

**MARKET REFORM, CONTESTABILITY  
AND DETERMINANTS OF THE  
MAIZE BOARD—MILLER MARKETING MARGIN  
IN THE  
SOUTH AFRICAN MAIZE INDUSTRY**

BY

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I hereby certify that, unless specifically indicated to the contrary in the text,  
this dissertation is the result of my own original work.



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W.J.F. VIGNE

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## ABSTRACT

The dissertation analyses market reform in the South African Maize Industry at two levels. Firstly, aspects of the theory of contestable markets are used to analyze maize grain marketing reform and identify what measures are appropriate to promote contestability (ease of entry and exit, and potential rather than actual competition as a means of constraining uncompetitive behaviour). A brief history of the South African Maize industry since 1931 shows a highly regulated grain marketing system which lacked contestability. Recent amendments to the Maize Marketing Scheme such as abolition of controlled prices for maize products at retail/merchant (1960) and wholesale/milling (1971) levels; movement away from limited registration of maize processors (1977); and abolition of the statutory single channel fixed price pool scheme and storage control allowing "free" trade within the domestic market (1995), promote market contestability. Contestability can be further enhanced by reduction of sunk costs through possible on-farm storage and handling facilities (bunker storage, plastic tunnels, steel and concrete silos) and the leasing of existing silo space (possible excess capacity and alternative uses) by producers and maize traders. The maintenance of some statutory powers for the Maize Board (single channel exports, compulsory registration and levy payments) still limits contestability.

Secondly, the determinants of the Maize Board — Miller (MBM) marketing margin between 1977 - 1993 (period defined by data limitations) are identified using Ordinary Least Squares (OLS), Three Stage Least Squares (3SLS) and Principal Component Analysis. The MBM margin was positively related to miller market power (proxied by industry conjectural elasticity), the real miller maize meal selling price, real variable processing costs, and a change

in Maize Board maize grain pricing policy after 1987 (export losses reflected in low real net producer maize price). The estimated conjectural elasticity was low, indicating competitive conditions, although concentration ratios indicate entrenched, but falling, market power. The main component of the Maize Board—Miller (MBM) marketing margin for 1977 - 1993 was variable processing costs. The real consumer price of maize could be reduced via lower real processing costs of maize meal, possibly with the removal of fixed administered prices of inputs (like electricity) and moderation of real wage demands in negotiations between trade unions and millers. Foreign exchange and import controls may, however, raise input costs if the Rand should continue to weaken. The increased number of "*bosmeulens*" (small mills not registered with the Maize Board and using relatively inexpensive technology not having substantial sunk investment) entering the market means that mill sunk costs may be less of a deterrent to entry in future. The 1987 Maize Board pricing policy change captured the effect of input price risk on the MBM margin indicating a significant effect of past maize pricing policies on this margin. The Maize Milling Industry appears to be competitive (low industry conjectural elasticity) over the study period, although the oligopoly component still contributes significantly to the MBM margin. Miller market power may possibly be exerted on other products (e.g. wheat) as white maize may be seen as a loss leader. This interrelationship between maize and other grains in processing is an area for future research.

## INTRODUCTION

Maize is the most important field crop in South Africa comprising 45% of all arable land (about 3.5 million hectares) and accounting for 40% by value of all field crops (*Cownie, 1992* and *Financial Mail, 1991*). This dissertation analyses market reform in the South African Maize Industry at two levels. Firstly, regulations affecting maize grain marketing at producer and Maize Board levels are studied using aspects of contestability theory. Which stresses potential, rather than actual, competition as a constraining force on anti-competitive behaviour and the ease with which a firm can exit and enter a market. Secondly, determinants of the Maize Board—Miller (MBM) marketing margin are identified to assess the extent of miller market power (if any) in the Industry. Ordinary Least Squares (OLS), Three Stage Least Squares (3SLS) and Principal Component Analysis empirical techniques are used.

