AN ABSTRACT OF THE THESIS OF

Houcine Boughanmi for the degree of Doctor of Philosophy in Agricultural and Resource Economics presented on May 3, 1991.

Title: A Policy Preference Analysis of the Tunisian Wheat Sector

Abstract approved:

Steven T. Buccola

Governments in less developed countries have recognized in recent years the need to liberalize economic policies in order to increase efficiency in agricultural commodity markets. In an attempt to help decision makers assess alternative choices, most policy studies, however, have focused on the efficiency norm criterion without much consideration for social preferences. A result is that some policies identified as desirable are politically infeasible.

The objective of the present study is to develop and apply a model explaining government behavior in setting agricultural price policies. It is assumed that government maximizes a policy preference function whose arguments are the welfares of interest groups affected by government policies. An interest group's well-being is represented by its utility rather than by the more commonly used, but

theoretically deficient, consumer/producer surplus or money metric measures.

The model is applied to the Tunisian wheat sector. The econometric revealed preference approach is used to estimate a Tunisian wheat policy preference function (PPF) and to derive social weights reflecting the distributional goals of the policy-making process. The bootstrap technique is employed to assess statistical reliability of these weights and to permit hypothesis testing.

Empirical results confirm and quantify a strong consumer bias in Tunisian price policy. The Tunisian government is willing to transfer one util's worth of its budget to increase consumer welfare by 0.076 util, whereas it will make the same one-util's worth of budget transfer only if it generates a 5.2 util increase in producer welfare.

Analysis based on the policy framework proposed here shows that, because efficient policy reforms are inconsistent with decision makers' preferences, they are likely to rejected in favor of the current policies. Successful policy reform therefore should be accompanied by institutional reforms that alter relative bargaining powers in the policy process and hence change the PPF weights.

A Policy Preference Analysis of the Tunisian Wheat Sector

by

Houcine Boughanmi

A Thesis

Submitted to

Oregon State University

in partial fulfillment of
the requirements for the
degree of

Doctor of Philosophy

Completed May 3, 1991

Commencement June 1991

APPROVED:

Redacted for Privacy

Professor of Agricultural and Resource Economics in Charge of Major

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Date thesis is presented May 3, 1991

Typed by Researcher for Houcine Boughanmi

ACKNOWLEDGMENT

This dissertation would never have been possible without the diligence of so many people at Oregon State University. I especially wish to single out for heartfelt gratitude my academic advisor Dr. Steve Buccola for his invaluable guidance and constant encouragement in the conceiving and writing of this dissertation; Dr. Alan Love for his generous assistance in the econometric estimation part of the study; and Dr. Mike Martin, Dr. Rich Adams, and Dr. Bruce Shepard for serving on my committee and their kind encouragements.

I would also like to thank my colleagues in the Tunisian Ministry of Agriculture for helping me gather the data necessary for this study.

Finally, I wish to express my indebtedness to USAID, whose sponsorship enabled me to enjoy and profit from this academic experience.

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CHAPTER 1

INTRODUCTION

This chapter is organized in three sections. The first section includes a general presentation of the problem and the objectives of the study. The second section reviews the theory and practice of government intervention in commodity markets. The third section outlines the organization of the thesis.

1.1 General Presentation

Developing countries intervene in agricultural commodity markets to achieve a variety of objectives. Prominent among these are support of farm income, provision of cheap staples for consumers, achievement of self-sufficiency in certain crops, and price stability. These objectives are often in conflict with one another (e.g. farm support versus cheap food for consumers) and policy makers are faced with the dilemma of achieving an appropriate trade-off between efficiency and equity.

Welfare economics suggests that economic efficiency and social optimality in resource allocation often are best served if the economy is governed by competitive markets.

However, externalities, imperfect information, and public goods -- leading to market imperfections and market failures -- are often cited as a rationale for government intervention in order to achieve a pareto superior position (Stiglitz, 1987; Timmer, 1989). Distributive and nutritional issues in most developing countries are also very important.

Government intervention has not, however, been conducted without cost. Many attribute the poor performance of the agricultural sector in LDCs to price policies pursued in these counties (Shultz, 1978). Research in this area suggests that LDC price policies usually have been biased against agriculture, taxing farmers and subsidizing consumers. This has led to a contraction of production, an increase in consumption, and a heavy dependence on food imports (Bale and Lutz, 1981; Lutz and Scandizzo, 1980; Peterson, 1979). Furthermore, government intervention is found to adversely affect resource allocation, growth, and income distribution.

There has among LDCs been a recognition in recent years of the need to liberalize policies in order to reduce price distortions in the agricultural sector. Such recognition has been further strengthened, more recently, by the difficulties these countries have experienced in foreign exchange expenditures and fiscal budget deficits.

In the process of liberalizing policy settings, many

analysts and international donors have advised third world countries to set domestic prices in line with world prices, which reflect better the opportunity costs of productive resources. The border price paradigm is a very popular and influential pricing strategy. Still, some (the structuralist school) argue that border prices are heavily influenced by protective and distorted national polices of developed countries, and thus are misleading and carry little information for allocative decisions. Prices, according to this view, should be set to enforce income distribution and stability objectives (Streeten, 1987; Rao, 1988).

The border price paradigm has been the standard approach for analyzing agricultural price policies in LDCs. Within this framework, any deviation of domestic prices from border prices reduces total economic welfare because of deadweight efficiency losses (see next section). Despite the clear-cut conclusion provided by this framework, most LDCs have rejected the border price paradigm and typically have adopted a mixture of ad hoc intervention rules.

More recently, a third view has emerged which favors taking a positive welfare economic approach to price policy analysis and which explains government behavior in a political-economic framework (Rausser, 1980; Just, 1988; Gardner, 1989). Policy and political decisions, in this framework, are the outcome of a bargaining process among

special interests. The idea is that policy makers maximize a policy preference function whose arguments are the gains to interest groups, and from which implicit preference weights are derived.[1] If this is the case, good policy analysis should be conducted within such a framework. The present study will follow the latter revealed preference approach in order to gain insight into wheat pricing policy in Tunisia, a developing country which faces some of the issues outlined above and which intervenes extensively in the wheat market. The study will take a political-economic approach to the problem of price formation and assume that pricing policy is implicitly derived from a government's political optimizing strategy over economic agents. Specifically the objectives of this thesis will be as follows:

1. To develop a model of government pricing behavior involving interested economic agents in the wheat sector, namely producers, consumers, and a marketing board which has monopoly power over buying, selling, and importing wheat.

2. Derive econometrically the implicit weights that government has attached to the welfare of these three agents in formulating its price policy.

3. Use the estimated policy preference function to investigate alternative price policies and their effects on the respective interest groups.

Objectives 1 and 2 require reliable estimates of wheat

supply and demand parameters. Given the previous absence of such parameters for Tunisia, we conduct an econometric supply-demand analysis from which welfare measures for wheat sector participants will be derived. The demand side is analyzed using a demand system consistent with utility maximizing behaviour, and for which an indirect utility function is known to exist. The indirect utility function is used as consumer welfare measure instead of the controversial consumer surplus.

The following paragraphs briefly review the literature on agricultural policy analysis and government intervention in agriculture. The contribution of this study then is explained in light of past work on agricultural policy modeling.

1.2 Literature Review

Studies of government intervention and price policy analysis in agriculture have drawn heavily on the welfare concept of economic surplus. The standard approach has been to determine the welfare impact of price intervention on consumers, producers, and taxpayers compared to a situation where free market prices prevail. This approach is extensively used in studies by the International Food Policy Research Institute, The World Bank, and other international institutions involved with food problems in third world

countries. The following paragraphs present a graphical analysis of this framework for a country that sets domestic price below the world market in order to support urban consumers.

The government sets a wedge between the world price, pw, and domestic price, pd, in order to provide cheap food for its consumers. Quantities supplied and demanded at that price, are, respectively, qs and qd with imports making up the difference (qd - qs). Consumers gain a Marshallian consumer surplus represented by the area ABCD and producers incur a loss given by the triangle ADEF, which also is an implicit income transfer to consumers. The government must, however, provide a budgetary subsidy on all imported quantities, a cost represented by rectangle EGHC. The net loss is represented by the two shaded triangles, which represent the efficiency loss caused by the induced price distortion. The net loss is computed as an unweighted sum of the surpluses accruing to each group, so that one dollar to one group is regarded as equally valuable as that to another group. This framework permits us to quantify the level and direction of income transfers between producers, consumers, and the budget and to measure the efficiency loss caused by government price policies. Most studies emphasize the importance, in LDC's, of the implicit transfers between producers and consumers, that is, the income distribution effect of the policy, relative to the visible transfer from

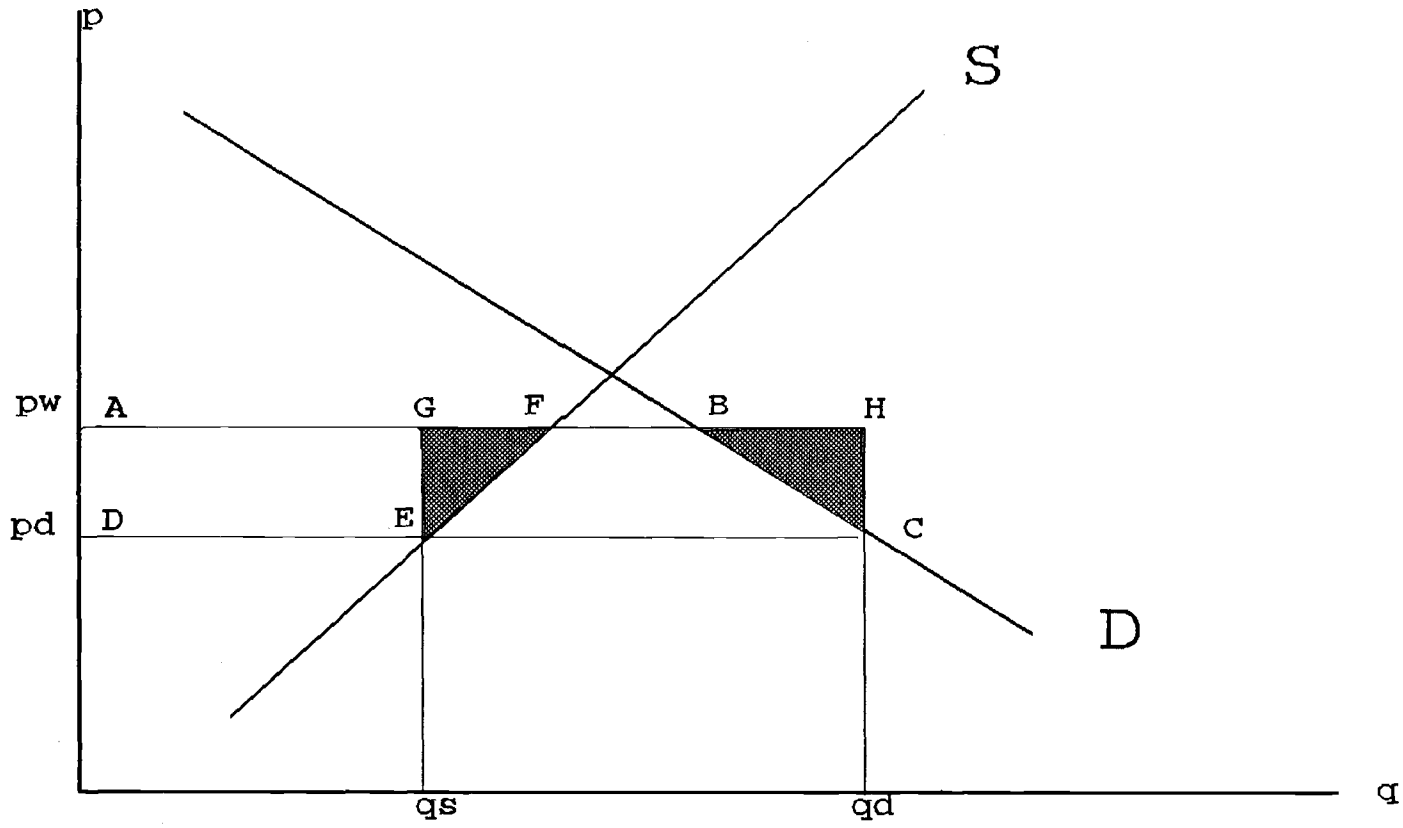

Figure 1 Welfare Implications of Government Interventions in Commodity Markets

the budget and the efficiency loss.

The driving force behind the use of this approach is the standard competitive efficiency norm reinforced with the compensation criterion. This criterion involves very little value judgment and implies, if compensation is not paid, equal welfare weights among individuals or groups (Just, 1988). The message sent to public decision makers using this analytical framework is that an efficiency loss occurs whenever prices are driven away from the competitive, free trade norm. Cochrane, among others, argues that welfare economics based on such an approach is irrelevant to policy makers, particularly in LDC's, where the perfect competition model is far from replicated and unequal weighting and income distribution considerations are a reality. Just suggests that, in order to improve its usefulness to policy analysis, welfare economics should take a more positive approach in explaining government behavior and choice among various policies.

The positive approach to agricultural policy modeling draws on the political economy literature, putting emphasis on the notion of interest groups and their attempt to influence government policy (Krueger, 1974; Becker 1983). Public decision making in a political economy setting is an interaction and bargaining process between the government and pressure groups interested in government policies. The outcome of the bargaining process is a set of government

policies reflecting the preferences of each group involved in the decision process, the influence of each interest group on the government, and the cost of influencing the government.

For empirical purposes, the collective preference structure of interest groups and decision makers most often is summarized by a policy preference or criterion function (Rausser and Freebairn, 1974). Thus, policy formulation can be viewed as an optimization process whereby the government maximizes a preference function whose arguments represent the desires and influences of the various interest groups. This function can be estimated and the welfare weights implicitly revealed from observation of past policy actions and choices. For the case of government intervention in agriculture, Rausser and Freebairn were among the first to use the policy preference approach to assess U. S. beef import quotas. The arguments of their policy preference function included a proxy measure of consumer welfare, beef producer welfare, and the import quota level. Given a quadratic preference function and an econometric model for the U. S. livestock sector, Rausser and Freebairn were able to infer the weights attached to the interest groups via the revealed preference approach[2].

Sarris and Freebairn (1983) used the same approach to explain domestic policy formulation and international wheat price determination. They assumed that, in setting its

domestic price policy, a country is concerned with the welfare of both consumers and producers as well with domestic price variability. They confirmed what is well known in the literature on price stabilization: that price policies, designed to stabilize domestic prices, tend to destabilize international prices.

Buccola and Sukume, along the same lines, developed a policy model in which regulated prices, stocks, and trade levels are determined simultaneously. They found that Zimbabwe producers have been weighted slightly more highly than consumers and the official marketing board in the government's social preference function. This finding is in contrast to the stylized facts that LDC's have heavily weighted the urban sector against the rural sector, depressing agricultural prices and agricultural growth (see, for example, Cleaver, 1985).

