1449	1380	2187	3976	0	0	0	0
1981	2393	2279	3168	5760	35	146	0	0
1982	2447	2330	2926	5320	21	86	44	59
1983	4985	4748	2970	5400	129	538	37	50
1984	8012	7630	3498	6360	56	233	73	99
1985	5243	4994	2024	3680	121	503	108	146
1986	13599	12951	3254	5916	305	1271	325	439
1987	19208	18214	3817	6940	772	3218	466	629
1988	37187	35416	4882	8876	0	0	240	324
1989	43260	41200	4197	7631	0	0	680	918
1990	65100	62000	3003	5460	1235	5145	1600	2160
1991	42840	40800	3080	5600	2340	9750	680	918

SOURCES: MARA/SEEMP 1992, and AIRD 1990b.

Table 5. Domestic production of crude oil and meal in Morocco from imported oilseeds

Year	Soybean		Rapeseed	
	Crude oil	Meal	Crude oil	Meal
(tons)				
1979	5256	21900	4800	11340
1980	4392	18300	5600	7560
1981	1908	7950	2080	2808
1982	6300	26250	2880	3888
1983	2790	11625	7700	10395
1984	3456	14400	4400	5940
1985	3960	16500	11640	15714
1986	3060	12750	0	0
1987	4536	18900	5280	7128
1988	1953	8136	0	0
1989	3931	16379	0	0

SOURCE: AIRD 1990b.

Table 6. Moroccan imports of crude oil and meal

Year	Soybean		Rapeseed
	Crude oil	Meal	Crude oil
		(tons)	
1979	149639	0	20782
1980	107428	0	40056
1981	120130	0	43800
1982	183675	5875	0
1983	138136	0	23277
1984	109800	8299	57335
1985	107772	0	93642
1986	68600	41011	130216
1987	130289	3096	51409
1988	62897	0	108759
1989	122570	16	70320
1990	94934	0	55075
1991	81069	0	108221

SOURCES: MMI 1992 and MARA/SEEMP 1992.

Marketing system and price policy in the Moroccan oilseed sector

As mentioned in Chapter 1, the oilseed sector faces two primary distortions: government intervention throughout the sector and the SEPO monopoly. To clarify the nature of these distortions, the construction of the corresponding formal model, and the workings of the supply and distribution network, this section describes in detail the marketing system and government price and trade policies.

Figure 1 presents linkages among economic agents in the Moroccan oilseed sector. Even if refineries and feed blending companies are the only users of crude oil and meal, SEPO remains the core of the

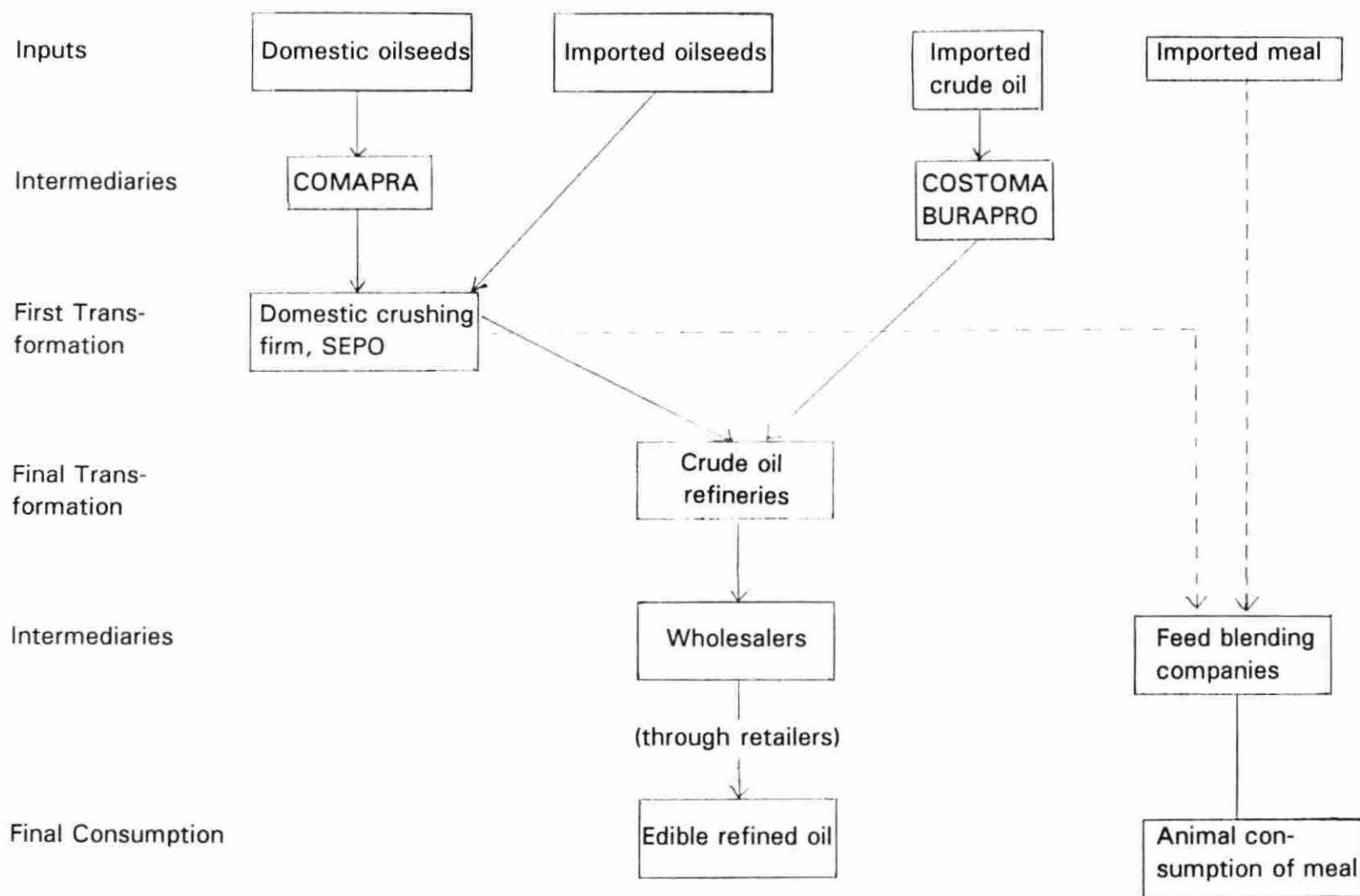


Figure 1. Marketing system of the Moroccan oilseeds sector

marketing system. COMAPRA, an intermediary, organizes the collection of domestic oilseeds from farmers and the selling of seed to SEPO.

COMAPRA is a semipublic Moroccan company that is the intermediary for farmers to sell products to SEPO. All related handling, packing, and transportation costs are paid by COMAPRA, which negotiates for an intervention margin annually within ministerial commissions. Table 7 presents this margin from 1979 to 1991.

COMAPRA supplies farmers with imported and domestic seeds (inputs), and, under the auspices of the Office Regional de Mise en Valeur (ORMVA), collects the domestically produced oilseeds from farmers. When they deliver their crops, farmers are automatically paid the domestic price fixed by the government. According to the World Bank proposition within the AAP, since 1989 the Moroccan Ministry of Agriculture has set a price policy for oilseeds, which is linked to the world market price

Table 7. COMAPRA margins

Year	Margin
	(dirham/ton)
1979	150
1980	150
1981	150
1982	175
1983	175
1984	175
1985	175
1986	230
1987	260
1988	350
1989	350
1990	350
1991	412

rather than to the national cost of production. The new domestic price of oilseeds is maintained throughout the year and is fixed annually by the Price Commission of the Moroccan Ministry of Agriculture.

As a first step in this new price policy, a moving average of five years of world prices is computed to limit the effects of short-term price fluctuations. Next, the border price is derived by means of the spot exchange rate (dirhams per dollar). To this border price, a protection rate of 25 percent is added, which yields the threshold price of oilseeds. This protection rate is consistent with the industrial sector protection rate fixed by the Industrial Trade Policy Adjustment (ITPA₁-ITPA₂) (AIRD 1990b, p. 58). For oilseeds, the 25 percent protection rate is more or less a levy equal to the difference between the lowest priced import on the day and the threshold price. Transportation costs from the major Moroccan port to SEPO are added to the threshold price, to derive the fixed price. But the objective of the new price policy is to define a domestic price that is competitive with world market price. Therefore, the official domestic price of oilseeds is equal to the difference between the target price and the COMAPRA margin. The safety clause states:

if the domestic price linked to the world market price is inferior to the current domestic price, the latter is taken in real terms, and it can be adjusted in nominal terms by the living costs indices. If the domestic price linked to the world market price is more than the current one, the former is taken (AIRD 1990b, pp. 58-59).

The task of COMAPRA can be summarized as that of organizing domestic production and marketing oilseeds. As internal-external Moroccan trade is liberalized, this intermediary could therefore be used to help the sector adjust to changing policies.