The South African Maize Industry has been characterised by government regulatory control since the promulgation of the Mielie Act in 1931. The Industry's single channel fixed price marketing scheme established in 1944 - and administered by the Maize Board - has come under increasing pressure since 1980 from various interest groups seeking reform : Certain maize producers (wanting to market their own crop and those selling to livestock producers) calling for an end to cross-subsidization whereby export losses are being covered by ever increasing Maize Board levies on domestic production; Feedlotters, poultry producers and maize millers wanting system deregulation to allow for direct purchasing so as to lower input costs; The General Agreement on Tariffs and Trade (GATT) moves from quantitative import controls to tariffication; The Board of Tariffs and Trade calling for the abatement of statutory controls; and the Kassier and Agricultural Policy Evaluation Committee (AMPEC) reports seeking

market liberalization (*Swart, 1994*). Given this pressure, world trends towards Agricultural reform (*Pasour, 1990; GATT, 1993; Ahmadi-Esfahani and Jensen, 1994a*) and present apparent commitment of the South African Government to market liberalization, existing maize marketing intervention measures must be evaluated to advise policy makers on how market liberalization could occur and, where continuing regulation is appropriate, what forms it should take. Contestability reinforces the view that any proposed regulatory barrier to entry must start off with a heavy presumption against its adoption (*Baumol, 1982*), since it is potential, rather than actual, competition which is seen as a constraining force upon incumbent behaviour. Contestability theory seeks to establish an improved set of guidelines for appropriate government intervention in the structure and conduct of firms and industries, and indicate where intervention is warranted socially (*Baumol and Willig, 1986*).

Past maize marketing studies in South Africa have focused on : Maize Board performance in terms of price and revenue stabilization where political rather than economic constraints were overriding (*Rees, 1979*); how different marketing arrangements impact on land use, prices, labour and welfare transfers (*Van Zyl and Nieuwoudt, 1990*); factors affecting demand and supply of maize exports (*Cleasby et al., 1993*); and welfare implications of maize price distortions (*Wright and Nieuwoudt, 1993*). No analysis has yet used contestability principles to study potential reform of regulations affecting maize grain marketing in South Africa.

White maize is milled to produce maize meal which forms the staple food for the majority of the population (*Cownie, 1992*). The size of the marketing margin between the farm and retail prices of maize, and changes in the margin, are thus important economic policy issues. *Faminow and Laubscher (1991)* evaluated alternative specifications of the marketing margin

for white maize in South Africa for the period 1982 - 1988. Using a relative model based on *Gardner's (1975)* work, they found that the margin was positively associated with the real retail maize meal price, a real production price index, the quantity of white maize marketed, retail price risk and two dichotomous variables to account for maize price policy change (1987/88 marketing year) and drought (1983/84 and 1984/5). However, this work did not consider the size, or causes of, individual components of the margin, nor the possible effect of miller market power on the margin. The second part of the dissertation therefore analyses determinants of the Maize Board—Miller (MBM) margin component, and considers their policy implications.

The chapters that follow outline the economic theory underlying the concept of contestability and marketing margins, and reviews the development of maize marketing regulations in South Africa. Trends in contestability since 1931, and in miller structure and the MBM margin since 1977 are assessed. Empirical models of the MBM margin determinants for 1977-1993 are then estimated using 3SLS and Principal Component Analysis. Chapter 4 presents study results, while policy implications of the two analyses are discussed in the conclusion.



## CHAPTER 1

### LITERATURE REVIEW

#### 1.1 OVERVIEW OF THE THEORY OF CONTESTABLE MARKETS

Perfect contestability is seen as a generalization of perfect competition and a more ideal benchmark for identifying structural impediments to market performance. It is also a guide for regulators in those areas where intervention is socially warranted by considerations of economic welfare (*Bailey and Baumol, 1984; Spence, 1983 and Baumol and Willig, 1986*). The theory is based on the notion that economic efficiency is best achieved by opening up markets to potential entrants (*Lapsley, 1993*) with the critical assumption being ease of entry and exit (*Spence, 1983 and Baumol et al., 1988*). The effectiveness of potential competition becomes an ever increasing constraining force to incumbent behaviour in an industry as entry becomes freer and freer. If entry and exit are totally free and there exist no significant barriers to entry, then a market is perfectly contestable. *Willig (1987:618)* formally defined a contestable market as a market "in which competitive pressures from potential entrants exercise strong constraints on the behaviour of incumbent suppliers". For a market to be contestable there must be :

- a) Freedom of exit (where an agent can leave a market without impediment, and in the process of departure can recoup any costs incurred in the entry process) which implies and guarantees freedom of entry (entry is not costless or easy, but the entrant suffers no disadvantage in terms of production technique or perceived product quality relative to the incumbent), that is, potential competition.
- b) No significant barriers to entry (factors that enable established firms to earn supra-

competitive profits without threat of entry), such as restrictive registration.