In the various studies surveyed above, the criterion function specified is quadratic in the policy variables. Optimizing this criterion function allows us to solve for the policy instruments as functions of the weights and other endogenous and exogenous variables (e.g. world prices and substitute prices). The weights are determined via econometric estimation of the policy instrument equations.[3]

The principal limitation of the criterion function approach, as specified in Rausser and Freebairn, is that the structure of the bargaining process is only implicit (Zusman

and Amiad, 1977). The political economy structure underlying the reduced form criterion function was first presented by Zusman (1976) and then by Zusman and Amiad (1977) in investigating Israeli sugar and dairy programs, respectively, within a cooperative game-theoretic framework. More recently, Beghin (1990) also presented government policies as an equilibrium outcome of a cooperative game among interest groups and the government, with application to the Senegalese food policy. In this framework, the players and their objective functions are identified and for each player or coalition a social power function is specified. The equilibrium outcome is found by applying the Nash-Harsanyi solution to the cooperative bargaining game. According to this solution, the cooperative game is preceeded by a noncooperative game in which disagreement pay-offs are determined by the relative social power of the players. Solution to the cooperative game is then found by determining the strategy that maximizes the product of the players' pay-offs. As Zusman (1976) showed, a solution of the Nash-Harsanyi type implies maximization of a weighted-sum utilitarian criterion function, where the weights are the bargaining powers derived from the prior noncooperative game.

Much of the empirical work on government intervention has, however, focused on reduced-form preference functions without reference to the gaming structure underlying the

preference function. For example, in studying Tanzania price policy, Gerrard and Roe (1983) assumed that the government fixes producer prices so as to minimize a loss function consisting of a weighted sum of price's squared deviation from the autarky price and the world price level. Similarly, Pinckney (1988) modeled price and storage levels in Kenya by assuming the government minimizes a weighted sum of the fiscal cost, import cost, and squared deviation of the fixed and target price. Since arguments of the loss function are economic variables rather than groups' welfares, one cannot derive statistical weights ascribed to different economic groups.

Much past work on policy modeling has used Marshallian consumer surplus as a measure of consumer welfare gain from alternative price policies. The concept of consumer surplus, however, has been heavily criticized as an individual welfare measure because it assumes that the marginal utility of income is constant with respect to a policy change or that the income effect from the policy change is small (see Currie, Murphy, and Smith). This assumption is not generally valid in food policy analysis, particularly in less developed countries where food's budget share is typically large. If the income effect of a change in food prices is large, it is likely that such a policy change will have an effect on consumers' marginal utility of income (Cochrane, 1980).

In response to this criticism of the Marshalian consumer surplus, an alternative utility indicator, the money metric, has been developed (Deaton, 1980; Mckenzie and Pierce, 1982). Money metric M_i is defined as the minimum income needed at reference prices p_r for an individual to achieve the utility level he had with prices p_i and income y_i. That is, M_i is defined implicitly by:

$$\mu(p_r, M_i) = \mu(p_i, y_i)$$

where $\mu(.)$ is the indirect utility function. Inverting the indirect utility function at p_r, we have:

$$M_i = M_i\{\mu(p_i, y_i), p_r\} = f(p_r, p_i, y_i)$$

The money metric M_i is a monotonic transformation of μ and therefore an exact indicator of utility.[4] It has the advantage of being measurable in monetary units, therefore easily interpreted, and can be derived from observable data (Mckenzie and Pierce, 1982). The money metric is, however, difficult to use in social welfare calculations. Blackorby and Donaldson (1988) showed that money metrics are not generally convex in prices at the arbitrary reference price vector and that this vector may change the location of the nonconvexities. Thus, a social welfare function based on money metrics contains arbitrary convexities and may lead to

social choices contradictory to those obtained from a social function defined on utilities.

To avoid problems of using consumer surpluses or money metrics, this study will estimate a policy preference function in utility space. In particular, consumer welfare will be evaluated in terms of its indirect utility function derived from a demand system consistent with utility theory.

1.3 Organization of the Thesis

The remaining thesis is organized in the following manner. The next chapter presents a background of the wheat sector in Tunisia and briefly describes past and current wheat price policy. This review provides a qualitative understanding of the factors affecting wheat supply and demand relationships in Tunisia and forms a foundation for subsequent analysis. The third chapter focuses on specification of the paper's conceptual model. Emphasis is on the theoretical foundation of the Almost Ideal Demand System (AIDS) used to estimate demand for durum and bread wheat, on the specification of the preference function, and on the procedure used to derive the preference weights. The fourth chapter is devoted to the empirical estimation and discussion of results. The fifth chapter evaluates alternative policies. The final chapter contains the summary and conclusions.

Endnotes of Chapter 1

1. To be sure, the political-economic framework and the structuralist framework both imply trade offs among various objectives. However, in the structuralist framework the weights are exogenous, determined by ethics or social justice, whereas in the political-economic framework the weights are endogenously determined by the policy bargaining process.

2. The revealed preference approach in modeling government behavior is much like revealed preference in consumer theory. As a consumer's preferences are revealed from his consumption choices, government preferences are inferred from its policy choices.

3. For example, Sarris and Freebairn and Buccola and Sukume specified the preference function as a weighted sum of government, consumer, and producer welfare. The welfare of interest groups are identified with their economic surpluses which are quadratic in the policy variables given a linear specification of demand and supply equations. After substituting the surplus expressions in the preference function, the latter turns out to be quadratic in the policy variables. The FOC can be solved for the policy variables as an expression of all other exogenous variables.

4. The money metric as defined here is sometimes called the indirect money metric (Donaldson, 1990, p. 8) or indirect compensation function (Varian, p. 123). The direct money metric is defined as the minimum income necessary at reference price p^r in order for an individual to consume a bundle of goods that is as good as the one he is actually consuming (Donalson, 1990).

CHAPTER 2

CURRENT WHEAT MARKET POLICY IN TUNISIA

2.1 Importance of the Wheat Sector

Wheat has traditionally been the most important crop and food grain in Tunisia. It has an economic, social, and political impact due to its relative share in agricultural output, its contribution to employment, and its role as a main source of energy to the majority of the population.

Of the nearly 5 million hectares cultivated annually in Tunisia, the three main cereals - durum wheat, soft wheat, and barley - cover approximately one-third. Durum wheat is the most important grain in terms of production and area planted (58% and 61% respectively) (Table 1). The preferred wheat for couscous, a staple in the Tunisian diet, it is also used primarily for pasta products (macaroni and spaghetti), for which it has no good substitutes.

Bread wheat, introduced by the French, is grown only on 10% of the land planted to cereals and provides 14% of total grain production. It is grown mostly on large farms and consumed in urban areas.

Barley is widely grown, particularly in the central and southern regions where rainfall is scarce. It is also a

Table 1 Wheat Acreage and Production, Tunisia, 1965-1987

YEAR	DWA (1000 Ha)	PDW (1000T)	BWA (1000 Ha)	BWP (1000T)
1965	938	421	169	100
1966	699	300	145	49
1967	653	280	166	50
1968	700	310	133	73
1969	600	245	145	91
1970	700	299	280	150
1971	771	460	200	200
1972	940	707	260	180
1973	980	655	230	165
1974	990	655	195	140
1975	924	803	185	162
1976	1266	700	126	110
1977	1080	480	104	90
1978	1031	650	101	100
1979	1046	600	88	80
1980	818	740	80	129
1981	821	804	94	159
1982	666	752	88	163
1983	956	509	121	109
1984	784	584	116	127
1985	883	1069	180	311
1986	725	378	115	96
1987	867	1065	153	295
Mean	862.52	585.57	151.04	136.05
st.dev.	164.46	233.98	55.20	66.37
CV	19%	40%	37%	49%

1) DWA = Durum Wheat Acreage; 2) PDW = Durum wheat Production

2) BWP = Bread Wheat acreage; 4) BWP = Bread Wheat Production

5) CV = Coefficient of Variability = St.Dev/Mean

good production substitute for wheat in the northern region in years where rainfall is insufficient. Barley is used mostly as feed grain and little of it is currently used as a food grain.

Aggregate cereal production grew at a rate of 4.4% over the 1965-1987 period, a rate higher than the population growth of about 2.2% per year. Most of the growth in production is due to yield improvement (4.3% annually). The increase in area cultivated over the same period was insignificant (0.05% annually).

This production, however, has not kept pace with cereal consumption, which grew at an extremely rapid rate over the last two decades. Demand-pull factors such as urbanization, increases in urban consumer income, development of an agro-industry sector, rapid population growth, and a cheap food policy are important in explaining the gap between production and consumption. Real bread prices declined consistently over the 1965-1987 period and Tunisia has relied heavily on imports to satisfy this increased internal demand (Table 2). Growing dependence on wheat imports in the last decade, combined with a high budget deficit and foreign exchange shortage, has led the government to reexamine wheat price policy, putting greater emphasis on production incentives and a gradual reduction of food subsidies.

Table 2 Evolution of Wheat Consumption and Imports, Tunisia, 1965-1987

Year	PCDW (1)	PCBW (2)	RPB (3)	DWI (4)	BWI (5)
1965	103	58	84	_	75
1966	86	56	81	_	56
1967	82	57	78	_	91
1968	83	68	81	20	101
1969	86	57	81	14	72
1970	65	84	80	35	90
1971	76	67	75	26	70
1972	99	67	73	12	47
1973	103	74	70	14	44
1974	103	74	68	_	72
1975	110	81	69	_	63
1976	107	71	69	_	69
1977	103	76	65	11	84
1978	105	80	61	44	69
1979	104	82	60	34	70
1980	106	80	64	49	98
1981	108	86	59	29	70
1982	107	93	52	30	70
1983	116	93	47	25	77
1984	112	95	46	51	77
1985	107	99	48	39	63
1986	104	101	48	10	89
1987	102	98	45	60	75

1) PCDW = Per capita consumption of durum wheat in Kg

2) PCBW = Per capita cosumption of bread wheat in Kg

3) RPB = Real bread price (deflated by cpi) in millimes per Kg; one dinar is equal to 1000 millimes

4) DWI = Durum wheat import as a percentage of consumption

5) BWI = Bread wheat imports as a percentage of consumption

2.2 Review of Wheat Price Policy in Tunisia

Although government involvement in the production sector is small, its involvement in pricing, input supply, marketing, and processing of wheat is much larger. Government intervenes at various levels of the cereal marketing channel. Through its marketing agency, the Office des Cereales (OC), government is the only seller and buyer of both imported and domestically produced wheat and barley. The Office des Cereales operates buying and selling centers all over the country, buys the entire quantity of domestic production offered to it, and has the monopoly to import whatever quantities it wishes to meet domestic demand.

Although the Office des Cereales is entrusted with legal monopoly purchasing power, a large share of production is marketed outside themxfficial marketing channel. The percentage of wheat procured by the OC varied between 32% and 56% for durum and 42% to 79% for bread wheat over the 1966-1987 period. Bread wheat is grown mostly on large farms and by more market oriented producers, a fact that explains the higher marketed surplus for bread wheat than for durum. Quantities not procured by the OC are either home consumed or sold in the parallel market. Home consumption is high for durum and was estimated to represent 25% of total production in 1985 (1985 National Expenditure Survey). The parallel market for durum wheat is very active after harvest

and presents a market outlet for producers who wish to avoid selling to the OC in order to avoid paying taxes and other charges. Such charges represent 6-8% of the procurement price.

The purpose of the government's wheat pricing policy is to assure low and stable prices for consumers and a fair farm-gate price to producers. This policy is maintained through rigid control over prices and marketing margins at the producer, wholesale, and retail levels and through an extensive system of explicit and implicit subsidies on both locally produced and imported wheat. Wheat prices, fixed at the same level everywhere in the country and throughout the year, reflect no transport or storage costs. The Office des Cereales sells locally produced and imported wheat to mill owners at a fixed mill-gate price which is below the official farm procurement price and import price. The mills are owned by private individuals but are highly regulated. Mills distribute wheat flour to privately owned bakeries, which in turn are obligated to sell bread to consumers at low fixed prices. Subsidies resulting from the difference between buying and selling prices are covered solely by the Treasury, which also pays an implicit subsidy on imported wheat through an over-valued exchange rate.

The amount of subsidy paid by government to the Office des Cereales, mills, and bakeries in order to carry out the government price-fixing policy has increased over the years.

The FAO (1986) estimated the 1986 financial transfer from government to the cereal sector to reach 10% of the 1986 government budget receipts, 2.6% of GDP, and twice the recurrent budget of the Ministry of Agriculture. The largest proportion (74%) of the total subsidy went to processing of wheat for human consumption (bakeries and mills) in order to keep consumer prices low. Furthermore, 60% of the subsidy for human consumption went to bread products (made from soft wheat); the rest to semolina, couscous, and pasta products processed from durum wheat. This distribution of subsidies among products and marketing agents provides insight into policy makers' preferences. It seems that the principal beneficiaries of the current price policy are bread consumers, who are mostly urban. In contrast, many rural dwellers consume farm-produced durum wheat and therefore do not benefit from consumer subsidies. In the last few years, government has recognized this "urban bias" and expressed in many official documents the need to remedy it. The 7th Plan of Economic and Social Development states:

> The agricultural sector, in particular the strategic commodities, has not benefited from recent price policy. The government price fixing policy has reduced producer motivation to produce these commodities and has led to a greater food dependency on imports. Price levels, particularly for cereals, oil, and certain livestock products, have been fixed, until recent years, in order to preserve consumer purchasing power without much consideration for production costs. This has resulted in an important distortion in resource allocation, discouraging the production of basic foodstuffs.

Price incentives for producers are reflected in the nominal protection coefficient (NPC), defined as the ratio of the border price equivalent to the domestic price at a given collection point. Table 3 shows that the NPC for bread wheat, for example, has varied between 0.518 and 1.717 over the 1966-1989 period. The ratio was less than one during 1972-1984 (except for 1977-1978); but after 1985, the ratio has become consistently greater than one, an indication of a policy shift toward more protection for domestic wheat producers.

2.3 Consumption Patterns and Income Distribution

Table 4 summarizes the structure of Tunisian food consumption in 1975, 1980, and 1985 National Household Expenditure Surveys (Tunisian National Institute of Statistics). Fruits and vegetables (23%), meats (22.2%), and cereals (15.8%) are the most important commodities in the Tunisian food budget. Cereals' share declined gradually over the 1975-1985 period as consumers' high income led them to substitute more expensive and nutritionally richer commodities into their food basket.