SEPO is a private Moroccan firm in Casablanca and the only crusher of domestic and imported oilseeds that produces crude oil and meal for the country. Its processing capacity is 120,000 tons of seeds a year (AIRD 1990b, p. 133). Although a private firm, SEPO accepts oilseed crushing decisions made by the Moroccan Ministry of Industry. Each year, Moroccan consumption of refined oil is estimated by the Ministry, which submits a program of refined oil needs to SEPO. SEPO subsequently derives the equivalent demand of crude oil and the quantities of oilseed to crush. The processing capacity of the monopoly is reserved primarily for crushing domestic sunflower and cottonseeds. The government set a crushing margin for SEPO in 1974, which has been revised periodically. Table 8 presents an evolution of this margin, which takes into account all of SEPO's variable and fixed costs and includes a benefit margin (MMI 1992). In addition to crude oil, SEPO derives meal from the processing of domestic

Table 8. SEPO crushing margins

Year	Crushing margin
	(dirham/ton)
1979	210
1980	272
1981	383
1982	344
1983	347
1984	372
1985	400
1986	495
1987	400
1988	466
1989	462

SOURCES: MMA/SEEMP 1992 and MMI 1992.

and imported seeds. There is a fixed technical coefficient between crude oil and meal production, as mentioned in Chapter 1.

Imported and domestic crude oils are distributed to refineries according to quotas from the Ministry of Industry. When a refinery sells its quota, the Ministry supervises a second distribution. Meal is sold to the feed blending companies, which are competitive firms, at a domestic price fixed annually by the government. The domestic price of meal affects SEPO's oilseed demand. Table 9 presents domestic meal prices since 1979.

The Model

In this section, annual data from 1979-91 are used along with a simple model to test certain effects of free trade with the EC on the

Table 9. Evolution of Moroccan domestic meal prices

Years	Meals			
	Sunflower	Cotton	Soybean	Rapeseed
	(dirhams/ton)			
1979	550	450	1000	400
1980	963	790	1750	700
1981	963	790	1750	700
1982	1031	845	1875	850
1983	1137	930	2067	1033
1984	1307	1312	2530	1404
1985	1307	1312	2602	1404
1986	1307	1312	2416	1404
1987	1307	1312	2538	1404
1988	1307	1310	2893	1400
1989	1307	1312	3774	1404
1990	1307	1312	3783	1404

Moroccan oilseed sector. The specification of the model can be improved by refining the underlying concepts and estimation techniques, and by gathering additional information. This model describes the workings of the sector and focuses on the behavior of SEPO, the central economic agent in marketing, processing and distribution.

Model assumptions

The model is based on four assumptions.

1. The sources of supply of primary products are the domestic oilseeds sunflower and cotton and the imported oilseeds soybeans and rapeseed.
2. The estimated domestic demand for refined oil is the net of imports. This residual demand is derived from the difference between total consumption of refined oil and total import of refined oil. The latter is equal to the total import of crude oil converted into refined oil. Because refined oil cannot be imported into Morocco, this conversion is used to obtain residual demand, a major component of consumption.
3. This net of imports is what SEPO must produce in equivalent crude oil.
4. The production costs of crude oil meal by SEPO are separated; in short, each kind of crude oil meal produced has a unique production cost. These linear costs are independent of each other, and separability of costs is the actual procedure followed by SEPO.

Description of production and production costs

Major inputs of SEPO: oilseeds

X_1 = domestic sunflower seeds,

X_2 = domestic cotton seeds,

X_3 = imported soybean, and

X_4 = imported rapeseed.

Major outputs of SEPO: crude oil and meal Crude oil is sold to refineries, and meal to feed blending companies.

Table 10. Coefficients of production and prices for the Moroccan oilseed sector

Production		Prices	
Crude oil	Meal	Crude oil	Meal
$Y_1 = \rho_1 X_1$	$M_1 = m_1 X_1$	P_{Y1}	P_{M1}
$Y_2 = \rho_2 X_2$	$M_2 = m_2 X_2$	P_{Y2}	P_{M2}
$Y_3 = \rho_3 X_3$	$M_3 = m_3 X_3$	P_{Y3}	P_{M3}
$Y_4 = \rho_4 X_4$	$M_4 = m_4 X_4$	P_{Y4}	P_{M4}

ρ_i and m_i are the technical coefficients for crude oil and meal derived from oilseeds. The relationship between crude oil production (Y_i) and meal production (M_i) is:

$$Y_i = \rho_i X_i,$$

$$Y_i = \rho_i M_i / m_i \text{ (from } M_i = m_i X_i \text{), and}$$

$$M_i = Y_i (m_i / \rho_i).$$

Therefore,

$$M_i = k_i Y_i ; \text{ with } k_i = \left(\frac{m_i}{\rho_i} \right) \quad (2.1)$$

Production costs of SEPO

Crude oil and meal production costs are

$$C_1 = c_1 Y_1,$$

$$C_2 = c_2 Y_2,$$

$$C_3 = c_3 Y_3, \text{ and}$$

$$C_4 = c_4 Y_4,$$

where

C_1 = total production costs of crude oil and meal from
sunflower seed;

C_2 = total production costs of crude oil and meal from cotton
seed;

C_3 = total production costs of crude oil and meal from
soybean; and

C_4 = total production costs of crude oil and meal from
rapeseed.

All production of crude oil is sold to 14 domestic refineries.

In addition to domestically produced crude oil, imports are used as inputs at the refinery demands. Therefore, Q_1 , Q_2 , Q_3 , and Q_4 represent imports of four different crude oils with import prices of P_{Q1} , P_{Q2} , P_{Q3} , and P_{Q4} .

Major output of refineries

Production of refined oil is

$$R_1 = \gamma_1 Y_1,$$

$$R_2 = \gamma_2 Y_2,$$

$$R_3 = \gamma_3 Y_3, \text{ and}$$

$$R_4 = \gamma_4 Y_4,$$

where

R_1 = production of refined oil of sunflower seed,

R_2 = production of refined oil of cotton seed,

R_3 = production of refined oil of soybean, and

R_4 = production of refined oil of rapeseed.

The γ_i 's are the technical coefficients of transformation from crude oil to refined oil. Y_1 is crude oil.

Production costs of refineries

Refined oil production costs are

$$C_1'' = c_1'' (Y_1 + Q_1),$$

$$C_2'' = c_2'' (Y_2 + Q_2),$$

$$C_3'' = c_3'' (Y_3 + Q_3), \text{ and}$$

$$C_4'' = c_4'' (Y_4 + Q_4),$$

where

C_1'' = total production cost of refined oil from sunflower seed,

C_2'' = total production cost of refined oil from cotton seed,

C_3'' = total production costs of refined oil from soybean, and

C_4'' = total production costs of refined oil from rapeseed.

The separate cost of refined oil is:

$$C_i'' = P_{Y_i} Y_i + \text{other costs} = P_{Y_i} \left(\frac{R_i}{\gamma_i} \right) + \delta_i R_i. \quad (2.2)$$

The unitary cost for each kind of refined oil is

$$c_i'' = \frac{P_{Y_i}}{\gamma_i} + \delta_i. \quad (2.3)$$

The refined oil price is P_{Ri} , so there are different prices for different types of refined oil. But the four refined oils are sold to the consumer at a common price, P_R fixed by the government.

Profits of refineries There are 14 refineries; therefore, the assumption for the 14 refineries is zero profit.

$$P_R (R_1 + R_2 + R_3 + R_4) - c_1'' R_1 - c_2'' R_2 - c_3'' R_3 - c_4'' R_4 \\ - P_{Q_1} Q_1 - P_{Q_2} Q_2 - P_{Q_3} Q_3 - P_{Q_4} Q_4 = 0 ,$$

Profits of SEPO It seems that SEPO is a profit maximizing monopoly. The profit maximization problem for a monopoly is generally written

$$\max_{P, Y} PY - C(Y) .$$

The monopolist will usually wish to produce the amount that consumers demand. The associated constraint can be written as the equality $Y = D(P)$ (Varian 1992, p. 234). Substituting for Y in the objective function, we obtain

$$\max_P P D(P) - C[D(P)] .$$

For SEPO,

$$\max_P P_{Y_1}(Y_1) + P_{M_1}(M_1) - C(Y_1, M_1) , \quad (2.4)$$

where

P_{Yi} = domestic prices of the four kinds of crude oil;

Y_i = quantities of the four kinds of crude oil produced;

P_{Mi} = domestic prices of the four kinds of meal fixed by the government;

M_i = quantities of the four kinds of meal produced; and

$C(Y_i, M_i)$ = separated production costs of the four kinds of crude oil and meal.

To simplify, SEPO's production costs can be written $C(Y_i)$ without meal, because when SEPO crushes X_i ton of seeds, it derives $(\rho_i X_i)$ crude oil, and $(m_i X_i)$ meal. Therefore, by the fixed relation between crude oil and meal production, when SEPO produces Y_i ton of crude oil, automatically M_i ton of meal is produced.

Substituting M_i by equation (2.1), and $C(Y_i, M_i)$ by $C(Y_i)$, we can derive SEPO's profit:

$$\pi = P_{Y_i}(Y_i) + P_{M_i}(Y_i k_i) - C(Y_i) . \quad (2.5)$$

The first-order condition states that at the profit maximizing choice of output, marginal revenue is equal to marginal cost. This condition can be expressed by the price equation of any oilseeds crusher:

$$P_{oilseed} + \text{crushing margin} = \frac{1}{A} P_{oil} + \frac{1}{B} P_{meal} ,$$

where

$P_{oilseed}$ = price of oilseeds,

A = quantity of oilseeds needed to produce one ton of oil,

B = quantity of oilseeds needed to produce one ton of meal,

P_{oil} = price of oil, and

P_{meal} = price of meal.

The right-hand side of this equation sums the marginal revenue received from oil and meal from every unit of oilseed crushed. The left-hand side is the marginal cost of acquiring and crushing a unit of oilseed (Morgan 1992, p. 23).