- c) Industry equilibrium which entails no significant excess profits so as to offer no profitable opportunities for entry. The industry will thus be disciplined by the threat of entry and firms will therefore possess standby authority (authority that can be used quickly when unsatisfactory incumbent performance offers entrants the prospect of profit).
- d) Efficient pricing and allocation of production among incumbent suppliers.
- e) Sluggishness or lags in the pricing response of incumbents to entry. Although not necessary or essential this may facilitate contestability. For example, if incumbents exhibit sluggishness in dropping prices in response to entry, then an entrant is able to earn rents before pricing adjusts to preclude any further entry. Potential entrants can and do sometimes make binding contracts with their future customers, and if such contracts can be agreed upon quickly, the fact that entry takes a long time becomes irrelevant (*Willig, 1987; Bailey and Baumol, 1984 and Baumol, 1982*).

Fixed costs, if sunk (outlays that cannot be recouped without substantial delay) are seen by *Baumol et al., (1988)* as a main obstacle to contestability in that sunk costs deter entry and diminish the rate at which entry responds to incumbents' profits. It is not the amount of capital that is crucial but the amount sunk. The smaller the share of investment that is composed of sunk capital, the more contestable that industry will be (*Bailey and Baumol, 1984*). Accessibility to a sunk facility (e.g. grain silo) through leasing arrangements or legislation (preventing exclusive access) could also contribute to contestability. If the opportunity cost of such a sunk facility is high (has many alternative uses ie. capital transferable) then contestability is also enhanced.



*Bain (1962:1)* stated prior to the development of contestability theory that "most analyses of how business competition works and what makes it work have given little emphasis to the force of the potential or threatened competition of possible new competitors, placing a disproportionate emphasis on competition among firms already established in any industry". Potential competition from potential entrants, rather than actual competition amongst active suppliers, effectively constrains incumbent behaviour so that a market which is contestable may consist of only a monopolist or of a large number of actively competing firms. This makes antitrust and regulatory attention unnecessary where sufficiently low barriers to entry exist (*Baumol et al., 1983; Baumol and Willig, 1986*).

There is much debate on whether potential competition or the mere threat of competition is indeed a sufficient regulatory force upon market incumbents. *Brock (1983), Shepherd (1984), Truu (1988)* and *Fourie (1993)* question the application of contestability theory and conclude that perfect contestability is of little practical value in most cases because its assumptions are too restrictive - a world in which any firm can enter and leave without loss is far removed from reality and of limited applicability. In practice, incumbent monopolists have advantages over new entrants related to factors such as complex technologies, financial power, access to distribution channels, and customer allegiance. Furthermore, it is already widely accepted that avoidance of unnecessary barriers to entry is a sound goal. *Baumol et al. (1988)*, however, consider the practical relevance of the theory as being its objectives of establishing an improved set of guidelines for appropriate government intervention and the determination of criteria distinguishing where intervention (if any) is warranted, in the belief that fostering contestability will lead to more effective markets. Therefore, policy analysts should determine what regulatory or other obstacles limit contestability and consider ways to reduce or eliminate

them. In addition, as vested interest groups respond, so government policy orientation must be dynamic to account for this.

Contestability theory has been used in the United States to analyze the airline, trucking, telecommunication, health and railroad industries, but there are very few applications to agricultural systems. *Brorsen et al. (1985)* suggest that the U.S. wheat flour milling and retail grocery markets approximated contestability as the U.S. wheat milling industry has never operated above 88% capacity, thus allowing a firm operating at below capacity to easily enter the market at a higher level of production with little additional cost. In addition retail grocery firms do not have large sunk costs (specialized buildings not required) so the only loss of exit would be loss on resale of specialised equipment and advertising costs, implying an operating environment approaching contestability. South African commercial mills are apparently only operating at 25% capacity as they operate on a one-shift basis (*Financial Mail, 1991*).