The food share of personal consumption expenditure declined slightly, from 41.7% to 39% between 1975 and 1985, a fact consistent with Engel's law. This law establishes a negative relation between personal income and the share of

Table 3 Tunisian Producer and World Prices of Durum and Bread Wheat, 1966-1989

	Durum Wheat			Bread Wheat		
Year	PP	WP	NPC	DP	WP	NPC
1966	42.0	37.87	1.109	34.50	37.87	0.911
1967	48.0	43.16	1.112	43.00	35.12	1.224
1968	48.0	41.56	1.154	43.00	35.27	1.219
1969	48.0	36.44	1.317	43.00	33.86	1.269
1970	48.0	40.24	0.198	43.00	37.14	1.158
1971	48.0	33.14	1.448	43.00	31.37	1.370
1972	48.0	43.59	1.101	43.00	43.30	0.991
1973	48.0	114.08	0.420	43.00	82.87	0.518
1974	61.0	106.82	0.571	55.00	87.79	0.626
1975	66.0	098.94	0.667	60.00	73.32	0.818
1976	66.0	058.03	1.137	60.00	60.12	0.999
1977	71.3	051.93	1.373	65.35	47.51	1.375
1978	76.0	059.76	1.271	70.00	55.00	1.272
1979	76.0	082.89	0.917	70.00	75.69	0.924
1980	86.0	123.03	0.699	77.00	84.65	0.909
1981	96.0	113.96	0.842	87.00	91.40	0.951
1982	110.0	107.52	1.023	100.00	93.70	1.067
1983	128.0	145.28	0.881	117.00	121.30	0.964
1984	140.0	159.57	0.877	140.00	141.64	0.963
1985	150.0	159.63	0.939	145.00	119.04	1.218
1986	160.0	132.16	1.210	160.00	113.98	1.403
1987	185.0	135.00	1.370	170.00	115.00	1.478
1988	210.0	158.00	1.329	190.00	111.00	1.717
1989	220.0	163.00	1.349	200.00	132.00	1.515

1) PP = Producer prices in dinars per ton;

2) WP = World prices in dinars per ton (CIF Tunis)

3) NPC = Nominal protection coefficient = PP/WP

TABLE 4 Structure of Tunisian Food Consumption, 1975-1985

	Budget Shares		
	1975	1980	1985
Cereals	21.4	19.7	15.8
Dairy Products & Eggs	7.2	9.2	9.9
Meats & Poultries	18.2	20.7	22.2
Fruits & Vegetables	19.6	21.9	23.0
Fish	2.7	2.6	3.1
Edible Oils	10.7	7.2	5.9
Sugar & Sugar Products	4.9	4.3	2.7
Pulses & Spices	3.6	3.4	3.4
Food & Drinks Outside the Household	9.7	11.0	14.0
Total	100.0	100.0	100.0
Food Budget Share (% of total expenditure)	41.7	41.7	39.0

Source: INS, Enquete National sur le Budget et la Consommation des Menages 1985

food in total household expenditures.

Engel's law is even more manifest in table 5, which gives budget shares for various commodities in three urbanization groups (rural areas, urban communities, large cities). Food's budget share rises from 34.5% in large cities -- where incomes are highest-- to 45.5% in the rural areas -- where incomes are lowest. Furthermore, cereal products become a more important part of food expenditures as we move from large cities to rural households, where cereals represent only 22% of the food budget.

Nevertheless, and contrary to other developing countries, table 5 shows that the Tunisian household's food budget is relatively diversified even for low income groups. The budget share for luxury items such as meats is high in all income groups and represents as much as 21% in the often poor rural areas. This is in contrast to most developing countries, where staple commodities represent the bulk of consumption. Most developing countries subsidize consumer staples. Price increases in staples are usually assumed to have a negative impact on poor consumers, who spend much of their budget on those staples. The negative impact would be less severe in countries such as Tunisia where the food basket is much more diversified (Laraki, 1988).

Table 6 summarizes consumption of the various types of cereals in Tunisia. Ninety three percent of cereal consumption consists of durum and bread wheat products. Per

Table 5: Tunisian Food Budget Shares-- Rural Versus Urban (%)

	Big Cities	Small Cities	Rural
Cereals	11.4	14.7	21.5
Fruits & Vegetables	22.5	23.8	22.9
Meats & Poultries	23.6	22.2	20.6
Fish	4.5	3.4	1.2
Milk Products & Eggs	12.1	9.7	7.7
Edible Oils	4.1	6.6	7.2
Sugar & Sugar Products	2.5	2.4	3.3
Pulses	3.5	3.3	3.4
Food & Drinks Outside the Household	15.8	13.9	12.2
Total	100.0	100.0	100.0
Food expenditure (D)	257.9	195.6	133.9
Food Budget Share (% of Total Expenditure)	34.5	39.0	45.5

Source: INS

Table 6 Per Capita Cereal Consumption in Tunisia[a]

	Nationwide	Rural	Urban
Durum Wheat	117	190	60
Semolina	71	135	20
Couscous	20	24	17
Pasta (Macaroni)	22	23	20
Other Durum Products	4	8	3
Bread Wheat	72	41	97
flour	6	9	5
Bakery bread	66	32	92
Barley	7	13	3
Other Cereals	8	3	10
Total Cereals	204	247	170

a) Per capita consumption is in Kg equivalent grain per year

Source: Institut National des Statistiques (INS)

capita durum wheat consumption is three times higher in the rural sector than in the urban sector. However, a large share (30-50%) of durum wheat in rural areas is home-grown and does not pass through commercial (and hence subsidized) channels. Bread wheat consumption, on the other hand, is 2.3 times higher in urban than in rural areas. Most of the bread wheat consumed goes through the heavily subsidized mill and bakery industries. It is not clear, therefore, that the equity objectives stated in the current wheat price and subsidy policy will be achieved, since the the poor mostly live in rural areas.

The survey document indicates, however, that bread wheat consumption in rural areas is increasing at a much faster rate than in urban areas (4.2% versus .2% annually). This pattern is influenced by the heavy subsidies aimed at keeping bread prices low, encouraging rural consumers to switch from unsubsidized home made bread to the subsidized commercial bakery bread.

The next chapter presents a theoretical model of wheat price policy formation in Tunisia. This will provide a framework for (1) a supply and demand analysis of durum wheat and bread wheat, and (2) an assessment of the social and political preferences revealed in the Tunisian wheat policy.

CHAPTER 3

THEORETICAL MODEL

As the discussion in the last chapter indicates, the Tunisian government's intervention in fixing wheat producer and consumer prices involves a trade-off between the interests of consumers, producers, and the net revenue position of the parastatal agency which trades in the domestic and international wheat market. This chapter develops a model that explains government behavior and which takes into account the trade-offs between interest groups. The model follows the revealed preference approach used in the recent literature on modelling government intervention in domestic commodity markets, in which observed policies are consistent with maximizing a policy preference function over the welfares of various participants in the commodity market (Sarris and Freebairn, 1983; Riethmuller and Roe, 1986; Buccola and Sukume, 1988; Love, et al., 1990).

3.1 The Conceptual Model

Let the domestic market structure of durum wheat and bread wheat be represented by the following supply and demand functions:

$$(1) \qquad q^s_{jt} = S(p^s_{jt},\ Z^s_{jt},\ u_{jt}) \qquad j = 1,\ 2$$

$$(2) \qquad q^d_{jt} = D(p^d_{jt},\ Z^d_{jt},\ v_{jt}) \qquad j = 1,\ 2$$

where q^s_{jt} and q^d_{jt} are quantities supplied and demanded in year t; p^s_{jt} and p^d_{jt} are the government-fixed producer and consumer prices for the year t[1]; Z^s_{jt} and Z^d_{jt} are vectors of supply and demand shifters; u_{jt} and v_{jt} are additive structural errors; and j = 1, 2 is the index of durum wheat and bread wheat respectively.

The parastatal agency acquires the quantity domestically marketed at price p^s, resells the grain to domestic consumers at price p^d, and meets the excess demand by imports at world price p^w. Assuming no stock changes, government's expected revenue from intervention in the wheat market is, therefore[2]

$$(3) \quad R^*_t = \Sigma_j(p^d_j\ q^{d*}_j - p^s_j q^{s*}_j) - \Sigma_j p^{w*}_j(q^{d*}_j - q^{s*}_j) \qquad j = 1,\ 2$$

where the asterisk represents an expectation at t-1 when government chooses price policies p^d and p^s for durum and bread wheat. The first term on the right hand side of (3) represents government net revenue (cost) earned from its intervention in the domestic market; the second term represents revenue (cost) from foreign trade.

Government is assumed to behave as though it maximizes a preference function whose arguments are the welfares of the economic groups involved in the wheat market. This policy preference function at time t is designated as:

$$(4) \qquad W_t = W\ (\mu_{1t},\ \mu_{2t},\ \mu_{3t})$$

where μ_i, i=1,2,3 represents respectively the utility of wheat producers, the utility of wheat consumers, and the utility of government. Utility levels are affected by policy instruments p^s and p^d. The PPF is assumed to be concave (increasing in its arguments but at a decreasing rate), and government preferences in wheat policies are assumed to be separable from other government concerns.

Utilities of wheat producers and government are specified as logarithmic functions of producer surplus (PS) and government expected revenue (R^*), respectively. Hence:

$$(5) \qquad \mu_{1t} = \log(PS_t)$$

$$(6) \qquad \mu_{3t} = \log(R^*_t)$$

where $PS_t = \Sigma_j \int q^s_j\, dp^s_j$. The logarithmic utility function has the property of diminishing marginal utility as implied by neoclassical economic theory.

A consumer's indirect utility function is assumed to be consistent with the Almost Ideal Demand System used to

estimate demand for wheat in Tunisia (see next section). It takes the following form:

$$(7) \qquad \mu_{2t} = \text{Log}(y/P)_t / (p^d_{1t})^{b1} \ (p^d_{2t})^{b2} \ (p^d_{3t})^{b3}$$

where y is total expenditure on food, P is an aggregate price index, p^d_1 is consumer durum wheat price, p^d_2 is consumer bread wheat price, p^d_3 is the price of an "other food" composite commodity, and b_1, b_2 and b_3 are parameters to be estimated.

Government chooses the level of producer price p^s and consumer price p^d of both durum and bread wheat in order to maximize equation (4). The first-order conditions of the linear form of (4) can be stated as:

$$w_1 \ \partial\mu_1/\partial p^s_j + w_2 \ \partial\mu_2/\partial p^s_j + w_3 \ \partial\mu_3/\partial p^s_j = 0 \qquad j = 1,2$$

$$w_1 \ \partial\mu_1/\partial p^d_j + w_2 \ \partial\mu_2/\partial p^d_j + w_3 \ \partial\mu_3/\partial p^d_j = 0 \qquad j = 1,2$$

where $w_i = \partial W/\partial\mu_i > 0$ is the marginal weight of the i^{th} interest group's utility in the policy preference function. The time subscript here and in subsequent notation is omitted for convenience. Impartiality would imply that the government refuse to discriminate between interest groups, so that w_i = constant for all i = 1, 2, 3. In this case we have

$$\Sigma_{i=1}^{3} \partial\mu_i/\partial p^s_j = 0 \qquad j = 1, 2$$

$$\Sigma_{i=1}^{3} \partial\mu_i/\partial p^d_j = 0 \qquad j = 1, 2$$

Most governments, however, redistribute or transfer income among social groups, implying unequal weighting in the policy preference function. Examination of actual government choices over prices p^s and p^d permits us to estimate these weights.

3.2 Estimation of Policy Preference Function[3]

Several methods have been developed and applied in empirical work to estimate the parameters of the policy preference function (Love, et al., p. 11-12). A direct approach is to interview policy makers and ask them to reveal their preferences by suggesting alternative policy options. The drawback of this approach is that policy makers may be reluctant to reveal their true preferences or that the policy alternatives presented by the interviewer are not relevant to them.

An indirect approach is to estimate the policy preference function econometrically. Such an approach makes use of the first-order conditions of the PPF, the economic constraints, and the revealed preference assumption that observed policies are the outcome of an optimization process by policy makers (Rausser and Freebairn, 1974). It is more

appealing than the direct approach because it allows formulation of testable hypotheses about the PPF.

The present study applies the latter approach to estimate equation (4). A functional form must be specified for this purpose and, for reasons of tractability, a quadratic functional form is used. The quadratic form has first order conditions linear in the parameters w_i and is a second order approximation to the true policy preference function.

The quadratic PPF is

$$(4') \quad W = w_1 \mu_1 + w_2 \mu_2 + w_3 \mu_3 + w_4 (\mu_1)^2 + w_5 (\mu_2)^2 + w_6 (\mu_3)^2 + 2w_7 (\mu_1 \mu_2) + 2w_8 (\mu_1 \mu_3) + 2w_9 (\mu_2 \mu_3)$$

where W is the level of the preference function defined for each period t; w_i, i = 1,..,9, are weights to be estimated; and μ_i, i = 1, 2, 3, are utility levels as defined in (5), (6), and (7). The utilities are functions of policy instruments p_1^s, p_2^s, p_1^d, and p_2^d.

Maximizing (4') with respect to the policy instruments yields four first-order conditions linear in parameters w_i.

$$\begin{aligned} \partial W/\partial p_j = {} & w_1 \partial\mu_1/\partial p_j + w_2 \partial\mu_2/\partial p_j + w_3 \partial\mu_3/\partial p_j + \\ & 2 w_4 (\partial\mu_1/\partial p_j) u_1 + 2 w_5 (\partial\mu_2/\partial p_j) \mu_2 + \\ & 2 w_6 (\partial\mu_3/\partial p_j) \mu_3 + 2 w_7 (\partial\mu_1/\partial p_j \mu_2 + \\ & \partial\mu_2/\partial p_j \mu_1) + 2 w_8 (\partial\mu_1/\partial p_j \mu_3 + \partial\mu_3/\partial p_j \mu_1) \end{aligned}$$

$$+ 2\ w_9\ (\partial\mu_2/\partial p_j\ \mu_3 + \partial\mu_3/\partial p_j\ \mu_2) = 0_j$$

$$j = 1,\ 2,\ 3,\ 4$$

where j = 1, 2, 3, 4 is the index of policy instruments p_1^s, p_2^s, p_1^d, and p_2^d, respectively. Some of the terms in (8) are, of course, zero for a particular instrument p_j.

Love, et. al. (1990) suggest the following steps in order to obtain estimates of w_i:

1) Partial derivatives $\partial\mu_i/\partial p_j$ and other terms in (8) are evaluated at the observed policy-determined price levels. This draws on the principal assumption of the revealed preference approach, namely that observed policies are assumed optimal. Evaluation of the partial derivatives is conducted numerically and gives the marginal change in the utility of each interest group caused by a marginal change in each policy instrument. Substituting these numeric values into (8) above, we obtain a system of four equations, one four each policy instrument and each of the form:

$$(9) \qquad w_1\ Z_{1j} + w_2\ Z_{2j} + w_3\ Z_{3j} + w_4\ Z_{4j} + w_5\ Z_{5j} + w_6\ Z_{6j}$$
$$+ w_7\ Z_{7j} + w_8\ Z_{8j} + w_9\ Z_{9j} = 0_j$$

$$j = 1,\ 2,\ 3,\ 4$$

where j is the index of the policy instruments. The Z's in (9) are the corresponding numeric derivatives in (8), namely

$$Z_{1j} = \{\partial\mu_1/\partial p_j\}_{p0j}$$

$$Z_{2j} = \{\partial\mu_2/\partial p_j\}_{p0j}$$

$$Z_{3j} = \{\partial\mu_3/\partial p_j\}_{p0j}$$

$$Z_{4j} = \{2\ \partial\mu_1/\partial p_j\ \mu_1\}_{p0j}$$

$$Z_{5j} = 2\{\partial\mu_2/\partial p_j\ \mu_2\}p_{0j}$$

$$Z_{6j} = \{2\ \partial\mu_3/\partial p_j\ \mu_3\}_{p0j}$$

$$Z_{7j} = 2\{\partial\mu_1/\partial p_j\ \mu_2 + \partial\mu_2/\partial p_j\ \mu_1\}_{p0j}$$

$$Z_{8j} = 2\{\partial\mu_1/\partial p_j\ \mu_3 + \partial\mu_3/\partial p_j\ \mu_1\}_{p0j}$$

$$Z_{9j} = 2\{\partial\mu_2/\partial p_j\ \mu_3 + \partial\mu_3/\partial p_j\ \mu_2\}_{p0j}$$

Symbol $\{\ -\ \}_{p0j}$ here indicates that the derivatives are evaluated at the current observed prices p_{0j}.