Model specification of the Moroccan oilseed sector

Before SEPO's profit is maximized, all components of the profit equation (2.5) can be converted into equivalent refined oil. This convention is explained by the fact that each year SEPO produces the equivalent of the residual demand of refined oil. This demand is derived by subtracting total import of crude oil in equivalent refined oil from total consumption of refined oil:

$$D_R - M_R = R, \quad (2.6)$$

where

D_R = actual consumption of refined oil,

M_R = imports of crude oil, in refined oil equivalents (using the technical coefficient of transformation from crude oil to refined oil $[\gamma_i]$), and

R = residual demand of refined oil or demand of refined oil net of imports.

Generally, the refined oil consumption is a function of its own-price (P_R), the price of its substitute (P_O), or the price of olive oil, and the income level (I). Therefore, residual demand of refined oil is a function of the same variables:

$$R = f(P_R, P_O, I) .$$

But estimation of the residual demand for the three variables showed that olive oil price is not a significant variable. A study by Stryker (1989) of the behavior of Moroccan consumers confirms this fact. Consequently, the price of olive oil is suppressed in the estimation of the residual demand of refined oil:

$$R = f(P_R, I) .$$

The residual demand of refined oil is estimated as

$$R = C + aP_R + bI , \quad (2.7)$$

where

- C = the intercept of the residual demand of refined oil,
- a = the estimated coefficient of the exogenous variable P_R ,
- P_R = the domestic price of the refined oil exogenous variable,
- I = the Moroccan income exogenous variable,
- b = the estimated coefficient of the exogenous variable I, and
- R = the estimated residual demand of the refined oil endogenous variable.

The estimated residual demand of refined oil produced by SEPO is subsequently substituted into SEPO's profit equation. After the first component of equation (2.5) is converted into refined oil, the revenue to SEPO from the production of refined oil is

$$P_R(R) ,$$

where

R = the residual demand refined oil, which should be produced by SEPO in crude oil equivalents; and

P_R = the price at which all refined oil will be sold.

If the second component of equation (2.5) is converted into equivalent refined oil, the revenue of SEPO from the production of meals from the total production of refined oil (R) is

$$\sum P_{M_i} k_i Y_i = P_{M_1} k_1 Y_1 + P_{M_2} k_2 Y_2 + P_{M_3} k_3 Y_3 + P_{M_4} k_4 Y_4 , \quad (2.8)$$

where

$\sum P_{M_i} k_i Y_i$ = SEPO's total revenue earned from total production of the four kinds of meal.

The equivalent of crude oil in refined oil is $R_i = Y_i \gamma_i$, and each portion ($Y_i \gamma_i$) of refined oil is β_i percent of the total production of refined oil, i.e.,

$$R = \beta_1 R + \beta_2 R + \beta_3 R + \beta_4 R , \quad (2.9)$$

where

R = the total production of refined oil.

The ratio of the technical coefficients of crude oil to meal (k_i) are transformed into refined oil meal as follows:

$$k_i = \frac{m_i}{p_i \gamma_i} .$$

Therefore, the total revenue of SEPO from meals is

$$\begin{aligned} & P_{M1} k_1 (\beta_1 R) + P_{M2} k_2 (\beta_2 R) + P_{M3} k_3 (\beta_3 R) + P_{M4} k_4 (\beta_4 R) \\ &= R (P_{M1} k_1 \beta_1 + P_{M2} k_2 \beta_2 + P_{M3} k_3 \beta_3 + P_{M4} k_4 \beta_4) \\ &= R(A) , \end{aligned} \quad (2.10)$$

where

$$A = \sum (P_{Mi} k_i \beta_i) ,$$

P_{Mi} = given price of meal, and

$k_i \beta_i$ = given constants.

The last components to convert into equivalent refined oil are the cost equations. The ordinary least squares procedure (OLS) is used to estimate SEPO's separated linear costs for crude oil. The estimated costs equation is

$$TC_i = \alpha_0 + \alpha_1 Y_i, \quad (2.11)$$

where

TC_i = total production cost for a kind of crude oil, and

Y_i = total production of crude oil (the reason for keeping only

Y_i and not M_i has already been explained).

The transformation of crude oil production costs to equivalent refined oil is achieved simply by dividing the estimated coefficient (α_i) of the exogenous variable (Y_i) by the technical coefficient of transformation of crude oil to refined oil (γ_i), and by retaining the intercept found in the first estimation. Separated estimated production costs converted into equivalent refined oil costs are,

$$[\alpha_{01} + \alpha_{11}(\beta_1 R)] + [\alpha_{02} + \alpha_{12}(\beta_2 R)] + [\alpha_{03} + \alpha_{13}(\beta_3 R)] + [\alpha_{04} + \alpha_{14}(\beta_4 R)] \\ \cdot (\alpha_{01} + \alpha_{02} + \alpha_{03} + \alpha_{04}) + (\alpha_{11}\beta_1 + \alpha_{12}\beta_2 + \alpha_{13}\beta_3 + \alpha_{14}\beta_4) R, \quad (2.12)$$

where $\alpha_{01} + \alpha_{02} + \alpha_{03} + \alpha_{04} = \alpha_0$ is the intercept of the estimated production costs of equivalent refined oil; and $\alpha_{11}\beta_1 + \alpha_{12}\beta_2 + \alpha_{13}\beta_3 + \alpha_{14}\beta_4 = \alpha_1$ is the estimated coefficient of R .

Profit maximization for SEPO When all components of SEPO's profit are transformed into equivalent refined oil, the profit equation (2.5) is

$$\pi = P_R R + AR - (\alpha_0 + \alpha_1 R) . \quad (2.13)$$

Substituting R for the estimated residual demand, we can pose SEPO's maximization problem as

$$\pi = P_R(C + aP_R + bI) + A(C + aP_R + bI) - [\alpha_0 + \alpha_1(C + aP_R + bI)] . \quad (2.14)$$

From the first-order condition for the problem, P_R^* is:

$$\frac{\partial \pi}{\partial P_R} = (C + aP_R + bI) + P_R a + Aa - \alpha_1 a = 0$$

$$C - \alpha_1 a + bI + Aa + 2aP_R = 0$$

$$C - \alpha_1 a + bI + Aa = -2aP_R$$

$$\left(-\frac{C}{2a} + \frac{\alpha_1}{2}\right) + \frac{bI}{-2a} + \frac{Aa}{-2a} = P_R$$

$$P_R^* = \left(-\frac{C}{2a} + \frac{\alpha_1}{2} - \left(\frac{b}{2a}\right) I - \frac{A}{2}\right) , \quad (2.15)$$

where

P_R^* = the optimal price of refined oil

$C < 0$ = intercept of the estimated residual demand,

$a < 0$ = estimated coefficient of P_R in the residual demand,

$b > 0$ = estimated coefficient of income (I) in the residual demand,

$\alpha_1 > 0$ = estimated coefficient of R in the estimated cost equation of refined oil, and

$A > 0 = \sum (P_{Mi} k_i \beta_i)$ (already defined).

Optimal price for SEPO From this optimal price of refined oil (P_R^*), the optimal price of each crude oil ($P_{Y_i}^*$) at which SEPO will sell its optimal output (Y_i^*) is derived by means of

$$P_{Y_i}^* = P_R^* \gamma_i, \quad (2.16)$$

where

γ_i = the technical coefficient of transformation of crude oil to refined oil.

The optimal price of crude oil, therefore, is positively related to income and negatively related to meal value. As expected, the sign of the estimated coefficient of the meal value is negative. As Bicherton (1990, p. 10) writes,

This relationship reflects the joint product nature of oilseeds which ties meal and oil market together, transmitting disturbances from one to the other. For example, the consequent higher meal price induces oilseed crushers to process additional oilseeds, thus increasing the supply of oil as well as meal. In the absence of any other market disturbances, the soybean oil price will fall.

Concerning the positive sign on the estimated coefficient of income, increases in income will lead to increases in oil demand and thus to increases in the price of oil.

Optimal output for SEPO The optimal output of refined oil (R^*) is derived by substituting the optimal price of refined oil (P_R^*) into the estimated residual demand for refined oil:

$$R^* = C + aP_R^* + bI . \quad (2.17)$$

The optimal output for each kind of crude oil (Y_i^*) that SEPO would produce is

$$Y_i^* = \frac{R^* \beta_i}{Y_i} , \quad (2.18)$$

where

β_i = the share of each refined oil in the total production of refined oil.

The Database

The sample period covered by this study is 1979 to 1991. This period was chosen because the data on the required variables for the model were available only for those years. The variables studied are: (1) domestic production of seeds, meals, crude oil, and refined oil; (2) imports of crude oil and oilseeds; (3) domestic prices of oilseeds, crude oil, meal, and refined oil; (4) world market prices of crude oil, oilseeds, and meals; (5) income; (6) production costs of crude oil meal, production costs of refined oil, technical coefficients of crude oil meal derived from seeds, and technical coefficients of the transformation of crude oil to refined oil; (7) domestic consumption of refined oil; (8) exchange rate; and (9) conversion coefficient from liter to kilo.

Domestic production of seeds, meals, crude oil, and refined oil

The domestic production data for oilseeds, meals, and crude and refined oils are obtained from the Moroccan Ministry of Agriculture, Service des Etudes Economiques de marchés et de prix (MARA/SEEMP) and from the AIRD studies of Morocco (1990).

Imports of crude oil and oilseeds

Data on imported oilseeds are obtained from both MARA/SEEMP and AIRD studies (1990). Imported crude oil data are obtained from MARA/SEEMP and from the Moroccan Ministry of Industry (MMI).