*Ahmadi-Esfahani and Jensen (1994a; 1994b)* used contestability theory to evaluate the Australian wheat processing industry. They identified performance inconsistent with contestability because of significant sunk costs and barriers to entry which lead to a high degree of concentration (Three Firm Concentration Ratio = 50%) in the processing and retail markets. Limited access to retail shelf-space, government regulations on food quality and high advertising costs were also seen as contributing factors. Analysing cost and technical conditions in the Australian wheat industry, *Quiggin and Fisher (1988)* found the market for wheat handling services at country receival points to be non-contestable because of considerable capital costs (effectively sunk) involved in the permanent handling facilities. However, bunker storage technology (low capital/high operating cost) may provide the means

for relatively costless entry and exit.

The next section reviews aspects of market concentration, which may be the result of restrictions on competitive behaviour (lack of contestability), or superior economic performance by larger firms.

## 1.2 CONCENTRATION

*Pearce (1983:76)* defines concentration as "the state of competitive conditions prevailing in an industry" and "the extent to which a market's total output is accounted for by the few largest member firms". Concentration (*Conc*) is thus seen as a function of size and inequality as shown in equation (1):

$$Conc = f(n, i) \quad (1)$$

where  $n$  = number of firms in an industry, and

$i$  = a measure of size inequality (*Waterson, 1984*).

In this study  $n$  is measured as the number of mills processing white maize (1977/78-1987/88) and the number of mills processing white maize for human consumption (1988/89-1993/94).

The size inequality variable  $i$  is measured as total tonnage processed by a mill for commercial purposes (including processing for own use and for sales to own account). The relationship between concentration and inequality is such that given the number of firms, concentration

increases with increases in inequality; and given the degree of inequality, concentration decreases with an increase in the number of firms (*Rosenbluth, 1966*).

The Structure-Conduct-Performance (SCP) Paradigm is often used to explain the workings of concentration in a market. In the SCP model, Structure refers to the characteristics that constitute a market's composition, status and pattern; Conduct refers to the activities, tactics and dealings of the market; Performance refers to the degree to which a market assimilates a specific normative standard eg. Competitive market, monopoly or Pareto optimality (*Brann, 1992*).

Two competing hypotheses explain concentration of economic power :

- a) The Monopoly Hypothesis - Entry barriers and related competition restricting behaviour/strategies (regulations, restrictive licensing etc) facilitate concentration. This argument is based on the SCP paradigm which argues that the structure of an industry (concentrated) will determine the conduct of the market participants (collusion) which leads to performance of players (monopoly pricing) in that industry. In concentrated markets, consumer prices are thus predicted to be less favourable because of non-competitive behaviour (*Darroch, 1992; Leach, 1992a; Berger and Hannan, 1989 and Reekie, 1984*).
  
- b) The Efficiency Hypothesis - Superior low cost firms which have higher profits grow to dominate their industries (technology development, product development, and benefits of economies of scale). Here the efficient performance of players in the market

(low costs) will lead to conduct (competition) which results in the structure (concentration) of the industry, and is thus the reverse of the SCP paradigm. Prices will be more favourable to consumers in concentrated markets because of their greater efficiency (*Darroch, 1992; Leach, 1992a; Berger and Hannan, 1989 and Reekie, 1984*). The efficiency hypothesis formed much of the basis for the development of contestability theory (*Purcell, 1990*).

If the monopoly hypothesis is valid, then policies that dictate the number of firms in an industry or prevent further concentration are justifiable as a means of fostering competition and improving the functioning of markets (*Gardner, 1979 and Reekie, 1984*). However, if evidence suggests that the efficiency hypothesis applies (causality flows from performance to structure), a "hands off" approach should be maintained, especially if the market which induced concentration is also likely to induce deconcentration (*Reekie, 1984*). *Brooks (1992)* cited by *Darroch (1992)* states that as long as concentration does not lead to abuse such as restrictive practices and price collusion, it is not necessarily bad. *Lubbe (1992)* cites *Armstrong (1982)* who argues that a positive relationship between the magnitude of concentration and profits does not necessarily imply competitive misconduct, but could well result from superior performance by larger firms in the absence of legal barriers to entry. *Baumol and Willig (1986)* consider the mere large size of a firm or high concentration ratios as insufficient grounds upon which to justify government intervention. *Bailey (1986)* also stresses that it is impediments to entry and exit, not concentration or scale of operations, which may primarily be the source of non-welfare optimal prices.