2) One of the weights w_i is chosen as numeraire and set equal to one. This permits its associated numeric derivatives Z_{ij} to be moved to the right-hand side of (9). All others parameters are interpreted relative to the numeraire. Hence, weights w_i to be estimated are unique only up to a factor of proportionality.

After step 2 is completed, (9) may be rewritten in the matrix form

$$\mathbf{Z}_j\ \mathbf{B} = \mathbf{z}_j \qquad j = 1,\ 2,\ 3,\ 4 \tag{10}$$

or more compactly,

$$\mathbf{Z}\ \mathbf{B} = \mathbf{z} \qquad (11)$$

where **Z** is a 4 x 8 matrix, **B** = $(w_1, \ldots, w_8)$ is a 8 x 1 parameter vector of weights, and **z** is a 4 x 1 vector consisting of the Z's of the numeraire. Each row of **Z** represents a set of numeric partial derivatives Z_{ij} with respect to a policy instrument j, and each element of the vector **z** represents a partial numeric derivative Z_{ij} attached to the chosen numeraire parameter.

3) Solve for the parameters **B** in (11) by premultiplying by **Z'** and by $(\mathbf{Z'Z})^{-1}$ to get:

$$\mathbf{B} = (\mathbf{Z'Z})^{-1}\ \mathbf{Z'z} \qquad (12)$$

B in (12) is a vector of weights w_i expressed relative to the chosen numeraire, reflecting marginal tradeoffs between the welfares of interest groups involved in the wheat market.

Identification of parameters **B** requires that the number of policy instruments J exceed or equal the number of the parameters in (4') minus one.[4] Here, this critical number is eight, whereas the number of policy instruments is only four. This would seem to require estimating four parameters

and restricting four parameters to arbitrary values. The problem is, however, solved by estimating weights **B** not for a single period but for multiple time periods, assuming that the weights are stable over time.[5] Multiperiod analysis has the advantage of increasing the number of parameters in **B** that can be estimated: each period increases the number of estimable parameters by J, the number of policy instruments. The necessary identification condition becomes: $JT > 8$, where T is the number of time periods.

3.3 Specification of Wheat Demand and Supply

3.3.1 An AIDS Wheat Demand Model

The demand for wheat is specified as a system of three equations and estimated using the Almost Ideal Demand System (AIDS) developed by Deaton and Muellbauer (1980). Wheat is disaggregated into durum wheat and soft wheat. All other foods are aggregated together as a composite commodity. This specification makes use of the separability assumption (Hicksian separability), which permits modeling consumers' choice of various types of wheat while taking the consumption of other goods as given. Prices of the other goods are assumed to change in the same proportion as one another so that these various commodities can be aggregated into a single composite commodity. The price of such a

composite commodity is a consumer price index (Varian, 1984).[6]

The AIDS model is derived from an explicit indirect utility function (or equivalently expenditure function) which can readily be used as a consumer welfare indicator. Consider the following log expenditure function,

$$(13)\quad \log c(u,p) = a_0 + \Sigma_i\, a_i \log p_i + 1/2\, \Sigma_i \Sigma_j\, g_{ij} \log p_i \log p_j + \mu\, b_0\, \Pi_i\, p_i^{bi}$$

where a_i, b_i, g_{ij} are parameters and $c(\mu,p)$ is the consumer's cost or expenditure function at utility μ and price vector p. The cost function is the minimum expenditure necessary to attain utility μ at given prices p. Summation in (13) is over durum wheat consumer price, bread wheat consumer price, and other-food prices.

By Shephard's lemma the compensated (Hicksian) demand of good i can be derived from (13) by taking the derivative of c(u,p) with respect to p_i:

$$(14)\quad \partial c(u,p)/\partial p_i = q^d_i$$

Multiplying both sides of (14) by $p_i/c(u,p)$ gives:

$$(15)\quad s_i = p_i q^d_i/c(u,p) = \partial \log c(u,p)/\partial \log p_i$$

where $s_i = p_i q_i / y$ is good i's share of the consumer's budget. Equation (15) shows that logarithmic differentiation of (13) gives the budget share of good i as a function of prices and utility:

$$(16) \qquad s_i = \partial \log c(u,p) / \partial \log p_i = a_i + \Sigma_j \, g_{ij} \log p_j + b_i \, u \, b_0 \, \Pi_j p_j^{bj}$$

Indirect utility function $\mu(p,y)$ can be obtained by inverting (13) given that total expenditure y is equal to c(u,p). Doing this and substituting the result in (16), we obtain the AIDS demand functions in budget share form:

$$(17) \qquad s_i = a_i + \Sigma_j \, g_{ij} \log p_j + b_i \log(y/P) + v_i$$

where v_i is an error term and P is defined as the antilog of

$$(18) \quad \text{Log } P = a_0 + \Sigma_i \, a_i \log p_i + 1/2 \, \Sigma_i \, \Sigma_j \, g_{ij} \log p_i \log p_j$$

If there is enough collinearity among prices, which often is the case in time series data, P can be approximated by the simple Stone expenditure-share-weighted price index

$$(19) \qquad \text{Log } P = \Sigma_i \, s_i \, p_i$$

where s_i is the actual observed budget share of the ith

commodity. Deaton and Muellbauer (1980, p. 318) noted that in most cases this approximation is very close to the real price index given by (18). In form (19), P would be known before estimation and (17) would be linear in a_i, g_{ij}, and b_i. Consistency with utility maximization requires that the following conditions hold in (17):

(20) adding up: $\Sigma_i\ a_i = 1$; $\Sigma_i\ g_{ij} = 0$, all j; $\Sigma_i\ b_i = 0$

(21) homogeneity: $\Sigma_j\ g_{ij} = 0$; all i

(22) symmetry: $g_{ij} = g_{ji}$

Deaton and Muellbauer list several properties that make the AIDS superior to competing demand systems (e.g. the linear expenditure system, translog, Rotterdam models): (1) it gives a first order approximation to any demand system; 2) it satisfies the axioms of choice exactly; 3) it aggregates perfectly over consumers; 4) it is simple to estimate in its linear version; and 5) it may be used to test for homogeneity condition (21) and symmetry condition (22). In addition, and in contrast to other common functional forms such as the linear expenditure system, the AIDS is flexible with respect to price and income elasticities.[7] In particular, the AIDS allows for goods to be inferior, complements, or substitutes. Inferiority and complementarity cannot occur, for example, in the linear expenditure system without violating concavity of the cost

function in prices (Deaton and Muellbauer, 1987; p. 66).

The estimable parameters of AIDS model (17) have a straightforward interpretation. Intercept coefficients a_i represent the average budget share when all prices and real income are equal to 1. The b_i parameters (expenditure coefficients) determine whether goods are necessities or luxuries. A negative (positive) b_i implies that the associated budget share s_i decreases (increases) as real expenditure increases, so good i is a necessity (luxury). Price coefficients g_{ij} represent the change in the ith budget share caused by a percentage change in jth price, ceteris paribus.

3.3.2. The Supply Equations

For simplicity, and to avoid introducing more complications to an already nonlinear policy model, the supply side is based on the following linear form:

$$(23) \quad q^s_{it} = c_{0i} + \lambda_i\, q^s_{it-1} + \Sigma_j c_{ij}\, p^s_{jt} + d_i\, p^f_t + f_i\, r_t + u_{it}$$

where i = 1, 2, 3 is the index for durum wheat, bread wheat, and barley, respectively; q^s_{it} is quantity of commodity i supplied to the parastatal agency during period t; p^s_j is the farm gate price of commodity i, j = 1, 2, 3; p^f is the price

of fertilizer; r is a weather index; λ, c_{ij}, d_i, f_i are parameters, and u_{it} is the random error for the ith equation and tth year. Structure (23) assumes that bread wheat, durum wheat, and barley all compete for the same farm resource base.[8] Lagged supply quantity q_{isit-1} is included as an explanatory variable to reflect the Nerlovian partial adjustment process whereby producers only partially adjust their short-run supply to its long-run or optimum value. The Nerlovian model is well documented elsewhere and will not be discussed here (for the Tunisian case, see Ben Senia, 1980).

In equations (23), q^s_{it} measures marketed surplus rather than total output. Price response of marketed surplus in an economy dominated by subsistence farmers is sometimes ambiguous.[9] In Tunisia, however, the aggregate own price effect is expected to be positive since subsistence farmers coexist with large commercial ones and the latter contribute a large share to marketed surplus. Hence, a priori coefficient signs in (23) are $c_{ij} > 0$ $(i = j)$; $c_{ij} < 0$ $(i \neq j)$; $0 < \lambda < 1$; $d_i < 0$; and $f_i > 0$.

Endnotes of Chapter 3

1. Producers respond to expected prices rather than to actual prices. In Tunisia, however, government announces prices for the next year before planting. hence producers' expected price for period t is equal to the price actually announced in t-1.

2. Normally R^* should be net of storage costs. However, these costs are considered to be a small component of government revenue from its direct involvement in the wheat market. Tunisia is easily accessible to international markets, which have been used to manage short-term fluctuations in the excess demand. Storage has seldom been used as an active government policy instrument to support intervention in the wheat sector. For an analysis where price and storage policies are simultaneously determined, see Buccola and Sukume (1989).

3. This section draws heavily from a paper by Love, et al., 1990.

4. This is only a necessary condition for identification. A necessary and sufficient condition for the parameters to be identified is that the rank of the $\mathbf{Z}$ (Jacobian) matrix equal the number of parameters to be estimated less one.

5. Stability of preference weights in agricultural policies is not an especially restrictive assumption. Gardner (1988) reports that policy makers' preferences in the U.S. agricultural sector have been stable for quite some time. Assumption of the stability of political preferences may not be more restrictive than the often made assumption of taste stability in consumer theory.

6. A second type of separability is also often implicitly assumed in demand analysis: functional separability or two-stage budgeting. In the first stage, consumers allocate their total expenditure to broad aggregate commodity groups (e.g food, housing, services, etc.). In the second stage, consumers consider only the food group and make consumption decisions given food expenditure and commodity prices within the food group. This implies that we can have a subutility function for each group and that the values of each of these subutilities combine to give total utility.

7. The linear expenditure system also has the peculiar property that price elasticities are proportional to income elasticities. This is a result of the underlying assumptions about consumer preferences used in that model,

which are too restrictive (Deaton, 1980).

8. Since barley is used mostly as a feed grain, it is for our purposes not included as an explicit policy variable in the policy model. However, we included it in the supply system along with wheat in order to increase estimation efficiency.

9. In many developing countries, on-farm consumption is a large share of total output. An increase in output prices increases farmers' income and, as a result, increases on-farm consumption (as long as the consumed commodity is a normal good). This may produce a positive relation between own price and consumption, which may partly offset the positive responsiveness of marketed surplus to own price. Apparently perverse marketed surplus behavior may result (Nowshirvani, 1967; Toquero, et al., 1975).

CHAPTER 4

ESTIMATION AND EMPIRICAL RESULTS

This chapter presents the estimation procedure and evaluates empirical results of the proposed policy model. The chapter is divided into four sections. The first two sections discuss statistical issues and results of supply and demand estimations, which collectively represent the constraints to the policy model. Based on this, the policy preference function (PPF) is estimated in the third section to yield the weights which the Tunisian government has implicitly assigned to the identified interest groups. Variability of these weights is discussed in the fourth section and a resampling procedure is performed to derive standard errors for the PPF parameters.

4.1 Supply Equations

Estimation of supply response is based on equation (23)

$$q_{it}^s = c_{0i} + \lambda_i\, q_{it-1}^s + \Sigma_j\, c_{ij}\, p_{jt}^s + d_i\, p_t^f + f_i\, r_t + u_{jt}$$

$$i, j = 1, 2, 3$$

where q_i^s $(i = 1, 2, 3)$ are quantities of durum wheat, bread

wheat, and barley supplied to the parastatal agency; p^s_j (j = 1, 2, 3) are durum wheat, bread wheat, and barley prices; p^f is nitrogen price; r is a weather index; and u_j are independently and identically distributed error terms. All variables are in log form and all prices are deflated by the consumer price index.[1] Prices are fixed by government and are known to producers before planting. Rainfall is an important weather variable under Tunisian dry farming conditions and is characterized by an extreme seasonal variability. In this study only rainfall during the planting season is used, since rainfall during that period is more critical than total rainfall in conditioning wheat acreage and output.[2]

The individual commodity supply equations were first estimated separately using OLS. However, because some cross-price coefficients had unexpected signs, symmetry conditions were imposed and the equations reestimated as a system of seemingly unrelated regressions. In addition, since there is no prior reason for the disturbances to be uncorrelated across equations, Zellner's system estimation procedure was employed as it is more efficient than OLS applied to each equation separately (Zellner, 1962).[3] Table 7 gives results from fitting the supply equations using Zellner's method. All coefficients have the expected signs and many are significant at the 10% level or better. In particular, all own-price coefficients are significant at

Table 7 Parameter Estimates for Wheat and Barley Supply, SUR Estimation Procedure, 1966-1987[a]

	Durum Wheat (D.W)	Bread Wheat (B.W)	Barely (BA)
Constant	1.540 (0.375)[b]	-0.197 (0.035)	10.154 (2.394)
Durum Wheat Price	2.173 (1.802)	-0.436 (-0.443)	
Bread Wheat Price	-0.436 (-0.443)	2.521 (2.504)	-0.388 (-0.694)
Barley Price		-0.388 (-0.694)	1.677 (3.144)
Nitrogen Price	-0.660 (-2.00)	-0.162 (-0.309)	-0.912 (-1.97)
Rainfall	0.835 (2.700)	0.993 (2.370)	1.399 (3.689)
Lag. Dep. Var.	0.469 (3.600)	0.434 (2.506)	0.0593 (0.402)
R-squared Adjus.	0.60	0.53	0.66
D.h[c]	2.78	1.75	2.43

a) All variables are in logarithmic form.

b) Numbers in parentheses are t-values.

c) Durbin-h is a large-sample test for autocorrelation in models with lagged dependent variables. In large samples, it has the standard normal distribution.

the 5% level. The results indicate also that rainfall is highly significant and is an important factor explaining durum wheat and bread wheat supply variability in Tunisia. High response (except in the bread wheat equation) to fertilizer price underscores the importance of fertilizer marketing policy in LDCs.[4]

Since the equations are estimated in logarithmic form, estimated coefficients are also the estimated elasticities. Supply elasticity of bread wheat is higher than that of durum since bread wheat is grown mostly by large market-oriented farmers. However, both durum and bread wheat elasticities found in this study are high compared to those reported for other developing countries. Scandizzo and Bruce (1980), in a survey of wheat supply response studies in LDCs, report estimates of short-term elasticities in the range of -0.02 to 1.59. In only one case was the supply elasticity found to be greater than 2.0.