Domestic prices of oilseeds, crude oil, meal, and refined oil

Data on domestic prices of oilseeds and meals are obtained from MARA/SEEMP. The refined oil price is the consumer price of refined oil fixed each year by the government for a one-liter bottle. Data are obtained from the MMI.

World market prices of crude oil, oilseeds, and meals

World market price data for oilseeds (soybean, rapeseed) are the CIF Rotterdam prices in U.S. dollars per ton. For imported crude oil of soybean, rapeseed, cotton seed, and sunflower seed, the world market price is the FOB ex-mill Rotterdam for the first two, and the CIF Rotterdam for the last two. The world market price of meals is the CIF Rotterdam for soybean and sunflower meal, the CIF Europe for cotton meal, and the FOB ex-mill Hamburg for rapeseed meal. All data are obtained from USDA's Foreign Agricultural Service Oilseeds and Products (August 1992).

Income

The income variable used in this study is the Moroccan Gross Domestic Product series (GDP). These data, in billions of dirhams, are obtained from the International Monetary Fund's (IMF) International Financial Statistics Yearbooks for 1985 and 1990.

Production costs of crude oil ,meal, refined oil, and all technical coefficients

These data for 1979-84 and 1987 are derived from the cost price structures of oils are obtained from MARA/SEEMP. For the remaining years, 1985-86 and 1988-91, the cost price structures of oils are set by following the same procedure used for the previous years. The variables of this cost price structure are changed each time actual data are needed, according to which part are obtained from the MMI (1992).

Domestic consumption of refined oil

Data regarding domestic consumption of refined oil are obtained from the MMI (1992).

Exchange rate between dirham (DH) and dollar (\$)

This exchange rate (DH/\$) is obtained from the IMF's 1988 International Financial Statistics for 1979-89, and for 1990-91, from the MARA/SEEMP publication (1992).

Conversion coefficient from liter to kilo

The conversion coefficient between 1 liter and its equivalent in kilos is 0.926. This coefficient is obtained from the AIRD studies of Morocco (1990).

CHAPTER 3.

ECONOMETRIC ESTIMATION

This chapter considers the residual demand of refined oil function (Equation 2.7), and uses the ordinary least squares procedure (OLS) (Gujarati 1988; Pindyck 1991a) assuming that the standard assumptions underlying the OLS are met, and employs the software program SHAZAM (Pindyck 1991b) to estimate the cost equations of four kinds of crude oil (Equation 2.11). The chapter then considers the conversion of equation costs to equivalent refined oil, the function of the optimal price of refined oil (Equation 2.15), the function of the optimal output of refined oil (Equation 2.17), and the optimal price and output of crude oil at the SEPO level. Finally, SEPO's profit from the production of refined and crude oil is derived. All these estimations are performed on data gathered before free trade. The second part of the chapter contains adaptations of the functions and equations under the free trade scenario.

Econometric Estimation before Free Trade

Function of residual demand of refined oil

The residual demand of refined oil,

$$R = C + aP_R + bI ,$$

is a function of income (I) and the consumer price of refined oil (P_R).

The OLS estimate of this equation yields an estimate of the coefficients a and b. Another variable, the price of a substitute of refined oil (olive

oil), was also tested and excluded on the basis of its statistical insignificance. The results of estimating the residual demand of refined oil are

$$R^e = -2594.9 - 4.5793 P_R + 404.33 I .$$

$$(12512) \quad (3.9886) \quad (124.94)$$

$$R^2 = .79, F = 18.911, DF = 10.$$

The statistical significance of the estimated coefficients of residual demand of refined oil was established by t-tests with $n - k$ degrees of freedom, by testing the hypotheses

$$H_0: a = b = 0 \text{ and}$$

$$H_A: \text{negation,}$$

where n is the number of observations, k is the number of regressors, and a and b are the joint coefficients of the regression.

Next, the F test was used:

$$F_{(k-1, n-k)} = \frac{R^2 / (k-1)}{(1 - R^2) / (n - k)} ,$$

where n and k are as defined previously, and R^2 is the coefficient of determination.

As expected, the sign is negative for the estimated coefficient of own price of refined oil. The regression indicates, however, that this estimated coefficient is insignificant at conventional 5 or 10 percent levels of significance. Given the importance of the own price effects, the variable is retained in the equation. The own price for an individual vegetable oil should theoretically be quite elastic, reflecting the

availability of numerous substitutes. Olive oil was omitted from the equation because of its insignificant effect. Perhaps variables that should have been included in the estimating equation were not, so the estimate of own price effect was relatively inelastic. The estimated coefficient of income (b) is significant at these levels.

The partial regression coefficient of -4.5793 means that if income (I) is held constant, the actual consumption of refined oil decreased on average by about 4.6 tons. Likewise, if the price of refined oil (P_R) is constant, the coefficient value of 404.33 implies that, over the same period, the actual consumption of refined oil (R) increased. This increase was, on average, about 404.33 tons for every one billion dirham increase in (I). In terms of prior expectations, both explanatory variables (P_R and I) have the expected signs. Finally, from the estimated regression, we observe that the F value (18.911) is clearly significant at the usual levels.

Production cost equations for crude oil

The OLS is used to estimate the separated production cost equation,

$$TC_i = \alpha_0 + \alpha_1 Y_i ,$$

for crude oil and meal of sunflower, cotton, soybean, and rapeseed. The results are provided in Table 11. The statistical significance of the estimated coefficients of these equations was determined by the same procedure as that used for the residual demand of refined oil.

Table 11. Estimated production cost equation

Estimated coefficients	Sunflower	Cottonseed	Soybean	Rapeseed
Intercept	-10,014,000	-3,965,300	2,823,500	-567,630
Standard error	(2,188,600)	(1,576,100)	(2,396,600)	(2,401,100)
α_i	5,475.5	3,387.5	2,005.9	3,056.9
Standard error	(78.720)	(486.01)	(601.10)	(421.74)
R^2	0.9977	0.8154	0.5530	0.8537
F	4838.045	48.580	11.135	52.538
df	11	11	9	9

For the sample period, for sunflower and cotton, the coefficient of production of crude oil (α_i) is significant at the 5 percent and 10 percent levels. For soybean and rapeseed, costs were estimated over a period of 11 years because data on production cost for the two last years were unavailable. The coefficients of production costs for crude oil from soybeans and rapeseed are significant at the same levels. The R^2 values of sunflower, cotton, and rapeseed represent a fairly significant level of explanatory power. For soybean, the R^2 could be improved by using additional information and production costs data.

Production cost equations in equivalent refined oil

The production cost equations for crude oil in equivalent refined oil are derived by converting the estimated coefficient of production costs of crude oil into refined oil and by keeping the estimated intercept. These results are summarized in Tables 12 and 13.

Table 12. Conversion of estimated coefficient of production costs for crude oil into equivalent refined oil

Coefficients	Sunflower	Cottonseed	Soybeans	Rapeseed
α_i	5475.500	3387.500	2005.900	3056.900
γ_i	0.966	0.884	0.960	0.948
α_i	5668.200	3832.013	2089.479	3224.578

Table 13. Production cost equations for crude oil in equivalent refined oil

Estimated coefficients	Sunflower	Cottonseed	Soybeans	Rapeseed
Intercept	-10,014,000	-3,965,300	2,823,500	-567,630
α_i	5,668.200	3,832.013	2,089.479	3,224.578

Optimal price of refined oil

By incorporating the estimated residual demand of refined oil and the estimated cost equations in (2.15), Table 14 presents the optimal price of refined oil (P_R^*) for the sample periods shown.

Optimal price of crude oil

The most important variable to derive from the optimal price of refined oil (P_R^*) is the optimal price of crude oil ($P_{Y_i}^*$), which should have been set by SEPO. From equation (2.16), differences are derived (see Tables 15 and 16).

Table 14. Optimal prices of refined oil

Years	P_R^*
	(dirham/ton)
1979	4092.773
1980	3755.160
1981	4359.997
1982	4053.809
1983	5210.512
1984	5357.155
1985	6107.989
1986	7512.470
1987	7646.973
1988	9146.096
1989	9206.059
1990	10713.110
1991	11637.640

Table 15. Optimal prices of crude sunflower and cotton oil

Year	P_Y^*	P_{Yi}^*				
		Sunflower P_Y observed	Difference $P_Y - P_Y^*$	P_Y^*	Cotton P_Y observed	Difference $P_Y - P_Y^*$
		(dirham/ton)				
1979	3953.61	3556.48	-397.13	3618.011	3277.543	-340.468
1980	3627.48	4641.02	1013.53	3319.561	4326.402	1006.840
1981	4211.75	4905.30	693.56	3854.237	4830.947	976.709
1982	3915.97	6525.38	2609.40	3583.567	5892.722	2309.154
1983	5033.35	6770.19	1736.83	4606.093	6121.200	1515.106
1984	5175.01	7393.40	2218.39	4735.725	6140.561	1404.835
1985	5900.31	9153.12	3252.80	5399.462	7791.579	2392.116
1986	7257.04	10479.79	3222.74	6641.023	9239.227	2598.203
1987	7386.97	10438.05	3051.07	6759.924	8829.690	2069.765
1988	8835.12	10816.69	1981.56	8085.149	9129.690	1044.540
1989	8893.05	11299.39	2406.33	8138.156	5981.357	1443.200
1990	10348.87	11313.68	964.80	9470.396	9735.902	265.506
1991	11241.96	11554.36	312.39	10287.680	9904.084	-383.596

Table 16. Optimal prices of crude soybeans and rapeseed oil

Year	P_Y^*	P_{Yi}^*				
		Soybeans	Difference $P_Y - P_Y^*$	P_Y^*	Rapeseed	Difference $P_Y - P_Y^*$
		P_Y observed			P_Y observed	
(dirham/ton)						
1979	3929.062	5690.11	1761.047	3879.949	3765.279	-114.670
1980	3604.954	3835.11	230.156	3559.892	3951.375	391.483
1981	4185.597	5248.72	1063.122	4133.277	5406.939	1273.661
1982	3891.656	6386.00	2494.343	3843.010	5730.798	1887.787
1983	5002.092	8932.60	3930.807	4939.565	7577.503	2837.937
1984	5162.869	5947.72	804.851	5078.583	8625.661	3547.077
1985	5863.669	7091.94	1228.270	5790.373	6923.960	1133.586
1986	7211.971	6764.19	-447.781	--	--	--
1987	7341.094	9518.71	2175.615	7249.330	5624.780	-1624.550
1988	8780.252	8438.77	-341.482	--	--	--
1989	8837.817	1275.48	-7562.330	--	--	--

P_Y^* s for soybeans and for rapeseed were derived for only the sample period 1979-89 because data are unavailable for 1990 and 1991. For rapeseed in 1986, 1988, and 1989, P_Y^* was not derived: Morocco imported no rapeseed in these years, so no crude oil was produced.