According to *Van Zyl and Kirsten (1992)*, if the South African food manufacturing industry

is highly concentrated, then deregulation and privatization of control Boards, without dissolving concentration of the industry (and simultaneously deregulating the manufacturing, distribution and retail industries), could raise prices of certain foodstuffs and commodities, and widen the producer-retail price gap. *Fourie (1993:149)*, however, cautions that "as important as economic structure or concentration may be, it is misleading to regard structural adjustments as an easy and final solution to the problems of economic injustice (and inefficiency) in a complex economy with formidable development problems".

Many measures of concentration in the maize milling sector in South Africa were computed for this study, and all showed a similar trend of decreasing concentration since 1977. Only the more commonly cited Three Firm Concentration Ratio (*CR3*) estimated by equation (2) has been employed in the study (*Central Statistical Services, 1988; Shepherd, 1979*) :

$$CR3 = \sum_{i=1}^3 S_i \quad (2)$$

where  $S_i$  = market share of the  $i^{th}$  firm.

The percentage market share is obtained by  $CR3 \times 100\%$  (*Central Statistical Services, 1988*). Concentration thus increases with inequality and decreases with the number of firms (*Leach 1992b*). *Shepherd (1979:189)* concludes that the concentration ratio "remains the best all-purpose measure of the degree of competition" since "it is unambiguous and has concrete meaning". Chapter 2 reports trends in maize milling structure and concentration using the

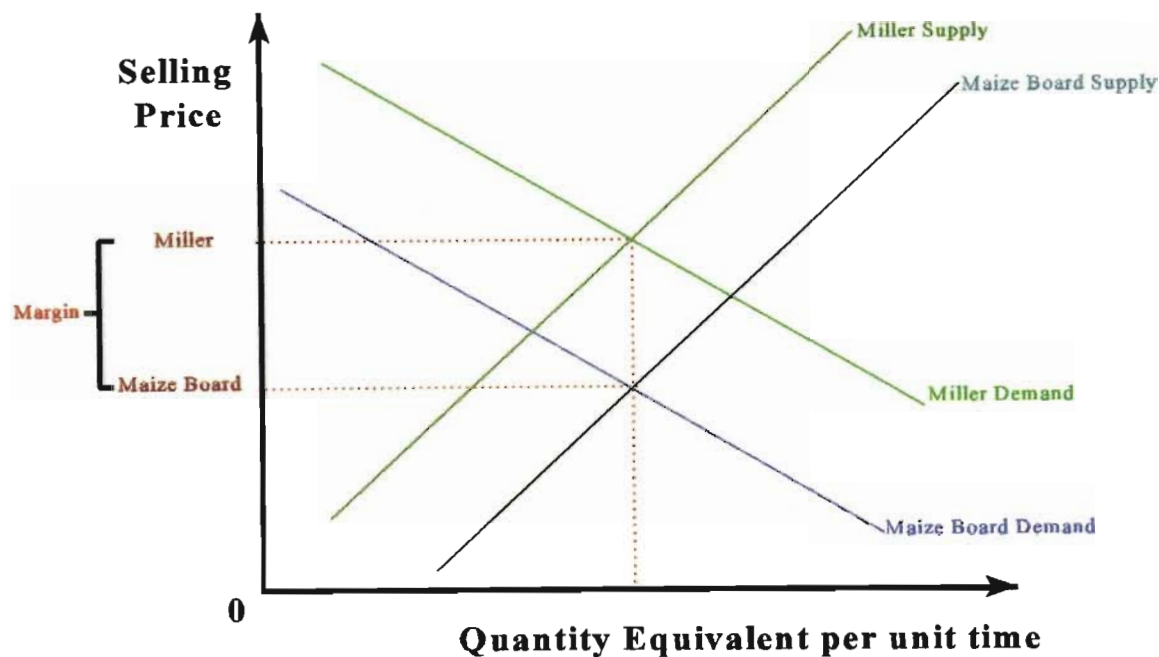


CR3. The following section discusses the economic theory of marketing margins and outlines developments in the modelling of marketing margins to account for oligopoly behaviour.