Most of the above studies, however, were concerned with acreage response; very few were concerned with marketed-surplus elasticities, which probably are much higher. Ben Senia (1980) estimated a marketed-surplus supply equation for Tunisia and reported price elasticities of 1.58 and 1.10 for durum and bread wheat, respectively. He argued that high supply response is due to the large share of marketed output contributed by large, market-oriented farmers. Another explanation for the high supply response in Tunisia

is that increases in official prices would divert large quantities of wheat from the parallel market (black market and home consumption) to official marketing channels.

In any case, the magnitude of price responses reported here and elsewhere contradict the assumption which apparently has inspired so much government intervention in the past, namely that farmers are not responsive to prices and that therefore the damaging consequences of price distortion are limited. Farmers evidently are responsive, and prices are important policy instruments by which governments can transfer and redistribute income.

4.2 Demand Equations

AIDS model (17) was fitted to the data in the appendix tables to estimate demand for durum wheat, bread wheat, and the "other food" composite commodity. Demand for each commodity was specified in budget share form (s_i) as a function of the logarithm of its own price, logs of prices of other food commodities, and the log of real expenditure. Consistency with demand theory implies that the system of equations should satisfy adding-up, homogeneity in prices and income, and Slutsky symmetry (equations 20, 21, and 22). The unrestricted model and a model with homogeneity conditions imposed can be estimated equation by equation using OLS. However, if symmetry is imposed the model cannot

be estimated on an equation-by-equation basis. The system estimator employed to solve this problem is the iterative seemingly unrelated regression (SUR), which gives maximum maximum likelihood estimates (Judge, et al. 1987).

Since the budget shares in (17) sum to one, disturbances v_i must sum to zero across commodities for each observation. This leads to a singular covariance matrix and a breakdown in the estimation procedure. The problem may be overcome by estimating only two equations and obtaining estimates of the third equation from the adding-up constraints in (20).

Results of estimating the model with homogeneity and symmetry imposed are shown in table 8. Nearly all coefficients are significant at the 1% level. Expenditure coefficient b_i measures the effect of an increase in food expenditure on the budget share of the ith commodity. It is negative for necessities and positive for luxuries. Results in table 8 show that durum and bread wheat are necessities and that the "other food" composite commodity is a luxury. The composite commodity includes such items as meat and fruit, which usually are highly demand elastic.

Price and expenditure elasticities, given in table 9, are computed at the sample mean using the following formulas (Ray, 1980):

Table 8 Demand Parameter Estimates with Homogeneity and Symmetry Imposed.

	Durum Wheat S_1[b]	Bread Wheat S_2[b]	Other Food[a] S_3[b]
Constant	0.151 (1.4)[c]	0.210 (3.5)	0.639
Durum Wheat Price	0.0206 (3.7)	-0.0176 (-4.1)	-0.003
Bread Wheat Price	-0.0176 (-4.1)	0.0406 (10.4)	-0.023
"Other Food" Price	-0.003	-0.023	0.026
Real Income	-0.0257 (-1.01)	-0.0335 (-2.3)	0.040
R^2	0.18100	0.79000	
SSE[d]	0.00678	0.00362	

a) The coefficients of the "other food" equation are derived from the additivity restrictions;

b) s_i = budget share of the ith commodity; c) numbers in parentheses are t-statistics;

d) SSE = standard error of the regression.

Table 9 Price and Income Elasticities Obtained from the AIDS Model, SUR Estimation, 1966-1987

	Price elasticities			Income elasticity
	DW	BW	OF	
DW[a]	-0.463	0.016	0.507	0.361
BW[b]	-0.405	-0.089	0.163	0.275
OF[c]	-0.006	-0.028	-1.03	1.06

1) DW = Durum Wheat; b) BW = Bread Wheat; c) OF = Other Food

Own-price: $\epsilon_{ii} = -1 + g_{ii}/s_i - b_i$

Cross-price: $\epsilon_{ij} = g_{ij}/s_i - b_i\ s_j/s_i\ ;\ i \neq j$

Expenditure: $E_i = 1 + b_i/s_i$.

As expected, all own-price elasticities are negative and all expenditure elasticities are positive. However, cross-price elasticities indicate that durum and bread wheat are demand complements, a result that is difficult to explain. Own-price elasticities indicate that durum and bread wheat are quite demand-inelastic (-0.463 and -0.089, respectively). There are no prior estimates of demand price elasticities in Tunisia. Empirical evidence from other LDCs shows elasticity estimates for aggregate wheat ranging from -0.10 to -0.22 (Scandizzo and Bruce, 1980). For Morocco, a country similar to Tunisia in many consumption and dietary habits, durum and bread wheat demand elasticities estimated in a recent study were -0.575 and -0.70, respectively (World Bank, 1989).

Income elasticities (table 9) are in the normal range for staple foods such as wheat in a less developed country. The ones estimated here are slightly higher than those obtained from the Tunisian National Expenditure Survey (INS, 1985) and used by the Tunisian Government for planning purposes. The higher income elasticities in this study should be interpreted as representing demand for commercially marketed wheat through official channels and

not for home-grown and home-consumed wheat. Higher income elasticities are expected as a growing urban population switches from consuming own-produced wheat to retail-purchased wheat products.

An appealing feature of the AIDS model is that it allows explicit testing of the demand restrictions. For this purpose, the unrestricted model is also estimated and a likelihood ratio test is used to test for homogeneity and symmetry, i.e. for (21) and (22).[5] Only Slutsky symmetry is not rejected at the 5% level (table 10). This contradicts demand theory but agrees with the results of earlier food demand system estimates such as in Deaton and Muellbauer (1980), Blanciforti and Green (1983), and others. Deaton and Muellbauer (1984, p. 77) argue that rejection of homogeneity may be due to the neglect of habit effects in the specification of demand systems. This might especially be the case for a traditional food such as wheat in Tunisia. However, including habit effects requires a dynamic demand specification, which is not dealt with in the present study.

4.3 Estimating Policy Preference Weights

The method outlined in Chapter 3 is used to estimate the parameters of policy preference function (4') for the 1966-1987 period. Adding an error structure to equation (11) results in the following four-equation statistical

Table 10 Tests of Economic Theory Restrictions

H_0	-2Log LR[a]	df	Critical values 0.05	0.01
Homogeneity	19.154	2	5.99	9.21
Symmetry	1.79	1	3.84	6.63
Homog.& Symm.	22.0	3	7.81	11.34

a) LR = Likelihood Ratio

model:

$$\underline{\mathbf{Z}}\,\mathbf{B} + \underline{\mathbf{e}} = \underline{\mathbf{z}} \qquad (24)$$

where $\underline{\mathbf{Z}}$ is the 4T x 8 Jacobian matrix, $\mathbf{B}$ is 8 x 1, $\underline{\mathbf{z}}$ is 4T x 1, $\underline{\mathbf{e}}$ is 4T x 1 and T is the sample size. Each row of $\underline{\mathbf{Z}}$ represents partial derivatives of the PPF's utility arguments with respect to a given policy instrument, e.g. durum wheat producer price. The components of $\underline{\mathbf{z}}$ are the negative partial derivatives attached to the numeraire parameter. In the present study, the numeraire is w_3, the weight assigned to the linear portion of government utility. Vector $\mathbf{B} = (w_1, w_2, w_4, \ldots, w_9)$ represents the unknown weights constituting the parameters of the PPF. The components of $\underline{\mathbf{Z}}$ and $\underline{\mathbf{z}}$ are evaluated at observed levels of the policy instruments and constitute the data at hand for estimation.

The error term in (24) is interpreted as representing the uncertainty arising from the policy making process (Love, et. al, 1990). For example, policy makers could overstate or underestimate the economic and political power of some interest groups or could be uncertain about the appropriate weights to employ because of the stochastic nature of uncontrolled variables. Error components are assumed to be independent and identically distributed over time, but not necessarily across equations, with mean $\mathbf{0}$ and joint variance-covariance $\mathbf{V}$; that is

(25) $E(\underline{e}) = \mathbf{0}$

(26) $E(\underline{e}\underline{e}') = \mathbf{V}$

where "**0**" refers to a 4T x 1 vector of zeros and **V** is 4T x 4T matrix. Further, the Jacobian $\underline{Z}$ and errors $\underline{e}$ are assumed to be independent. Although $\underline{Z}$ is stochastic, the latter assumption ensures that the least squares estimator is still unbiased (Judge, p. 574). The model as it stands can be estimated by the GLS-SUR procedure (Zellner, 1962) with identical coefficients constrainted equal across equations.

The properties of the restricted Zellner estimator $\mathbf{B}^{\wedge}$ are:

(27) $\mathbf{B}^{\wedge} = (\underline{Z}'\mathbf{V}^{\wedge -1}\underline{Z})^{-1}\underline{Z}'\mathbf{V}^{\wedge -1}\underline{Z}$

(28) $E(\mathbf{B}^{\wedge}) = \mathbf{B}$

(29) $Vcov(\mathbf{B}^{\wedge}) = (\underline{Z}'\mathbf{V}^{\wedge -1}\ \underline{Z})^{-1}$

where **B** is the true vector of the PPF parameters and $\mathbf{V}^{\wedge}$ is an estimate of the unknown error variance-covariance matrix **V**. Since $\underline{Z}$ is stochastic, the estimated variance-covariance matrix (29) is conditional on a given $\underline{Z}$: the one evaluated at the observed policy instruments. Furthermore, the error structure $\underline{e}$ in (24) represents only uncertainties arising from the optimization process and not the uncertainties related to the constraints (1) and (2). Therefore, (29) is

unlikely to be a good approximation for the variance of the PPF weights (Love, et al., 1990). A resampling technique such as the bootstrap (Effron, 1979) offers a viable alternative for attaching standard errors to the PPF parameters and will be considered in the next section.

Point estimates of the parameters were obtained using the SUR procedure available in TSP 4.1. Estimation was performed for the 1966-1987 period, assuming constancy of the welfare weights over that period. This assumption is somewhat restrictive if policy preferences have in fact changed frequently.

Using the above procedure, the following policy preference function was obtained:

$$(30)\quad W = 0.535\ \mu_1 - 5.86\ \mu_2 + \mu_3 - 0.0091\ \mu_1^2 + 0.75\ \mu_2^2 - 0.024\ \mu_3^2 - 0.0001\ \mu_1\ \mu_2 - 0.0138\ \mu_1\ \mu_3 + 0.0244\ \mu_2\ \mu_3$$

The coefficients estimated here are those required in order for actual past prices to have maximized policy preference function (4'). Given these coefficients, we may calculate marginal social weights $sw_i = \partial W/\partial \mu_i$ and evaluate these at the observed levels. This is accomplished in table 11. For example, producer's social weight 0.0117 (column 1) is computed as

$$(31)\quad sw_1 = \partial W/\partial \mu_1 = .535 - 0.0182\ \mu_1(p_1,p_2) - 0.0001\ \mu_2(p_3,p_4) - 0.0138\ \mu_3(p_1,p_2,p_3,p_4)$$

where p_i are price policy instruments. The μ's in (31) are then evaluated at the sample means of observed price levels using equations (5), (6), and (7).

The sw_i in table 11 represent estimates of the government's relative weighting among various interest groups. Results show that, over the period 1966-1987, wheat consumers have been weighted more highly than the budget (taxpayers), which in turn has been weighted more highly than wheat producers. The latter group has been assigned a very small weight, indicating the government has been little concerned with producers' welfare during the sample period. Since the normalization rule ($w_3 = 1$) employed to obtain the above results is somewhat arbitrary, estimation was also carried out using different normalization rules (table 12). Estimated social weights were quite sensitive to the normalization rule, but the conclusion that consumers are the preferred group in the Tunisian PPF is still valid.

For a given level of social welfare, trade-offs among the welfares of various interest groups can be derived by equating the total differential of (30) to zero ($dW = 0$) and solving for $\partial \mu_i/\partial \mu_j$. Each trade-off is a function of the utility levels of the three interest groups. For example,

Table 11 Estimates of Social Weights and Trade-offs[a], Tunisia, 1966-1987

Social weights[b]			Trade-offs[c]		
Producer (sw_1)	Consumer (sw_2)	Government (sw_3)	P-G ($\partial\mu1/\partial\mu3$)	C-G ($\partial\mu2/\partial\mu3$)	C-P ($\partial\mu2/\partial\mu1$)
0.0117	0.809	0.0621	5.3	0.076	0.014

a) Social weights and trade-offs are calculated at the mean of observed levels of the policy instruments.

b) sw_1, sw_2, and sw_3 are, respectively, social weights for producers, consumers, and government.

c) P-G, C-G, and C-P are producer-government trade-off, consumer-government trade-off, and consumer-producer trade-off, respectively.

Table 12 Social Weights Corresponding to Various Normalization Rules[a]

Normalization[b]	Social Weights		
	Producer sw_1	Consumer sw_2	Government sw_3
$w_1=1$	-0.0002	0.004	0.00005
$w_2=1$	0.00003	0.028	-0.00003
$w_3=1$	0.0117	0.809	0.0620
$w_4=1$	0.0062	0.035	0.0005
$w_5=1$	-0.00003	0.0112	0.0005

a) The normalization rule is to set one of the PPF parameters in equation (4') equal to one so that the partial derivatives attached to it in (9) can be removed to the right hand side.

b) w_1, w_2, w_3, w_4, and w_5 are PPF parameters as defined in (4').

$$\partial\mu_2/\partial\mu_3 = - \frac{(1 - 0.048\ \mu_3 - 0.0138\ \mu_1 + 0.0244\ \mu_2)}{(-5.86 + 1.5\ \mu_2 - 0.0001\ \mu_1 + 0.0244\ \mu_3)}$$

Table 11 gives the trade-offs calculated at the sample mean of policy instruments' observed levels. They indicate that the Tunisian government is willing to transfer one util's worth of its budget to help consumers even if that transfer generates only an increase of 0.076 utils in consumer welfare. However, the same transfer is acceptable only if it generates an increase of at least 5.3 utils in producer welfare.

These results support and quantify a strong consumer bias in Tunisian price policy. That is, the Tunisian policy process strongly favors consumers' interests over producers' interests. Similar results have been found for other less developed countries (Lutz and Scandizzo, Bale and Lutz, World Bank, 1986). For example, in a cross-country analysis of wheat price policy, Byerlee and Sain (1988), using a nominal protection coefficient approach (NPC), presented strong evidence of widespread bias toward urban consumers in LDCs. They reported in Tunisia an NPC of 0.30 for consumers and 0.80 for producers.[6] Sarris and Freebairn (1983) used a policy preference function approach to derive group welfare weights in the main wheat trading countries. Their evidence for North Africa and Middle East countries indicates that consumers, producers, and the government treasury are

equally weighted. However, estimates in Sarris and Freebairn correspond to an aggregate regional level and are likely to depart from those obtained for individual countries. This is particularly true for regions which include countries of quite different price policy regimes.