According to these data, it seems that SEPO has set a crude oil price higher than the optimal price. On average, the observed price is higher by 29 percent, 24 percent, 17 percent, and 26 percent for sunflower, cotton, soybeans, and rapeseed.

Optimal production of refined oil

By substituting the optimal price of refined oil P_R^* into the estimated residual demand of refined oil, we obtain the optimal production of refined oil, R^* .

Table 17. Optimal production of refined oil

Year	R*
	(ton)
1979	3747.697
1980	10165.900
1981	9393.565
1982	16403.740
1983	13629.870
1984	18295.510
1985	21799.560
1986	25565.220
1987	26417.010
1988	28499.900
1989	32074.530
1990	33255.850
1991	37917.410

From R^* , the optimum of each kind of crude oil that would have been produced under optimal pricing is derived (Y_i^*).

Optimal production of crude oil

Tables 18 and 19 summarize the results. It seems that, on average, crude oil production has been either more or less than optimal. This difference between actual and optimal production can be explained by the effects of two factors. First, each refined oil share of total production has changed within the sample period. Second, whether a specific kind of crude oil will be produced depends upon production decisions regarding the other kinds of crude oil. Finally, sufficiently comprehensive information and sophisticated tools were unavailable.

Table 18. Optimal production of crude sunflower and cottonseed oil

Year	Y^*	Y_i^*				
		Sunflower	Difference $Y - Y^*$	Y^*	Cotton	Difference $Y - Y^*$
		Y observed			Y observed	
(ton)						
1979	1125.085	6097	4971.914	322.200	1753	1430.799
1980	1157.607	1449	291.392	1724.983	2187	462.017
1981	2528.288	2393	-135.288	3294.123	3168	-126.123
1982	2886.786	2447	-439.786	3525.690	2926	-599.690
1983	3950.686	4985	1034.313	2312.760	2970	657.239
1984	7954.569	8012	57.430	3518.367	3498	-20.367
1985	5190.371	5243	52.629	1972.810	2024	51.189
1986	18260.870	13593	-4667.870	4337.989	3254	-1083.980
1987	16134.610	19208	3073.387	3287.184	3817	529.815
1988	25077.550	37187	12109.440	3223.970	4882	1658.029
1989	28222.930	43260	15037.060	2721.255	4197	1475.744
1990	32705.020	65100	32394.970	150.479	3003	2852.521
1991	36896.850	42840	5943.141	257.358	3080	2822.642

Table 19. Optimal production of crude soybeans and rapeseed oil

Year	Y^*	Y_i^*				
		Soybean	Difference	Y^*	Rapeseed	Difference
		Y observed			$Y - Y^*$	
(ton)						
1979	975.963	5256	4280.037	1541.774	8400	6858.225
1980	3494.528	4392	897.472	4396.644	5600	1203.355
1981	2054.842	1908	-146.842	2179.941	2080	-99.941
1982	7518.380	6300	-1218.386	3460.704	2880	-580.704
1983	2129.667	2790	660.333	6038.550	7700	1661.450
1984	3430.408	3456	25.592	4438.784	4400	-38.784
1985	4087.417	3960	-127.417	11727.610	11640	-87.611
1986	4260.870	3060	-1200.870	0.000	0	0.000
1987	3852.480	4536	683.519	4458.567	5280	821.433
1988	1484.369	1953	468.630	0.000	0	0.000
1989	2672.877	3931	1258.122	0.000	0	0.000

It seems that actually SEPO is producing more or less than the optimal output and selling it at a price higher than the optimal price. As suggested by Stanley R. Johnson¹, this could be the result of the two-stage decision-making process at the SEPO level; in other words, SEPO is going through two rounds of negotiations. In the first stage, SEPO negotiates its profit maximizing output in crude oil that should be produced. Then, in a second stage, SEPO negotiates the output price in order to get more than the monopoly price. This is due to the subsidies on refined oil paid by the government to the refineries.

SEPO's profit from refined oil production before free trade

Equation (2.13) is used to determine actual per unit profit from refined oil production, at the level of SEPO, and before free trade. Thus, the profit equation is

$$\pi = P_R R + AR - (\alpha_0 + \alpha_1 R) ,$$

where

P_R : actual domestic price of refined oil;

R : actual production of refined oil;

A : $\sum (P_{M_i} K_i \beta_i)$, the sum of revenues from production of meals;

α_0 : estimated intercept of the production cost equation of refined oil; and

α_1 : estimated coefficient of the exogenous variable (R) of the production cost equation of refined oil.

¹Stanley R. Johnson, Director of the Center of Agricultural and Rural Development (CARD) of Iowa State University and C. F. Curtiss Distinguished Professor of Agriculture.

Substituting the known values for these variables into the profit equation, we present total profit and per unit profit from production of refined oil in Table 20.

Actual profit is an important variable and is used later to derive the change in producer surplus under free trade scenario.

Table 20. Total profit and per unit profit from production of refined oil before free trade

Year	Total profit	Profit per unit	Exchange rate	Profit per unit
	(dirhams)	(dirhams/ton)	(dirhams/dollars)	(dollars/ton)
1979	17620988.43	861.73	3.89	221.01
1980	47512228.21	3695.10	3.93	938.65
1981	35418900.38	3972.66	5.17	768.06
1982	73429148.14	5348.47	6.02	888.01
1983	85647759.73	4916.92	7.11	691.42
1984	105450763.30	5755.80	8.81	653.29
1985	146418119.60	6750.41	10.06	670.85
1986	118366481.40	6245.99	9.10	686.04
1987	189408974.60	6053.50	8.35	725.04
1988	206885015.20	4912.59	8.17	600.99
1989	275566525.00	5592.64	8.45	661.80

SEPO's profit from crude oil production before free trade

The total profit from crude oil production is derived using this equation:

$$\pi_R \times \beta_i \times \gamma_i = \pi_{Ci}$$

where

π_R = total profit from production of refined oil; and

π_{ci} = total profit from production of crude oil from oilseed.

β_i and γ_i are as explained in Chapter 2. Then, the sum of π_{ci} yields total profit from total production of crude oil (π_C). From π_C , the per unit profits in dirhams and in dollars are derived. Table 21 summarizes these results.

Table 21. Total profit and per unit profit from production of crude oil before free trade

Year	Total profit	Profit per unit	Profit per unit
	(dirhams)	(dirhams/ton)	(dollars/ton)
1979	16770599.53	779.81	199.99
1980	44867697.59	3292.32	836.34
1981	33129422.66	3469.41	670.77
1982	69330333.09	4763.99	790.97
1983	80957688.41	4389.14	617.21
1984	99845000.79	5155.69	585.18
1985	137571536.80	6016.16	597.88
1986	111636163.20	5606.19	615.77
1987	180555999.20	5497.88	658.50
1988	196106305.90	4454.73	544.98
1989	264483239.30	5146.79	609.04

Free Trade Scenario

First, total consumption of refined oil at world market price is derived using both equation (3.1) and the world market price. Next, domestic production by SEPO in refined oil equivalents is estimated to

derive refined oil imports, as shown in Figure 2, and to compute the change in SEPO's surplus after free trade. In addition, the change in consumer surplus after free trade is derived by computing the shaded area of Figure 3. Finally, social welfare for a typical year is determined, taking into account changes in producer surplus (SEPO), consumer surplus, and government revenue.

Total demand of refined oil at domestic price

The demand for refined oil estimated at the domestic price is

$$R^d = C + aP_R^d + bI, \quad (3.1)$$

where

R^d = total consumption of refined oil at domestic price;

P_R^d = domestic price of refined oil;

I = income;

C = estimated intercept;

a = estimated coefficient of the first exogenous variable,

P_R^d ; and

b = estimated coefficient of the second exogenous variable, I .