### 1.3 MARKETING MARGINS

A marketing margin, assuming purely competitive conditions, is "the price of a collection of marketing services that is the outcome of the demand for and supply of such services" (*Tomek and Robinson 1990:108*). Marketing services include processing, packaging, transportation and retailing of the product. A marketing margin thus represents the difference between the price of an equivalent unit of product at two different marketing levels. For this study, the absolute Maize Board—Miller (MBM) marketing margin equals Miller selling price per ton of maize milled ( $P_M$ ) less the Maize Board selling price of an equivalent unit of product ( $P_{MB}$ ).

Assuming a competitive market structure, equivalent units and that the miller product is made from fixed proportions of inputs (whole maize from Maize Board and marketing inputs), **Figure 1** shows how the Miller Supply curve for maize meal is derived from the Maize Board supply of an equivalent quantity of whole maize. Likewise, the Maize Board demand for whole maize is derived from the Miller demand for whole maize. The MBM margin is therefore the difference between the Miller selling price (intersection of Miller supply and demand curves) and the Board's selling price (intersection of the Maize Board demand and supply curves). Alternatively, the derived (Maize Board) demand is obtained by subtracting the per unit costs of all marketing components from the primary (Miller) demand function.



**Figure 1** Maize Board—Miller Marketing Margin (Adapted from *Tomek and Robinson, 1990*)

The assumption of fixed proportions implies that the elasticity of substitution between inputs is zero. *Gardner (1975)* provides a mathematical analysis of this situation and for that where substitution possibilities exist between the various inputs in production. If substitution is possible, a shift in primary (Miller) demand increases the derived (Maize Board) demand for both Maize Board maize grain products and marketing services. The relative prices of both inputs would change depending on their respective supply elasticities. The change in the margin will, in turn, depend on the degree of substitution between maize grain and other inputs in the marketing process. *Gardner (1975)* however, sees an elasticity of substitution tending to zero as the more realistic limiting case.

Following *Gardner (1975)*; *Heien (1977)* and *Wohlgenant and Mullen (1987)* the relative



margin  $P_{MB}/P_M$  (graphical relations of **Figure 1**) can be expressed as equation (3) :

$$\frac{P_{MB}}{P_M} = f \left( TTPI ; \frac{RVCOP}{P_M} \right) \quad (3)$$

where  $P_{MB}$  = Real Maize Board selling price for a quantity ton equivalent,  
 $P_M$  = Real Miller selling price for a ton of milled maize,  
 $TTPI$  = Quantity of whole maize processed by the industry (tons), and  
 $RVCOP$  = Real variable milling costs per ton of milled maize.

Increases in RVCOP and in farm level output marketed locally are likely to lower the MBM price ratio by raising  $P_M$  relative to  $P_{MB}$ . When the Maize Board price is measured in the same units as the Miller price, the absolute price spread or absolute MBM margin can be written as equation (4) :