In developed countries, most policy preference function studies indicate the decision-making process favors producer surplus over consumer surplus or budget cost (Oehmke and Yao, 1990; Oskam and Witzke, 1990; Love and Rausser, 1988). For example, Oehmke and Yao report for U.S. wheat the relative weights of 0.4, 1.4, and 1.0 for consumers, producers, and taxpayers, respectively.

The contrast in preference ordering between developed and less developed countries is best explained by the political-economic structure underlying the policy preference function. As explained above, the PPF is a reduced form representation of a political-economic equilibrium reached through a process of deliberation and interaction between interest groups. Policies government chooses are determined by the bargaining power of these groups and by the government's response to the pressures exerted by such groups (Zusman, 1977). In LDCs, where the food budget constitutes a large share of total expenditure, urban consumers are more willing than in developed countries to spend resources to influence policy favoring low consumer prices. By contrast the rural sector in LDCs is highly

diversified with high organizational and informational cost and is therefore less willing to exert pressure to influence policies in its favor. Consequently, LDC policies value consumers more highly than producers. As a nation develops and food becomes a smaller component of total expenditure, urban consumers become less willing to spend resources to influence policies. The agricultural sector, however, becomes a smaller component of the economy and more specialized, so that farmers face low organizational and lobbying costs and become more willing to influence policies that subsidize food production (Bates, 1983).

Official wheat prices in Tunisia are set annually by an inter-ministerial pricing committee. Involved in the deliberations of this committee are: the parastatal agency (Office des Cereales), the Prime Ministry, Ministry of Agriculture, Ministry of Finance, and the National Union of Producers (UNA). Producers' interests are represented by the UNA and the Ministry of Agriculture, which generally support proposals to raise producer prices based on production costs. The Ministry of Finance and Office des Cereales insure that the agreed prices do not strain the Government's budget and generally favor policies of higher consumer prices. However, each Ministry involved in this pricing procedure is aware of the social and political impact of high consumer prices. Urban consumers constitute a large group, highly organized through syndicates and other

legal institutions, and capable of influencing inter-ministerial decisions. The political significance of the urban block was recently demonstrated in Tunisia, when bread prices were increased and subsidies eliminated (1984). Following the announcement of the policy, widespread social unrest caused the government to reverse its decision to raise bread prices.

4.4 Estimating Standard Deviations of PPF Weights

No information was given in the previous section on the reliability of the PPF parameter estimates. Calculated parameters $\hat{\mathbf{B}}$ are functions of stochastic variables, namely the Jacobian $\underline{\mathbf{Z}}$ and the vector $\underline{\mathbf{z}}$, and therefore are stochastic. $\underline{\mathbf{Z}}$ is stochastic because it involves welfare measures (e.g producer surplus) that are functions of random regression coefficients obtained when the supply and demand models are estimated. Given the stochastic nature of the PPF, measures (such as standard errors) of the reliability of the estimated welfare weights should be calculated so that statistical inferences, including hypothesis tests, can be made.

Estimates of parameter variances obtained from regressing equation (24) are conditional on a given $\underline{\mathbf{Z}}$. The only way to obtain unconditional variance estimates of the PPF weights is to use the bootstrap by reasampling from the

constraint error structures (Love, et al., 1990).

The bootstrap is a computer-based statistical procedure for estimating standard errors of an estimator by resampling the data at hand (Effron, 1979). The main idea is to resample the residuals obtained from fitting a statistical model and generate pseudo-data to which the model is refitted a large number of times. This generates an empirical distribution of the estimates which can approximate the statistical uncertainty associated with the parameters' estimates (Freedman and Peters, 1984). The technique has been used in applied welfare analysis to construct confidence intervals for welfare measures derived from demand functions (Kling and Sexton, 1989). Love, Rausser, and Burton (1990) discussed application of the bootstrap in policy preference function studies and is the method used here.

A bootstrap technique for estimating standard errors of PPF parameters includes the following steps :

1. Residuals $u_t = (u_{1t}, u_{2t}, u_{3t})$ and $v_t = (v_{1t}, v_{2t})$, $t = 1,...T$, are computed from the estimated supply (23) and demand (17) equations. Let $\mathbf{m}_1$ and $\mathbf{m}_2$ be the respective empirical distribution of u_t and v_t, where each u_t and v_t is assigned a probability mass of 1/T.

2. Five hundred random draws of $u_t^* = (u_{1t}^*, u_{2t}^*, u_{3t}^*)$ and

$v_t^* = (v_{1t}^*, v_{2t}^*)$ with replacement are made from the empirical distributions $\mathbf{m}_1$ and $\mathbf{m}_2$ and used to create 500 pseudo-data samples $q_t^{s*} = (q_{1t}^{s*}, q_{2t}^{s*}, q_{3t}^{s*})$ and $s_t^* = (s_{1t}^*, s_{2t}^*)$, t = 1,...T. For example, q_{1ts}^* is generated as:

$$q_{1t}^{s*} = c_{01} + \lambda_1 q_{1t-1}^* + c_{11} p_{1t}^s + c_{12} p_{2t}^s + d_1 p_t^f + f_1 r_t + u_{1t}^*$$

where the parameters c_{01}, λ_1, c_{11}, c_{12}, d_1, f_1 are set at their estimated values. Policy variables p_{1t}^s, p_{2t}^s and other exogenous variables are held fixed at their observed values.

3. For each pseudo-sample, new supply and demand parameters are estimated using the original estimation procedure, that is by regressing the starred variables q_t^{s*} and s_t^* on the given policy and exogenous variables. In this way, 500 sets of supply parameters and 500 sets of demand parameters are obtained.

4. Each set of new supply and demand coefficients is utilized to compute the utility of each interest group in the PPF and for each set, a new jacobian $\underline{\mathbf{Z}}^*$ is formed out of the PPF's first order conditions. The Jacobian $\underline{\mathbf{Z}}^*$ is, in turn, used to estimate new PPF parameters $\underline{\mathbf{B}}^{\hat{}*}$ and new group social weights $\mathbf{sw}^*$ (see step 2 and 3 in section 3.2). This procedure results in 500 sets of parameters $\mathbf{B}^{\hat{}*} = (w_1, w_2, w_4,$

w_5, w_6, w_7, w_8, w_9) and 500 sets of derivatives $\mathbf{sw}^* = (sw_1, sw_2, sw_3)$.

5. The mean and the variance of $\hat{B}^*$ and $\mathbf{sw}^*$ generated from the process above are calculated as

$$\begin{aligned} \bar{\hat{\mathbf{B}}}^* &= \Sigma_n (\hat{\mathbf{B}}_n^*)/500, \qquad n = 1, \ldots, 500 \\ \mathrm{var}(\hat{\mathbf{B}}^*) &= \Sigma_n (\hat{\mathbf{B}}_n^* - \bar{\hat{\mathbf{B}}}^*)^2/499 \\ \bar{\mathbf{sw}}^* &= \Sigma_n (\mathbf{sw}_{n*})/500 \\ \mathrm{var}(\mathbf{sw}^*) &= \Sigma_n (\mathbf{sw}_{n*} - \bar{\mathbf{sw}}^*)^2/499 \end{aligned} \tag{31}$$

The square root of the variance of $\hat{\mathbf{B}}^*$ and $\mathbf{sw}^*$ are used to estimate the standard error of the point estimates of $\hat{\mathbf{B}}$ and $\mathbf{sw}$ and to conduct hypothesis testing.

The five steps above were performed using the Monte Carlo Analysis option in TSP 4.5. A problem in the bootstrap procedure is that some trials produce inconsistent parameters, yielding implausible arguments for interest group utilities. For example, randomly selected negative own-price supply slopes may lead to negative producer surpluses (ps), in which case producer utility (log{ps}) is undefined. To avoid such a breakdown, utility function arguments were restricted to be positive. Only trials resulting in positive utility arguments were used to compute statistics (26). Solutions were checked at the 300th and 400th trials to be sure there would be a sufficient number of

successful ones and that additional trials would not change significantly the estimated means and variances.

Results of the bootstrap are shown in table 13. Standard errors are large, indicating the estimated policy preference function parameters and estimated social weights are not precise and should be interpreted with care.[7] For example, standard errors of producer and consumer social weights (column 4) are of the same magnitude as the associated point estimates. Government's social weight (sw_3) is, however, significantly different from zero at the 1% level.

Although individual PPF parameters do not appear to be measured with high accuracy, this does not imply that the parameters are not uninformative. Table 14 shows results of two hypothesis tests concerning groups of PPF parameters. The hypothesis that all parameters of the PPF equal zero (hypothesis 1) is rejected at the 1% level, suggesting that interest groups as specified are of some importance in explaining government price-setting behavior. The hypothesis that all quadratic and interaction term parameters of the PPF equal zero (hypothesis 2) also is rejected at the 1% level. This suggests the Tunisian government PPF has a non-utilitarian form, that is welfare consists of more than the simple sum of interest group utilities.

Table 13 Point Estimates and Standard Errors of the PPF Parameters

PPF Parameters (equation 4')		Social Weights ($sw_i = \partial W/\partial \mu_i$)	
Point Estimates[a]	S. Errors[b]	Point Estimates[a]	S. Errors[b]
$w_1 = 0.536$	0.810	$sw_1 = 0.0117$	0.0126
$w_2 = -5.87$	6.700	$sw_2 = 0.809$	0.8340
$w_4 = 0.0091$	0.021	$sw_3 = 0.062$	0.0140
$w_5 = 0.7517$	0.900		
$w_6 = -0.024$	0.0045		
$w_7 = -5\ 10^{-4}$	0.018		
$w_8 = -0.0068$	0.007		
$w_9 = 0.0122$	0.0095		

a. Estimates obtained from the original regressions.

b. Standard Error estimates from the Bootstrap.

Table 14 Joint Hypothesis Testing about the PPF Parameters

Null Hypothesis	Test Statistic (χ^2)[a]	j
1) H_0: w1 = w2 = w4 = ... = w9 = 0	2703.52	8
2) H_0: w4 = ...= w9 = 0;	1203.76	6

a) General linear hypotheses about the k elements of the parameters' vector B can be written as:

$$RB = r$$

where R is jxk and r is jx1, and j is the number of parameters under test. In hypothesis (1), R is an 8x8 identity matrix and r is an 8x1 null vector. Under the null hypothesis, the statistic $(RB-r)'(R\ V\ R')^{-1}(RB-r)$ is distributed chi-square with j degrees of freedom, where V is the variance-covariance matrix of B obtained (in our case) from the bootstrap procedure.

Endnotes of Chapter 4

1. The linear and other forms were also tested. The results, however, favor the logarithmic form in terms of both goodness of fit and the significance levels of the coefficients.

2. Different specifications of the rainfall variable was tried, based on various combinations of seasonal rainfalls. However, planting season rainfall was found to contribute better to the overall fit of the supply equations. Also, see Ben Senia (1980) for a more detailed analysis of the rainfall variable.

3. The Zellner estimator yields no efficiency gains over OLS if (1) the error terms are uncorrelated across equations or (2) the explanatory variables are the same in different equations (Johnson, 1984, p. 338). The error terms are likely to reflect some common omitted variables and u_j in (20) are correlated across equations. However the explanatory variables are the same in all three equations except for the lagged variables. Small efficiency gain is therefore expected in our case from using SUR over OLS, but the imposition of restrictions across equations certainly calls for the use of the former technique.

4. Fertilizers are marketed also by the parastatal OC and prices are set by government. Recognizing that this activity is more suitable for the private than the public sector, the government has recently increased fertilizer prices to encourage private businesses to take over the fertilizer distribution network.

5. The likelihood ratio is computed as

$$l = \frac{\text{max. value of the likelihood function restricted}}{\text{max. value of the likelihood function unrestricted}}$$

The statistic -2 Ln l is distributed as Chi-square with degrees of freedom equal to the number of restrictions (Judge et.al, 1988, p.105)

6. Although the consumer bias is strong, Byerlee and Sain found no evidence of price policy discrimination against wheat producers, contradicting earlier analyses in this area. They conclude, " the significant finding of this study is that in only a few countries has the policy been implemented at the direct expense of producers. In most

cases, explicit government fiscal subsidies to consumers have played a much larger role than low producer prices in urban cheap food polices." The analysis, however was done for the 1980s, a period in which many developing countries have increased domestic producer prices significantly.

7. Most policy preference function studies (i.e Sarris and freebairn, 1974; Oehkme and yao 1989;) do not to attach standard errors to the point estimate weights. Fulton, Murray and Karp, among the few, estimated standard errors of PPF parameters. Due to a small sample size, most coefficients are, however, found to be insignificant.

CHAPTER 5

SENSITIVITY ANALYSIS AND ALTERNATIVE PRICE POLICIES

This chapter is divided into three sections. In section 5.1 the robustness of the estimated PPF is examined by showing the sensitivity of social preferences to variations in structural model parameters. In section 5.2, the estimated PPF is used to determine sensitivity of optimal policy instrument values to changes in selected exogenous variables. Finally, section 5.2 demonstrates the use of the PPF in conducting public policy analysis. Alternative policy regimes are formulated and their welfare effects analyzed in terms of the estimated social criterion function.

5.1 Sensitivity of Social Preferences

The social weights attributed to identified social groups are estimated given the structural supply and demand model assumed for the Tunisian wheat sector. However, supply and demand elasticity estimates are not known with certainty; and the preference structure revealed by the the policy preference function might change according to assumptions about the values of these elasticities. To reflect this uncertainty, producer, consumer, and government

social weights are estimated with own-price coefficients of supply and demand set alternately at one-half standard error below and above the estimated sample mean values. Results are reported in table 15.

Social weights are moderately sensitive to changes in demand and supply parameters. For example, increasing durum wheat demand elasticity from 0.46 to 0.53 raises the estimated weights from 0.117 to 0.183 for producers, and from 0.809 to 0.98 for consumers, and decreases that of government from 0.0620 to 0.0520. Results are much more sensitive to changes in supply elasticities. Producers' weight, for example, changes from a positive to a negative value as durum wheat supply elasticity increases from 2.17 to 2.77. Note, however, that this movement in weights is not of a magnitude to change the qualitative results of our Tunisian government price policy, namely that consumers are weighted more highly than the government budget, which in turn is weighted more highly than producers.