The results of estimating equation (3.1) are

$$R^d = 144010 - 1.4272 P_R^d + 404.38 I .$$

$$(14662) \quad (4.6741) \quad (146.41)$$

$$R^2 = 0.82, \quad F = 23.95, \quad DF = 10 .$$

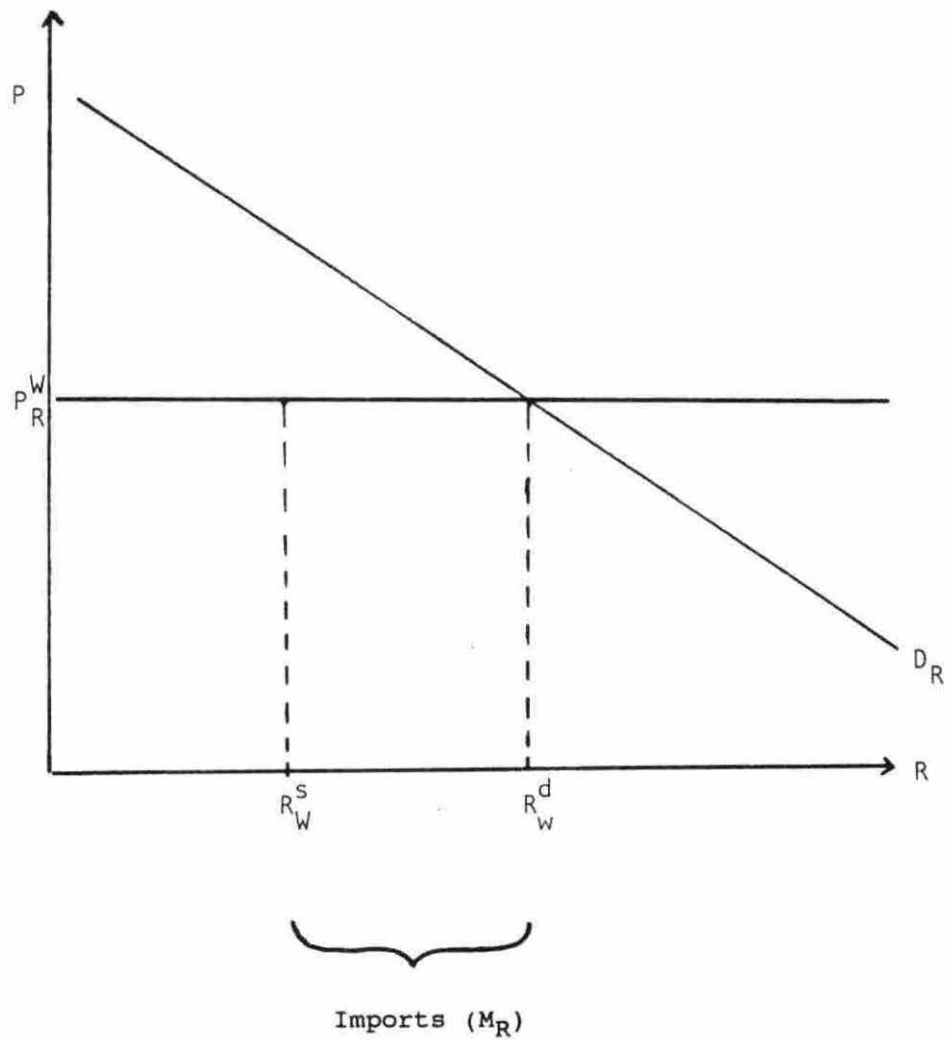


Figure 2. Consumption of refined oil at world market price (R_W^d), production of SEPO (R_W^s), and imports of refined oil (M_R)

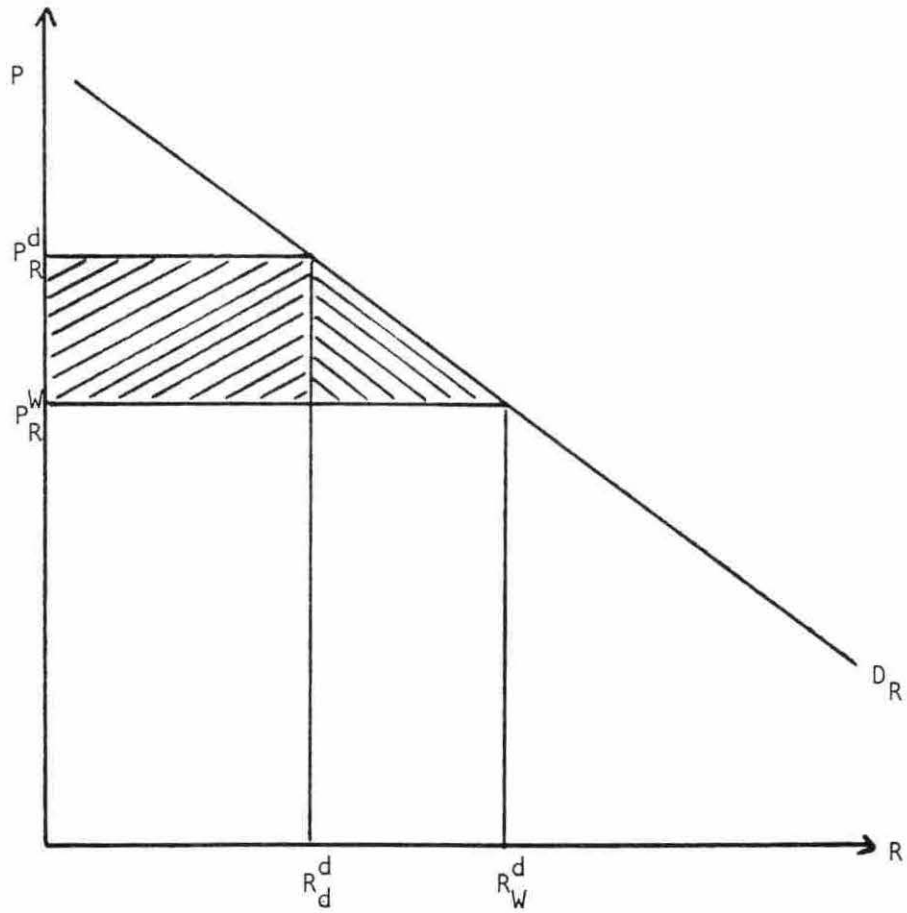


Figure 3. Change in consumer surplus after free trade

The procedure used to test the statistical significance of the estimated coefficients is the same as that used in the first part of Chapter 3. For the sample period, as expected, the sign of the estimated coefficient for the own price of refined oil is negative. The regression, however, shows that the regression coefficient a is insignificant at the conventional 5 or 10 percent levels of significance. For reasons stated earlier, the own price of refined oil is retained, and the price of olive oil is excluded. In terms of prior expectations, both explanatory variables, P_R^d and I , have the expected signs. From the estimated regression, we observe that the F-value (23.95) is obviously significant at the usual levels.

Total demand of refined oil at world market price

In essence, the process to derive the refined oil demand for free trade is simple. First, equation (3.1) is modified by replacing domestic price (P_R^d) with world market price (P_R^W). The proxy for world market price of refined oil is the crude soybean oil Rotterdam price converted into refined oil price. There are several reasons for using this proxy:

1. The published world prices are of crude, not refined, oil;
2. The main problem with the weighted average of the four prices of crude oil (sunflower, cottonseed, soybeans, and rapeseed) is the high multicollinearity among the four prices;
3. Crude soybean oil is the most imported by Morocco;
4. The world price of crude soybean oil is the leading price on the world market; and
5. The largest soybean oil exporter is the European Community (Crowder 1990, p. 13), the trading partner with whom Morocco will make its

Table 22. Derived Moroccan border prices of refined oil

Year	P_R^W (dirham/ton)
1979	2583.316
1980	2329.319
1981	2618.692
1982	3049.394
1983	5518.961
1984	5947.454
1985	4193.127
1986	3291.240
1987	4053.188
1988	3900.067
1989	4058.400

free trade agreement. Table 22 summarizes the refined oil border prices assumed in this study.

The estimated refined oil consumption level under free trade is presented in Table 23. A history of this consumption appears in Figure 4.

Domestic production of refined oil under free trade

Because estimated production costs are linear, SEPO's optimal production of refined oil under free trade cannot be derived by maximizing firm profit. These production costs, when estimated in quadratic form, tend to reduce R^2 . Therefore, the logical procedure is to estimate SEPO's potential capacity rather than to derive optimal production, and can be estimated as:

$$PC_{ci} = \frac{\bar{Y}_i}{\%CU} , \quad (3.2)$$

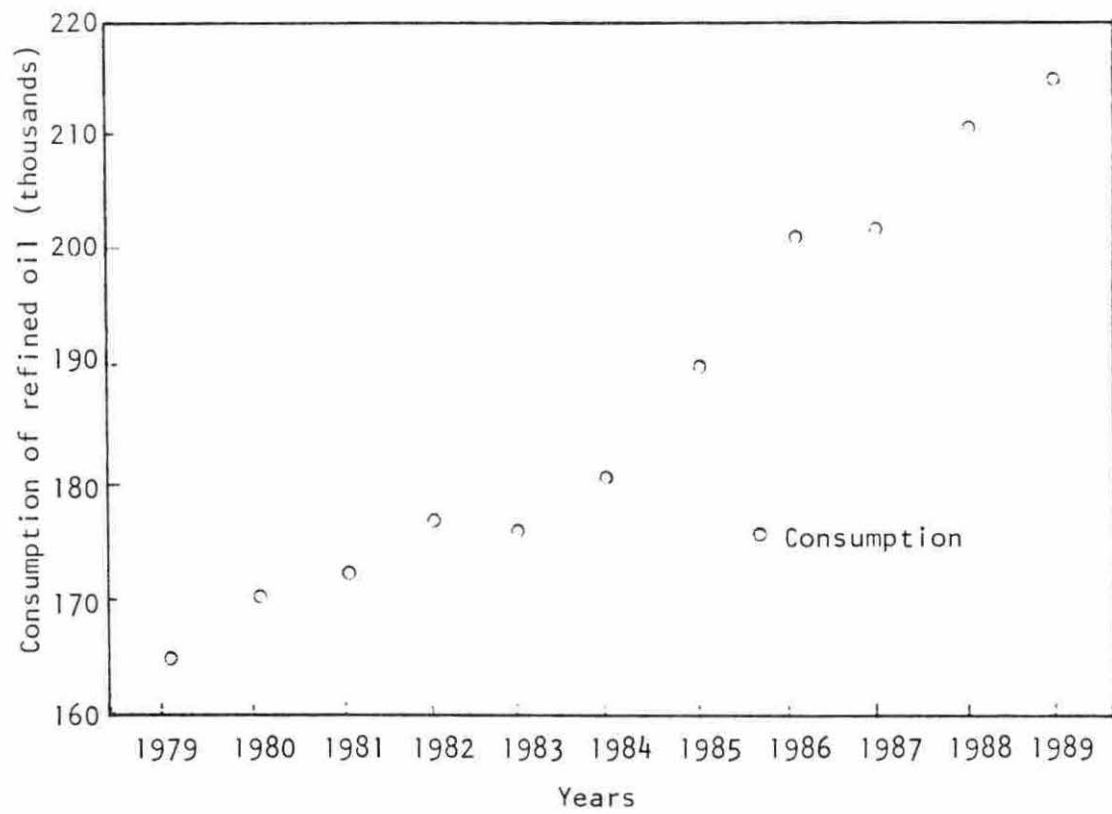


Figure 4. Demand for refined oil at the world market price

Table 23. Demand for refined oil at the world market price

Year	R^W
	(ton)
1979	165410.8
1980	170646.1
1981	172230.7
1982	177224.8
1983	176223.5
1984	180949.8
1985	190396.8
1986	201882.4
1987	202262.9
1988	211430.3
1989	215054.0

where

\bar{Y}_i = the average of total output of crude oil for the sample period
1979-1989,

%CU = percentage utilized of SEPO capacity (on average, the
percentage CU is 75 percent (AIRD 1990b, p. 133), and

PC_{ci} = estimated potential capacity of SEPO to produce different types
of crude oil.

Next, equation (3.2) is transformed into refined oil equivalents by
technical coefficients:

$$PC_{ri} = PC_{ci} \gamma_i, \quad (3.3)$$

where

γ_i = technical coefficients, and

PC_{ri} = estimated potential capacity of SEPO to produce different types of refined oil.

Arriving at the sum of PC_{ri} , we write the potential capacity of SEPO to produce refined oil as

$$PC_R = \sum PC_{ri} , \quad (3.4)$$

where

PC_R = estimated potential capacity of SEPO in the production of refined oil.

The estimated PC_C and PC_R are equal to 32,494.30 tons and 30,909.94 tons each year.

Imports of refined oil under free trade

These imports are derived as:

$$M_R = R^W - PC_R , \quad (3.5)$$

where

R^W = total demand of refined oil at world price,

PC_R = estimated potential capacity of SEPO to produce refined oil, and

M_R = imports of refined oil under free trade.

Figure 5 presents data on the import trend of refined oil under free trade. Imports of refined oil then include different kinds of oil

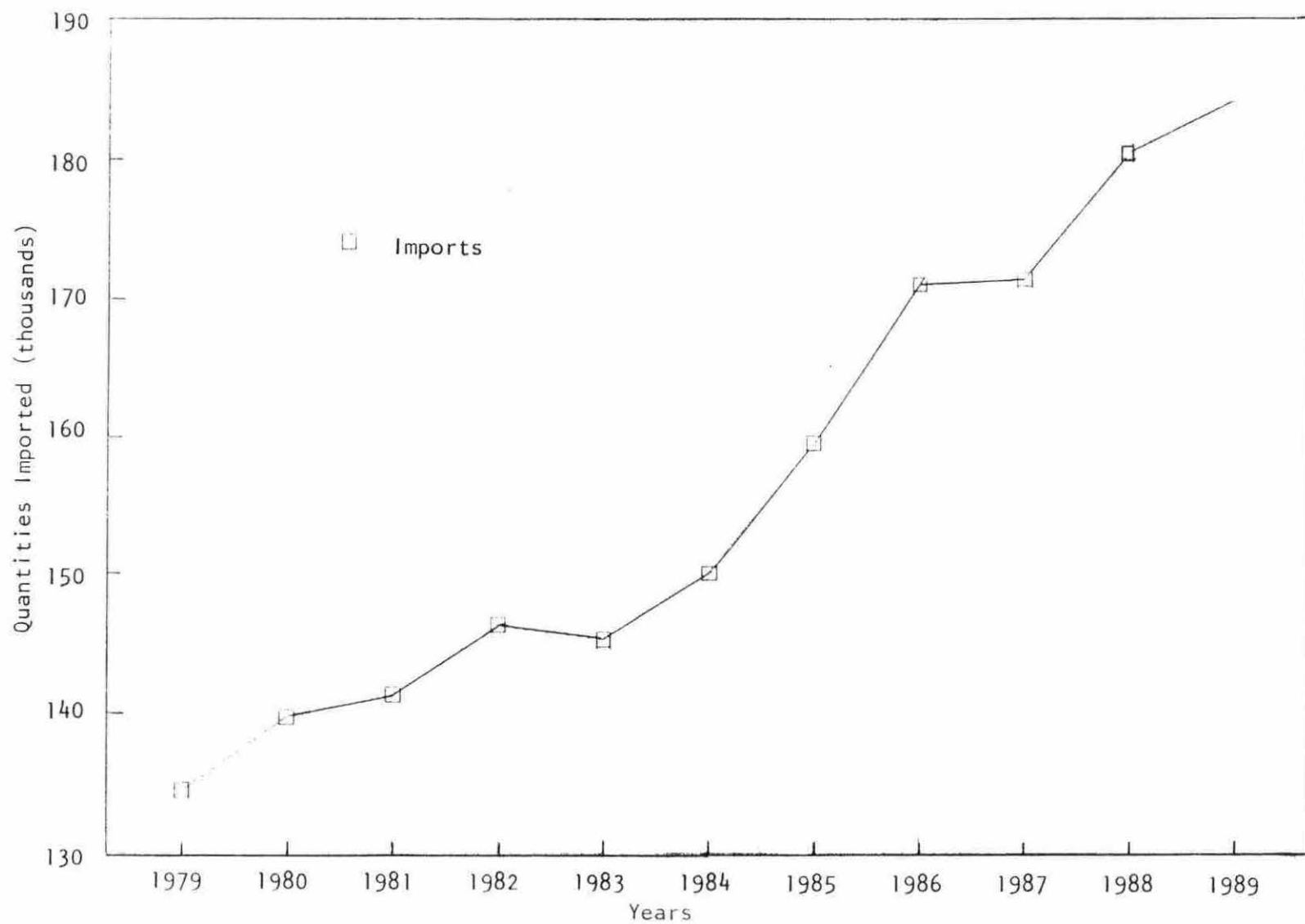


Figure 5. Imports of refined oil under free trade scenario

(sunflower, cottonseeds, soybeans, rapeseed). Nevertheless, because of high substitutability among the different kinds of refined oil, imports in equivalent crude oil cannot be determined.

SEPO's profit from refined oil production under free trade

When P_R^d is substituted with P_R^W , R with PC_R , and A with $(\sum P_{Mi}^W k_i \beta_i)$ instead of $(\sum P_{Mi}^d k_i \beta_i)$ in equation (2.13), SEPO's profit equation under free trade becomes

$$\pi = P_R^W PC_R + A PC_R - (\alpha_0 + \alpha_1 PC_R) , \quad (3.6)$$

where

P_R^W : the world market price of refined oil, as explained above;

PC_R : the estimated potential capacity of SEPO to produce refined oil;

A : $\sum (P_{Mi}^W k_i \beta_i)$, total revenue of SEPO earned from total production of the four kinds of meal;

P_{Mi}^W : the world market price of sunflower, cotton, soybean, and rapeseed meal;

$k_i \beta_i$: given constants;

α_0 : estimated intercept of the production costs of equivalent refined oil; and

α_1 = estimated coefficient of the exogenous variable in equivalent refined oil.

When the figures for these different variables are inserted into equation (3.6), total profit and per unit profit of SEPO's production of refined oil are as presented in Table 24.

SEPO's profit from crude oil production under free trade

The per unit profit from production of crude oil, in dirhams and in dollars, is derived using the procedure outlined above. Table 25 summarizes these results.

Table 24. Total profit and per unit profit from refined oil production under free trade

Year	Free Trade		
	Total profit	Profit per unit	Profit per unit
	(dirhams)	(dirham per ton)	(dollar/ton)
1979	-1387330.14	-44.88	-11.51
1980	8853689.36	286.44	72.76
1981	13623989.49	440.76	85.22
1982	63710116.25	2061.15	342.21
1983	108205623.90	3500.67	492.27
1984	107296006.20	3471.25	393.99
1985	75315531.41	2436.61	242.15
1986	34714923.40	1123.10	123.36
1987	68987988.51	2231.90	267.32
1988	35269787.73	1141.05	139.59
1989	40889400.28	1322.86	156.54

Table 25. Total profit and per unit profit from crude oil production under free trade

Year	Free Trade		
	Total profit	Profit per unit	Profit per unit
	(dirhams)	(dirham per ton)	(dollar/ton)
1979	-1320377.58	-40.63	-10.42
1980	8360893.01	257.30	65.36
1981	12743334.80	392.17	75.82
1982	60153817.56	1851.21	307.36
1983	102280284.00	3147.64	442.62
1984	101592150.50	3126.46	354.86
1985	70764967.01	2177.77	216.42
1986	32741032.85	1007.59	110.67
1987	65763489.92	2023.85	242.40
1988	33432231.79	1028.86	125.87
1989	39244828.60	1207.74	142.92

CHAPTER 4.