$$MBM = P_M - P_{MB} = P_M h \left( TTPI , \frac{RVCOP}{P_M} \right) \quad (4)$$

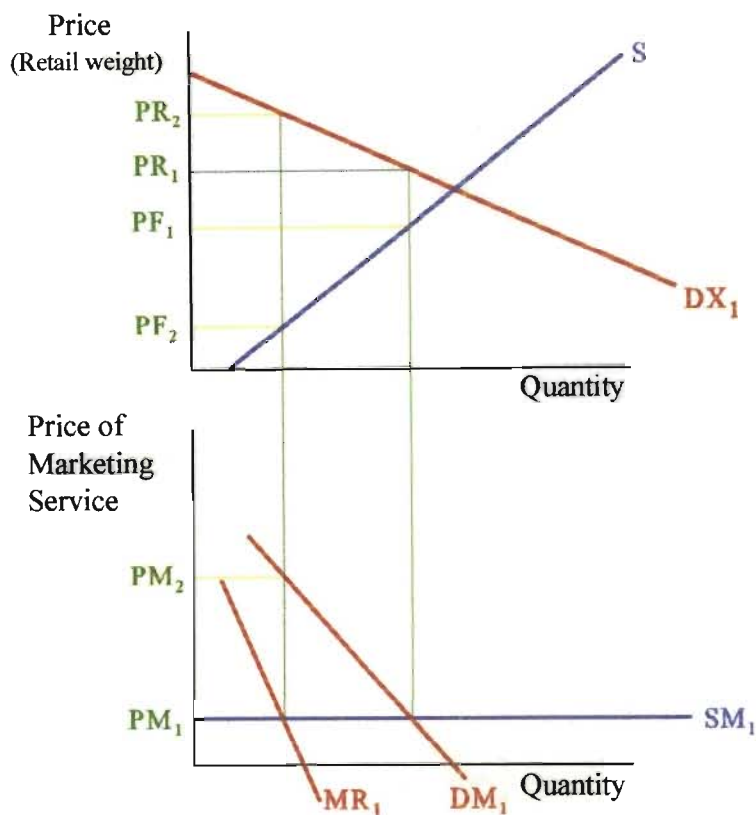
since the relative MBM margin is, by definition equal to  $1 - P_{MB}/P_M$  (*Wohlgemant and Mullen, 1987*). See Appendix A, page 81 for derivation. In general, the relationship between the prices will change as output and relative marketing input prices change. This formulation suggests that shifts in miller demand and Maize Board supply can influence the margin via two possible mechanisms : quantity of output processed ( $TTPI$ ) and output price ( $P_M$ ). Increases in output and increases in relative marketing costs will lead to a higher relative margin. Since

shifts in both demand and supply cause changes in output and price, the effects on the margin depend on the relative shifts and price elasticities of demand and supply (*Wohlgenant and Mullen, 1987*).

The actual nature of a marketing margin may be difficult to determine, since most food products undergo a complex transformation from the farm to the consumer and different products require different marketing services (*Tomek and Robinson 1990*). For example, if the supply curve for marketing services has a positive slope, the price of such services would rise as demand increases, resulting in a higher margin with increased production. This may be unrealistic as economies of scale in providing marketing services could lead to a negatively shaped supply curve for marketing services, at least over some range (lower margins with increased production). Marketing margins will change with changes in factor prices, the quantity and quality of services contained in the final product and the efficiency with which services are provided.

*Fisher (1981)* graphically modelled *Gardner's (1975)* mathematical relationships and illustrated the effects of a change in the cost of an existing marketing service on the margin under competitive conditions. He concluded that for most agricultural products, the major adjustment to a change in marketing charges will be made by farm prices. *Faminow and Laubscher (1991)* adapted *Fisher's (1981)* model to include the case of oligopoly pricing in the marketing sector. They abstracted from the monopoly position of the Maize Board and assumed that firms in the marketing sector are able to effectively collude to realise the monopoly solution (see **Figure 2** and **Figure 3**). In **Figure 2** under the competitive case, the farm-retail marketing margin is determined by the intersection of the demand ( $DM_1$ ) and supply

( $SM_1$ ) of marketing services, resulting in  $PM_1$  as the price of marketing services and  $PR_1 - PF_1$  as the margin (where  $PR_1$  is retail price and  $PF_1$  is farm price). The monopoly solution equates marginal revenue ( $MR_1$ ) and marginal cost ( $SM_1$ ). The price of marketing services under monopoly is therefore  $PM_2$ , which equals the margin ( $PR_2 - PF_2$ ) determined from the vertical distance between the retail demand ( $DX_1$ ) and farm supply ( $S$ ).