5.2 Sensitivity of Optimal Prices to Exogenous Shocks

The problem facing policy makers is to choose the level of policy instruments $p^s = (p_1^s, p_2^s)$ and $p^d = (p_1^d, p_2^d)$ so as to maximize the policy preference function subject to the constraints of the estimated econometric wheat model. That is

Table 15 Response of Social Weights to Elasticity Changes[a]

Elasticity		Social Weights[b]		
		sw_1	sw_2	sw_3
τ_{11}	0.39	0.0198	0.0270	0.0263
	0.46	0.0117	0.8090	0.0620
	0.53	0.0183	1.0700	0.0307
τ_{22}	0.048	0.0174	0.5450	0.0486
	0.089	0.0117	0.8090	0.0620
	0.132	0.0132	0.9740	0.0639
ϵ_{11}	1.57	0.0399	0.4370	0.0029
	2.17	0.0117	0.8090	0.0620
	2.77	0.0900	0.9800	0.0960
ϵ_{22}	2.00	0.0190	0.8580	0.0520
	2.52	0.0117	0.8090	0.0620
	3.12	0.0089	0.7200	0.0310

a) τ_{11} is durum wheat demand elasticity; τ_{22} is bread wheat demand elasticity; ϵ_{11} is durum wheat supply elasticity; ϵ_{22} is bread wheat supply elasticity.

b) sw1, sw2, and sw3 are the social weights of producers, consumers, and government, respectively.

$$\max W_t = W\{\mu_{1t}(p_t^s,\ z_t^s),\ \mu_{2t}(p_t^d,\ z_t^d),\ \mu_{3t}(p_t^s,\ p_t^d,\ z_t^s,\ z_t^d)\}$$

$$\text{(31)} \qquad \text{s.t } q_t^s = S(p_t^s,\ z_t^s,\ u_t)$$

$$q_t^d = D(p_t^d,\ z_t^d,\ v_t)$$

where μ_1, μ_2, and μ_3 are utilities of interest groups; q_s = $(q_1^s,\ q_2^s)$ and $q^d = (q_1^d,\ q_2^d)$ are quantities of wheat supplied and demanded; $z^s = (z_1^s,\ z_2^s)$ and $z^d = (z_1^d,\ z_2^d)$ are vectors of exogenous variables affecting supply and demand, respectively; $u = (u_1,\ u_2)$ and $v = (v_1,\ v_2)$ are vectors of random errors; and the subscripts 1 and 2 refer to durum wheat and bread wheat, respectively. When policy preference function W is quadratic in the policy variables and the constraints are linear, maximization problem (31) can be solved for each policy instrument as a linear expression of the exogenous variables (Intriligator, 1978, p. 546). These linear expressions are known in the literature as linear decision rules since they permit decision makers to form linear predictions of the effects of changes in the exogenous variables (shocks) on the optimum prices.

Policy preference function W in this study is quadratic in the utilities but not in the policy variables. Consequently, analytical expressions for decision rule equations are not possible. Instead, responses of optimum prices to changes in exogenous shocks are determined

numerically using GAMS (1982), in which equation (31) is viewed as a nonlinear mathematical programming problem. First, numerical solutions are obtained for optimum p^s and p^d levels where all variables included in the wheat sector model are set at their 1965 -1987 mean values. Then, new optimum prices are computed after changing the value of one exogenous variable, ceteris paribus. The difference in the resulting optimum price values for the two simulations can be attributed to the particular exogenous variable that has changed.

Table 16 shows the effect on optimum prices of selected exogenous variable changes. Six exogenous shocks are considered: in the world price of durum wheat, p_1^w; in the world price of bread wheat, p_2^w; in fertilizer price p^f; in the price p^{of} of other foods; and in consumer food expenditure y. Results suggest that price policies are more responsive to domestic conditions than to world prices. World prices of both durum and bread wheat have only a negligible effect on the level at which the Tunisian government chooses to set domestic prices. This suggests the government seeks to isolate the domestic from the international market in order to enforce, for example, low consumer prices.

The elasticity with respect to fertilizer is positive for both producer prices p_1^s and p_2^s, implying that an increase in fertilizer price induces the government to

Table 16 Elasticity of Price Policies with Respect to Exogenous Shocks

	Price Policies			
Shocks	p_1^s	p_2^s	p_1^d	p_2^d
p_1^w	$0.2\ 10^{-3}$	$0.42\ 10^{-3}$	$0.67\ 10^{-3}$	$-0.9\ 10^{-3}$
p_2^w			$0.48\ 10^{-3}$	
p^f	0.32	0.15	0.0	
p^{of}			-0.12	$-0.2\ 10^{-3}$
y			1.0	0.46

increase producer prices for durum wheat and bread wheat. Hence, the government tends to protect producers from an increase in production costs. Results also suggest the government-announced consumer prices p_1^d and p_2^d are positively related to consumer income y. A one percent increase in consumer income leads to a one percent increase in durum wheat consumer price and to a 0.46% increase in bread wheat consumer price. Durum wheat is more income-elastic than bread wheat, that is, more responsive to income changes. An increase in other food prices p^{of}, on the other hand, has a small negative effect on both durum and bread wheat consumer prices. Government appears to respond to an increase in the "other food" price index by lowering consumer wheat prices, thereby compensating consumers for, or protecting them from, these other price changes.

5.3 Evaluation of Alternative Price Policies

The estimated policy preference function (PPF) can be a useful tool in evaluating price policies within a framework consistent with policy maker preferences. The PPF is readily used to evaluate alternative policy proposals, given the social values and preferences embodied in the estimated PPF parameters. One policy is considered superior to another if the PPF level W of the first is higher than that of the second. The ordinality of W makes it possible to

identify social preferences but not necessarily welfare levels.

As explained in chapter 2, wheat policy in Tunisia takes the form of government control over prices and trade through the parastatal agency Office des Cereales (OC). The OC purchases wheat from producers at a fixed price and sells it to private processors at a (generally lower) fixed price. The discrepancy between the OC's purchase price plus marketing costs and the OC's selling price is paid to the OC as a subsidy from the public treasury.

Cereal subsidies have grown sharply in recent years (168 million dinars in 1988) and government is looking for ways to reduce the cost burden of these subsidies. Options for reducing government intervention costs include increasing consumer prices, cutting producer prices, or increasing efficiency of the marketing services provided by OC. In this section, various alternative price policies are formulated and evaluated in terms of their effects on the level of social welfare W. In particular, three policies are examined: (1) "free trade" or a no-subsidy price policy, (2) complete removal of durum wheat subsidies, and (3) removal of durum wheat subsidies and a fifty percent reduction in bread wheat subsidies.

The free trade policy employs the small-country assumption, so that the world price is assumed to prevail in the domestic economy at the official exchange rate. In this

setting, government follows the border price paradigm and sets producer durum and bread prices p_1^s and p_2^s at their respective world prices p_1^w and p_2^w (CIF Tunis). The public agency (OC) buys the marketed supply, sells it to processors at full cost, and imports the excess demand at the prevailing world price. Selling price p^d is therefore equal to the fixed producer price p^s plus marketing margins (mc). For this scenario, no direct government subsidies are required. Average marketing (storage, transport, and interest) costs are assumed constant and estimated at 14 Tunisian dinars (TD) per ton (Newman, et. al, 1989).

Tunisian decision makers have in the past been reluctant to remove bread wheat subsidies because of bread's significance as a staple food for politically important urban populations. In the short run, therefore, proposals for policy reform should assume that bread wheat subsidies will continue. Hence, option 2 considers only the removal of subsidies on durum wheat consumption; subsidies on bread wheat consumption are maintained at current levels. That is, p_1^d is set equal to p_1^s plus marketing margins mc; all other policies are unchanged.

Option 3 assumes complete removal of durum wheat and a 50% cut in bread wheat subsidies. This permits policy makers to contemplate a policy change within a longer-run context than option 2.

Price levels identified in each such policy scenario

affect the welfares of producers, government, and consumers according to equations (5), (6), and (7), respectively. Interest group utility values then are used in (30) to compute the social welfare corresponding to each policy. Results are reported in table 17.

The current policy, which has consumer prices set below producer prices, and implies a unit subsidy of TD 25.74 for durum wheat and TD 26.17 for bread wheat, dominates all other options with a PPF evaluation of 3.054. This is not surprising since the policy preference function was estimated on the basis of the revealed preference assumption, namely that observed policies are optimal.

The second best policy is option 2, which generates a social welfare level of 3.050. This policy fixes a unit subsidy of TD 26.17 for bread wheat and no subsidy for durum wheat. As expected, removal of durum wheat subsidies in this scenario increases government utility, decreases consumer utility, and has no effect on producer utility.

The least favored option is the free trade one (no government subsidy), where implied social welfare is 3.045. Compared to the existing situation, government utility increases, while that of consumers and producers decreases. Note that producer welfare has decreased because, in the existing situation, producer prices are higher than those that prevail in a free trade option.

Policy analysis using a policy preference function

Table 17 Evaluation of the Social Desirabilty of Alternative Price Policies in Terms of the Policy Preference Function W

	Social Welfare W	Interest group's welfare		
		$\mu 1$	$\mu 2$	$\mu 3$
Existing policies[a]	3.054	15.684	4.301	18.033
p_1^s= 72.15 (TD/t) p_2^s= 65.88 p_1^d= 60.41 p_2^d= 53.17				
Free Trade[b]	3.045	15.676	4.287	18.315
p_1^s= p_1^w= 72.90 p_2^s= p_2^w= 58.38 p_1^d= p_1^s+mc= 86.90 p_2^d= p_2^s+mc= 72.38				
Subsidy reduction (option 2)	3.050	15.684	4.293	18.198
p_1^s= 72.15 p_2^s= 65.88 p_1^d= p_1^s+mc= 86.15 p_2^d= 53.17				
Subsidy reduction (option 3)[c]	3.048	15.684	4.290	18.276
p_1^s= 72.15 p_2^s= 65.88 p_1^d= 86.15 p_2^d= 66.52				

a) p_1^s and p_2^s are producer durum wheat and bread wheat price; p_1^d and p_2^d are consumer durum wheat and bread wheat price; prices are in Tunisian dinars per ton (TD/t) and set at their 1966-1987 mean values;
b) World prices p_1^w and p_2^w are import prices (CIF Tunis) in Tunisian dinars per ton (TD/t).
c) In option 3, consumer bread wheat price is increased such that 50% of current bread wheat subsidies are removed.

framework should, however, be interpreted with caution. Estimated policy preference function weights reflect the current structure underlying government policy formation. Decision structures other than the current one would imply different relative weighting of the various interest groups in the PPF. Thus, social evaluation of alternative policies based on a revealed preference criterion function will always be biased toward policies that mimic the current situation. As shown above, because of the high social weight attached to consumers, any proposal that makes consumers worse off (for example, the free trade scenario) would most likely be ranked less favorably than the original policy. Successful price policy reforms should therefore be accompanied by institutional reforms that tend to change the weights in the PPF. As Rausser (1990, p.651) points out, price reforms prescribed by an outside government body (such as "getting the prices right") would be short-lived if weights in the PPF remain unchanged. The underlying bargaining power pattern reflected in those weights tends to move government policies back to the previous policy equilibrium.

CHAPTER 6

SUMMARY AND CONCLUSIONS

The purpose of this study has been to estimate a policy preference function (PPF) that explains wheat price policy in Tunisia. It has been postulated that the Tunisian government sets policy instrument levels as though it seeks to maximize a policy preference function. Arguments of this function are the interests of the government marketing agency and of durum and bread wheat producers and consumers. The revealed-preference econometric approach was used to infer interest groups' social weights from actual government pricing behavior.

Results reported in this study quantify, and lend support to, the stylized fact that price policies in Tunisia and most LDCs are biased toward urban consumers. That is, the political decision process revealed in the estimated policy preference function favors consumer interests over those of producers or taxpayers. Results indicate that, on average during the 1966-1987 period, the Tunisian government has been willing to transfer one util's worth of its budget to consumers in order to increase consumer welfare by only 0.076 util. Government is willing to transfer a util's worth of its budget to producers only if this generates a 5.3 util increase in producer welfare.

A major contribution of this study is the use of an indirect utility function as a measure of consumer well-being instead of the controversial, and most often used, Marshallian consumer surplus. For this purpose, Tunisian wheat is specified as an Almost Ideal Demand System (AIDS), for which a closed-form indirect utility function is known to exist.

The bootstrap technique is employed to estimate standard errors of the PPF weights and to permit tests of hypotheses about the structural form of the policy criterion function. The utilitarian (additive utility) form of PPF is rejected as a description of the price formation process in Tunisia.

Numerical estimates also are obtained of price policy responses to exogenous economic shocks. Results show that changes in world prices have only negligible effects on domestic wheat price policies, suggesting that the Tunisian government seeks to insulate domestic policies from world prices. Price policies are, however, responsive to variables such as fertilizer prices and consumer income affecting domestic supply and demand conditions.

The PPF estimated in this study was used to assess alternative price policies aimed at reducing government subsidies. Given current social weights, results indicate that social welfare is highest under current policies. A move toward free trade is the least desirable because of the

negative welfare impact it would have on consumers, whose current social welfare weight is quite high. This underlines the importance of altering relative social weights before a move to (more efficient) free trade becomes politically feasible.

The PPF is a useful tool for conducting policy analysis within a framework consistent with policy maker preferences. However, one must keep in mind that a move from one policy to another may entail relative changes in groups' bargaining power and thus changes in policy preference function weights. Hence, policy recommendations made on the basis of constant PPF weights may be inappropriate.

Nevertheless, this study's framework is a step toward a utility-based model in which policy weights can be made endogenous, that is, functions of the policy instruments. Recent advances in game-theory frameworks may prove useful in this context. The present model also might be expanded to include other objectives in the government's policy criterion function. Objectives such as self-sufficiency, price stability, and hard currency earnings are important in most developing countries, and policy choices clearly imply a trade-off among these objectives.

Finally, the model may be expanded to consider specified income groups and related commodity markets. In Tunisia, such markets might include sugar and edible oil, prices of which also are set by government. Dividing

consumers into several income categories might permit differential social weighting among these income groups.

BIBLIOGRAPHY

Bale, M., and E. Lutz. "Price Distortions in Agriculture: An International Comparison." American Journal of Agricultural Economics 63(1981):8-22.

Banque Nationale de Tunisie. Statistique Financieres (Various Issues).

Bates, R. Markets and States in Tropical Africa: The Political Bias of Agricultural Policies. Berkeley: University of California Press, 1981.

Becker, G. S. "A Theory of Competition Among Pressure Groups for Political Influence." Quarterly Journal of Economics XVIII(1983): 371-399.

Beghin, J. C. "A Game-Theoretic Model of Endogenous Public Policies." American Journal of Agricultural Economics 72(1990): 138-148.

Ben Senia, M. Supply Response of Cereals in Tunisia. Ph.D Dissertation, University of Minnesota, 1980.

Blanciforti. L., and R. Green. "An Almost Ideal Demand System Incorporating Habits: An Analysis of Expenditures on Food and Aggregate Commodity Groups." The Review of Economics and Statistics(1983): 511-515.

Braverman, A., C. Young Ahn, and J. Hammer. Alternative Agricultural Pricing Policies in the Republic of Korea. WorldBank Staff Paper No. 621, 1982.

Buccola, S. T., and C. Sukume. "Price and Stock Policy in Developing Economies: Interaction Effects and Welfare Preference." Working Paper, Dept. of Agricultural and Resource Economics, Oregon State University, Corvallis (1989).