RESULTS

This study has identified some important effects of trade liberalization on the Moroccan oilseed sector. Econometric analysis indicates relevant effects of the free trade agreement with the European Community. These effects include increased consumption and imports of refined oil, a net gain for consumer and government budgets, a loss for the producer (SEPO), and a net gain for society.

Change in Producer Surplus

In the analysis of the change in producer surplus, attention has focused on the change in SEPO's surplus, which would have been negative under Morocco's free trade agreement with the European Community. For example, in 1989 SEPO's surplus would have decreased by almost 76 percent. The change in SEPO's surplus is illustrated in Tables 26 and 27.

Will SEPO be able to compete in the international market, even with the decrease in its surplus? The answer depends upon the level of its marginal cost (MC) is situated with respect to the world market price of refined oil (P_R^W). If its marginal cost is less than P_R^W , the firm can survive. But if its marginal cost is greater than P_R^W , SEPO will be forced out of business. From the comparison in Figure 6, it seems that SEPO's marginal cost has been consistently above the world market price, except for 1983 to 1986. This gap has narrowed in the last period (-15 percent in 1989 in comparison with -46 percent in 1979). Thus, to become

Table 26. Change in SEPO's surplus from production of refined oil under free trade

Year	Profit per unit under free trade	Profit per unit before free trade	Change in SEPO's surplus	Change
	(dirham/ton)	(dirham/ton)	(dirham)	(percent)
1979	-44.88	861.73	-906.62	-105.21
1980	286.43	3695.10	-3408.67	-92.25
1981	440.76	3972.66	-3531.90	-88.91
1982	2061.15	5348.47	-3287.32	-61.46
1983	3500.67	4916.92	-1416.24	-28.80
1984	3471.24	5755.80	-2284.55	-39.69
1985	2436.61	6750.41	-4313.79	-63.90
1986	1123.09	6245.99	-5122.90	-82.02
1987	2231.90	6053.50	-3821.60	-63.13
1988	1141.05	4912.59	-3771.54	-76.77
1989	1322.86	5592.64	-4269.78	-76.35

Table 27. Change in SEPO's surplus from production of crude oil under free trade

Year	Profit per unit under free trade	Profit per unit before free trade	Change in SEPO's surplus	Change
	(dirhams/ton)	(dirhams/ton)	(dirhams)	(percent)
1979	-40.63	779.81	-820.44	-105.21
1980	257.30	3292.32	-3035.01	-92.18
1981	392.17	3469.41	-3077.24	-88.70
1982	1851.21	4763.99	-2912.78	-61.14
1983	3147.64	4389.14	-1241.50	-28.29
1984	3126.46	5155.69	-2029.22	-39.36
1985	2177.77	6016.16	-3838.39	-63.80
1986	1007.59	5606.20	-4598.60	-82.03
1987	2023.87	5497.88	-3474.04	-63.19
1988	1028.86	4454.73	-3425.87	-76.90
1989	1207.74	5146.79	-3939.04	-76.53

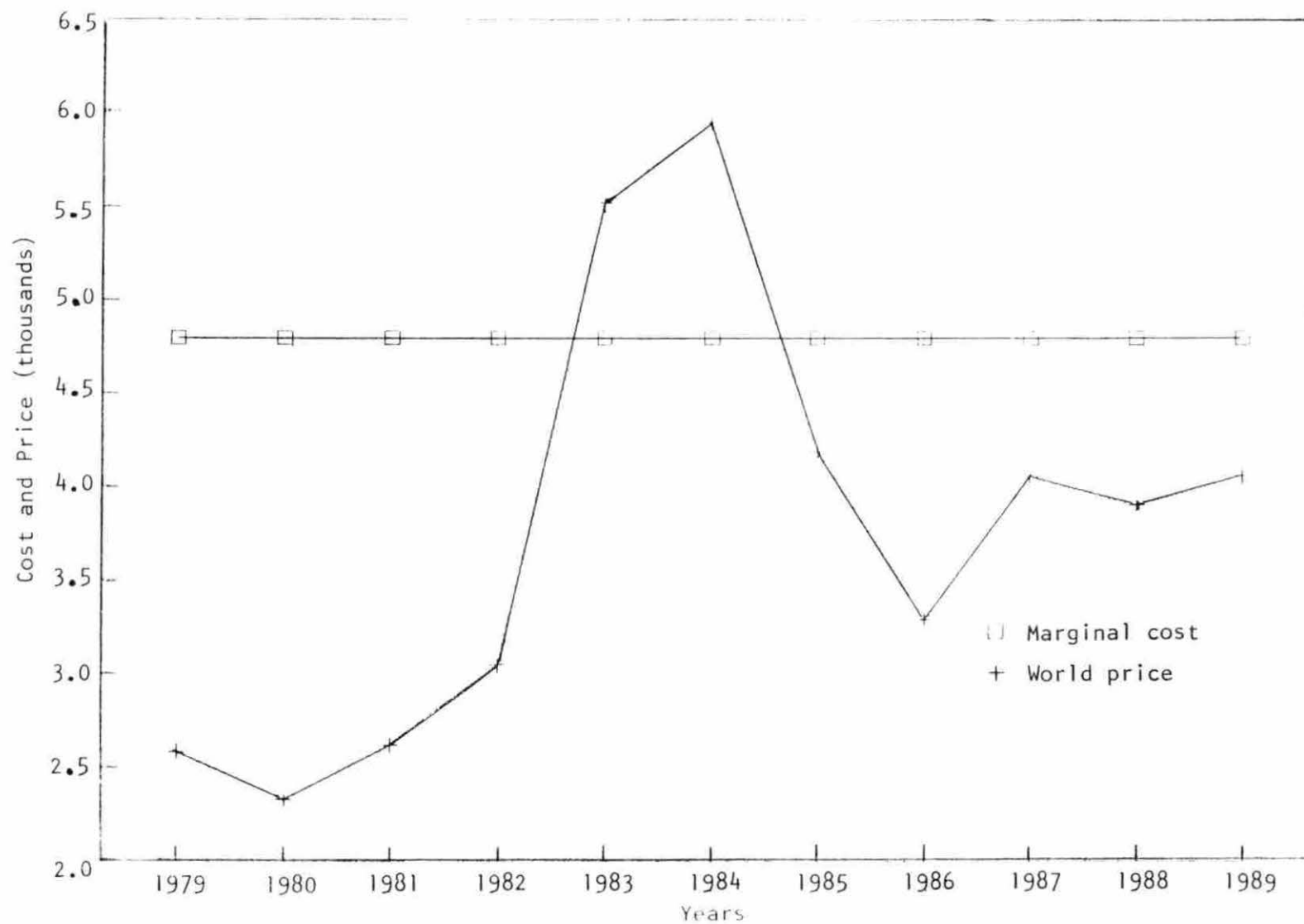


Figure 6. SEPO's marginal cost and world market price of refined oil under free trade

efficient enough to compete successfully with foreign industries under free trade, SEPO must reduce production costs.

Change in Consumer Surplus

From the free trade agreement with the European Community, the consumer would gain because of decreases in the domestic prices of refined oils. For example, the change in consumer surplus per person in 1989 would have been almost 30.48 dirhams, the equivalent of \$3.60. Table 28 shows the estimated changes in consumer surplus.

Table 28. Change in consumer surplus under free trade

Year	Consumer surplus (dirhams)	Population (thousands)	Consumer surplus per person (dirhams)	Exchange rate (dirhams/ dollars)	Consumer surplus per person (dollars)
1979	164089475.15	19470	8.42	3.90	2.16
1980	326001787.90	20050	16.26	3.94	4.13
1981	394934351.25	20646	19.13	5.17	3.70
1982	347602712.95	20419	17.02	6.02	2.83
1983	163795864.29	20890	7.84	7.11	1.10
1984	94551554.32	21465	4.41	8.81	0.50
1985	660295517.09	22068	29.92	10.06	2.97
1986	867166864.54	22703	38.20	9.10	4.20
1987	701514760.31	23376	30.01	8.35	3.59
1988	764443552.67	23059	33.15	8.17	4.06
1989	744640267.26	24430	30.48	8.45	3.61

Government Revenue

On average, the consumption subsidy was 1.98 dirhams per liter of refined oil from 1979 to 1986 (AIRD 1990b, p. 141). The government used to pay an average of 2138.238 dirhams per ton of refined oil, but under the free trade agreement scenario, it would gain this amount per ton on the total consumption of refined oil. For example, in 1989 the Moroccan government would have saved 449,742,903 dirhams under the free trade agreement option.

Overall Welfare

Society as a whole gains from the free trade agreement. This is shown by summing changes in producer surplus, consumer surplus, and government revenue:

$\Delta CS:$ 744,640,267.258

$\Delta PS:$ -234,677,124.700

$\Delta GR:$ +449,742,903.400

Net Gain: 959,706,045.900 dirhams

where

ΔCS = change in consumer surplus,

ΔPS = change in producer surplus, and

ΔGR = change in government revenue.

Thus, for 1989, the net gain for all of Moroccan society would have been 959,706,046 dirhams, or 113,574,680 dollars.

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