Buccola, S. T., and C. Sukume. " Optimal Grain Pricing and Storage Policies in Controlled Agricultural Economies: Application to Zimbabwe." World Development 16(1988): 361- 371.

Buccola S. T. "Social Welfare and Interpersonal Comparisons in Applied Policy Research." American Journal of Agricultural Economics 70(1988): 454-458.

Byerlee, D., and G. Stain. "Food Pricing Policy in Developing Countries: Bias Against Agriculture or for Urban Consumers?" American Journal of Agricultural Economics 68 (1986): 961-969.

Cleaver, K. The Impact of Price and Exchange Rate Policies on Agriculture in Sub-Saharan Africa. World Bank Staff Working Paper No. 728, 1985.

Cochrane, W. W. "Some Nonconformist Thoughts on Welfare Economics and Commodity Stabilization Policy." American Journal of Agricultural Economics 62 (1980): 508-511.

Currie, J. M., J. Murphy, and A. Schmitz. "The Concept of Economic Surplus and its Use in Economic Analysis." Economic Journal 81(1971).

Deaton, A. and J. Muellbauer. Economics and Consumer Behaviour. Cambridge University Press, 1980.

Deaton, A. and J. Muellbauer. "An Almost Ideal Demand System." American Economic Review 70(1980): 312-326.

Donaldson, D. "On the Aggregation of Money Measures of Well-Being in Applied Welfare Economics." Discussion Paper NO. 90-12, Dept. of Economics, University of British Columbia, Vancouver, Canada, 1990.

Effron, B. "Bootstrap Methods: Another Look at the Jacknife." Annals of Statistics 7(1979): 1-26.

Freedmon, D., and S. C. Peters. "Bootstrapping a Regression Equation: Some Empirical Results." Journal of the American Statistical Association 79(1984):97-106.

Fulponi, L. "The Almost Ideal Demand System: An Application to Food and Meat Groups for France." Journal of Agricultural Economics 40(1980): 82-92.

Fulton, M., and L. Karp. "Estimating the Objectives of a Public Firm in a Natural Resource Industry." Journal of Environmental Economics and Management 16(1989):268-87.

Gardner, B. The Economics of Agricultural Policies. MacMillan Publishing Company, New York, 1987.

Gardner, B. "Economic Theory of Farm Politics." American Journal of Agricultural Economics 71(1989): 1166-1171.

Gerrard, C. D., and T. Roe. "Government Intervention in Food Grain Markets: An Econometric Study of Tanzania." Journal of Development Economics 12(1983): 109-132.

Institut National des Statistique. Enquète National sur le Budget et la Consommation des Ménages en Tunisie-1985. Tunis, 1985

Institut National des Statistique. Enquète National sur le Budget et la Consommation des Ménages en Tunisie-1980. Tunis, 1980.

International Monetary Fund (IMF). International Financial Statistics (Various Issues).

Intriligator, M. D. Econometric Models, Techniques, and Applications. Prentice-Hall, Inc., Englewood Cliffs, N.J., 1987.

Johnston, J. Econometric Methods, 3rd Edition (McGraw-Hill, New York, 1984).

Judge G. G., R. C. Hill, W. Griffiths, H. Lutkepohl, and T. Lee. Introduction to The Theory and Practice of Economics. John Wiley & Sons, Inc., 1988.

Kling, C., and R. Sexton. "Bootstrapping in Applied Welfare Analysis." American Journal of Agricultural Economics 72(1990): 407-418.

Laraki, K. Food Consumption and Food Subsidies in Morocco: Justification of Policy Reform. Ph.D Dissertation, Cornell University, 1988.

Love, H. A., G. C. Rausser, and D. M. Burton. "Policy Preference Functions: Grand Themes and New Directions." Working Paper, Dept. of Agricultural and Resource Economics, Oregon State University, Corvallis, 1990.

Love, H. A., and G. C. Rausser. "Flexible Public Policy: The Case of the U.S. Wheat Sector." Working Paper, Dept. of Agricultural and Resource Economics, Oregon State University, Corvallis, 1988.

Lutz, E., and P. Scandizzo. "Price Distortions in Developing Countries: A Bias Against Agriculture." European Review of Agricultural Economics 7(1980):5-27.

Mckenzie, L. "Demand Theory Without a Utility Index." Review of Economic Studies 24(1974): 185-189.

Newman M. D., and M. Boughazala. "What Role for Public and Private Sectors in Tunisia's Grain Assembly and Imports Markets." Paper Presented at a Conference on Agricultural Policy Reform In Tunisia, Tunis, 1989.

Nowshirvani, V. "A Note on the Elasticity of the Marketed Surplus of a Surplus Crop-- A Comment." Indian Journal of Agricultural Economics XXII(1967): 110-114.

Oehmke, J. F., and X. Yao. "A Policy Preference Function for Government Intervention in the U.S. Wheat Market." American Journal of Agricultural Economics 72(1990):631-640.

Oskam, A., and H. Witske. "Agricultural Policy Preferences: Wheat in the United States." Paper Presented at the American Agricultural Economics Association Annual Meetings, University of British Columbia, Vancouver, 1990.

Peterson, W. L. "International Farm Prices and the Social Costs of Cheap Food Policies." American Journal of Agricultural Economics 61(1979): 12-21.

Pfost, H., R. Dahl, W. Thornburrow, and K. Steinke. "Study of the Tunisian Grain Marketing System." Food and Feed Grain Institute, Kansas State University, Manhattan, 1974.

Pinckney, T. C. "Storage, Trade, and Price Policy Under Production Instability: Maize in Kenya." Report No. 71, IFPRI, Washington DC, 1988.

Ray, R. "Analysis of a Time Series of Household Expenditure Surveys for India." Review of Economics and Statistics LXII(1980): 595-602.

Rao, M. "Getting Agricultural Prices Right." Food Policy 16(1989): 28-37.

Rausser, G. C., and W. E. Foster. "Political Preference Functions and Public Policy Reform." American Journal of Agricultural Economics 72(1990): 641-652.

Rausser, G. C, and J. W. Freebairn. "Estimation of Policy Preference Functions: An Application to U.S Beef Import Quotas." The Review of Economics and Statistics 56(1974): 437-49.

Republique Tunisienne. Ministere de l'Agriculture. Annuaire Statistique (Various issues).

Republique Tunisienne. Le VI Plan de Developpement Economique et Social 1987-1990. Ministere du Plan et des Finances, Tunis, 1987.

Republique de Tunisie. Ministere de l'Agriculture. Programme de Developpement du Secteur des Cereales., Tunis, 1986.

Riethmuller, P., and T. Roe. "Government Intervention in Commodity Markets: The Case of Japanese Rice and Wheat Policy." Journal of Policy Modeling 8(1986): 327-349.

Sarris, A. H., and J. Freebairn. "Endogenous Price Policies and International Wheat Prices." American Journal of Agricultural Economics 65(1983): 214-224.

Scandizzo, P., and C. Bruce. Methodologies for Measuring Agricultural Price Intervention Effects. World Bank Staff Paper No. 394, 1980.

Stiglitz, J. "Markets, Market Failures, and Development." American Economic Review 79(1989): 197-203.

Timmer, C. P. "Food Price Policy: The Rationale for Government Intervention." Food Policy 16(1989): 7-27.

Timmer, C. P. Getting Prices Right: The Scope and Limits of Agricultural Policy. Cornell University Press, Ithaca, NY, 1986.

Toquero, Z. et al. "Marketable Surplus Functions for a Subsistence Crop: Rice in the Philippines." American Journal of Agricultural Economics, November(1975): 705-709.

Republique Tunisienne. Le VI Plan de Developpement Economique et Social 1987-1990. Ministere du Plan et des Finances, Tunis, 1987.

Republique de Tunisie. Ministere de l'Agriculture. Programme de Developpement du Secteur des Cereales., Tunis, 1986.

Riethmuller, P., and T. Roe. "Government Intervention in Commodity Markets: The Case of Japanese Rice and Wheat Policy." Journal of Policy Modeling 8(1986): 327-349.

Sarris, A. H., and J. Freebairn. "Endogenous Price Policies and International Wheat Prices." American Journal of Agricultural Economics 65(1983): 214-224.

Scandizzo, P., and C. Bruce. Methodologies for Measuring Agricultural Price Intervention Effects. World Bank Staff Paper No. 394.

Stiglitz, J. "Markets, Market Failures, and Development." American Economic Review 79(1989): 197-203.

Timmer, C. P. "Food Price Policy: The Rationale for Government Intervention." Food Policy 16(1989): 7-27.

Timmer, C. P. Getting Prices Right: The Scope and Limits of Agricultural Policy. Cornell University Press, Ithaca, NY, 1986.

Toquero, Z. et al. "Marketable Surplus Functions for a Subsistence Crop: Rice in the Philippines." American Journal of Agricultural Economics, November(1975): 705-709.

Varian, H. R. Microeconomic Analysis. W. W. Norton & Company New York, 1985.

Zusman, P., and A. Amiad. "A Quantitative Investigation of Political Economy--The Israeli Dairy Program." American Journal of Agricultural Economics 59(1977): 88-98.

Zusman, P. "The Incorporation and Measurement of Social Power in Economic Models." International Economic Review 17(1976): 447-462.

APPENDIX

DATA USED FOR ECONOMETRIC ESTIMATION

Appendix Table Data Used in Estimating Demand, Supply, and Policy Preference Function, Tunisia, 1966-1987

Year	Durum Wheat Market Surplus (T)[a]	Bread Wheat Market Surplus (T)[a]	Durum Wheat Consumption (T)[b]	Bread Wheat Consumption (T)[b]
1966	168500	31300	115050	220698
1967	115000	21100	128540	240086
1968	123300	44700	152030	259474
1969	80100	41000	175520	278862
1970	95500	86900	199020	298250
1971	162100	123300	222510	317638
1972	262100	106100	246000	337026
1973	187000	75300	269490	356414
1974	252800	78200	292980	375802
1975	307600	69200	316480	395190
1976	257000	66600	320970	414578
1977	170700	46500	333460	433966
1978	272000	65000	356950	453354
1979	174200	45900	400440	472742
1980	274900	83300	413940	492130
1981	300000	113300	427430	511518
1982	291400	121600	440920	530906
1983	170300	71500	484410	550294
1984	248900	97200	507900	569682
1985	428600	176600	515400	589070
1986	185900	75800	524890	608458
1987	488900	222200	627846	609300

Source: OC

Notes: a) Market surplus is the supply to the official marketing channels.

b) Demand through the official marketing channels only. Figures in these columns do not include quantities that are home-consumed or sold in the black market. All quantities are in metric tons (T).

Appendix Table Data Used in Estimating Demand, Supply, and Policy Preference Function, Tunisia, 1966 - 1987 (Continued)

p_1^s	p_2^s	p_3^s	p_1^d	p_2^d	p_3^d
42.0	34.5	25.0	46.61	38.66	56.70
48.0	43.0	28.0	46.61	38.66	58.70
48.0	43.0	28.0	52.71	47.26	60.20
48.0	43.0	28.0	52.71	47.26	62.70
48.0	43.0	28.0	52.71	47.26	63.50
48.0	43.0	28.0	52.71	47.26	72.20
48.0	43.0	28.0	52.71	47.26	74.50
48.0	43.0	28.0	52.71	47.26	80.90
61.0	55.0	40.0	52.72	47.26	81.30
66.0	60.0	45.0	59.70	49.30	88.90
66.0	60.0	45.0	59.70	49.30	94.30
71.3	65.3	50.3	56.70	48.80	100.00
76.0	70.0	55.0	56.70	48.80	107.50
76.0	70.0	55.0	56.70	48.80	118.30
86.0	77.0	59.0	80.00	72.50	133.20
96.0	87.0	69.0	80.00	72.50	147.70
110.0	100.0	80.0	80.00	72.50	171.60
128.0	117.0	95.0	80.00	72.50	188.60
140.0	140.0	100.0	80.00	72.50	208.30
150.0	145.0	105.0	80.00	72.50	227.50
160.0	160.0	110.0	80.00	72.00	237.20
210.0	190.0	140.0	80.00	72.50	254.89

Source: Ministry of Agriculture.
National Institute of Statistics.

Notes: p_1^d = Producer durum wheat prices (D/T).
p_2^s = Producer bread wheat prices (D/T).
p_3^s = Producer barley prices (D/T).
p_1^d = Consumer durum wheat prices (D/T).
p_2^d = Consumer bread wheat prices (D/T).
p_3^d = Consumer price index for the "other food" commodity.
Consumer prices are prices at which OC sells to the mills.

Appendix Table Data Used for Estimating Demand, Supply, and Policy Preference Function, Tunisia, 1966-1987 (Continued)

Y	pop	cpi	p_1^w	p_2^w
169034	4460	62.10	38.00	38.00
192800	4820	64.00	43.00	35.00
207132	4920	65.60	42.00	35.00
223332	5030	68.30	36.00	34.00
240084	5130	69.00	40.00	37.00
257247	5218	73.20	40.00	37.00
275912	5306	74.70	38.00	32.00
295701	5396	78.10	71.00	56.00
317553	5494	81.20	90.00	76.00
342088	5608	89.00	108.00	58.00
391477	5774	93.70	61.00	55.00
448093	5935	100.00	59.00	49.00
512064	6096	105.40	68.00	46.00
584591	6259	113.50	84.00	66.00
667992	6423	124.00	105.00	91.00
712959	6565	136.10	127.00	86.00
781686	6704	154.60	105.00	93.00
857485	6838	168.60	128.00	105.00
985463	7034	183.00	158.00	120.00
1336024	7261	197.30	190.00	116.00
1509200	7546	208.60	90.00	92.00
1672056	7741	223.40	130.00	114.00

Source: Ministry of Agriculture, Annuaires Statistiques (various Issues).
International Monetary Fund, International Financial Statistics (Various issues).

Notes: Y = Total food expenditure (1000D);
Pop = Population (1000);
CPI = Consumer price index (base 1977);
p_1^w = Durum wheat world price (D/T, CIF Tunis);
p_2^w = Bread wheat world price (D/T, CIF Tunis).

Appendix Table Data Used in Estimating Demand, Supply, and Policy Preference Function, Tunisia, 1966-1987 (Continued)

Year	Rainfall[a] (mm)	Nitrogen fertilizer Price (D/T)[b]
1966	389.6	36.2
1967	330.2	31.0
1968	363.4	46.0
1969	265.7	30.0
1970	449.9	46.7
1971	468.0	30.0
1972	444.7	30.0
1973	645.1	30.0
1974	393.2	30.0
1975	485.0	30.0
1976	442.0	50.0
1977	537.2	50.0
1978	372.7	50.0
1979	371.7	50.0
1980	474.4	50.0
1981	379.2	50.0
1982	410.5	65.0
1983	490.4	66.1
1984	450.7	66.1
1985	540.7	72.0
1986	296.1	78.5
1987	468.5	84.1

Source: Ministry of Agriculture, Planning Division.

Notes: a) Total rainfall during September-April period in millimeters.

b) Fertilizer prices are fixed by government and announced before planting. Fertilizers are sold by the OC and other cooperatives through their selling centers' network.