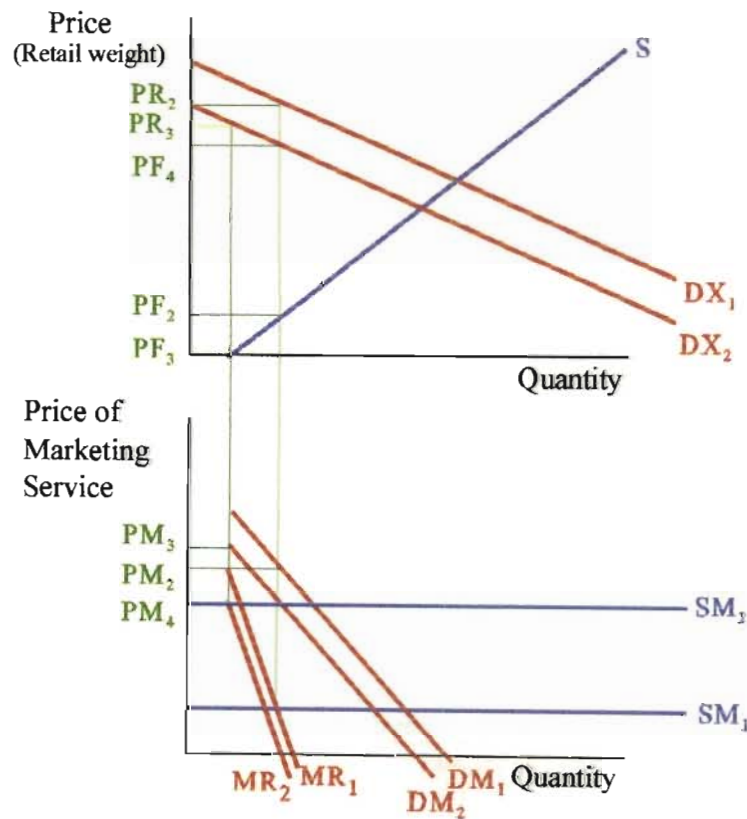


**Figure 2** Competitive and Monopoly Solution of Price Spread Model (Source : Faminow and Laubscher, 1991).

**Figure 3** illustrates the effects of decreases in retail demand and increases in the cost of marketing services, relative to the monopoly solution of **Figure 2**. A downward shift in retail demand from  $DX_1$  to  $DX_2$  lowers the demand for marketing services to  $DM_2$  and marginal revenue to  $MR_2$  such that the monopoly margin is  $PR_3 - PF_3$ .

Any increase in marketing service costs beyond  $SM_2$  results in a negative farm price.

$PM_3$  is therefore the limit to which the monopolist marketing firms are able to depress the farm price and extract monopoly profits. If the marketing firms were pricing competitively under cost ( $SM_2$ ) and demand ( $DM_2$ ) conditions, the price would be  $PM_4$  and the margin  $PR_2 - PF_2$ .  $PM_3$  and  $PM_4$  therefore represent the prices of two extreme forms of pricing behaviour with presupposed structural shifts in retail demand and marketing service costs.



**Figure 3** Effects of Demand and Marketing Cost Shifts (Source : Faminow and Laubscher, 1991).

Producers through the power of the Maize Board could conceivably counteract a non-competitive marketing sector and prevent firms from setting the price of marketing services at the monopoly level and thereby force down the price of marketing services from  $PM_3$

towards  $PM_t$ . The result of a change in Maize Board pricing policy from 1987 onwards whereby losses on export sales were reflected in a lower real net price to farmers indicates that this has not occurred. This aspect is considered in more detail in Chapter 2 which analyses trends in the MBM margin, and in the empirical model specified in Chapter 3.

*Azzam et al., (1989)* and *Schroeter and Azzam (1991)* went beyond the above graphical analyses by modelling oligopoly behaviour using iterated 3SLS. In a perfectly competitive market the margin would be a function of marginal processing costs (positively related). In a non competitive market, they estimated the margin to be a function of an additional two positive terms accounting for potential monopoly and monopsony price distortions which would exceed marginal processing costs. These distortions reflect the ability (if any) of marketing firms to exercise some power over price in both the market for the farm product and the food output market. Chapter 3 shows the derivation of the empirical model and its application to the MBM margin.

Chapter 2 describes developments in the South African Maize Industry since 1931 and outlines trends in miller structure and the MBM margin since 1977 (period defined by data limitations).

## CHAPTER 2

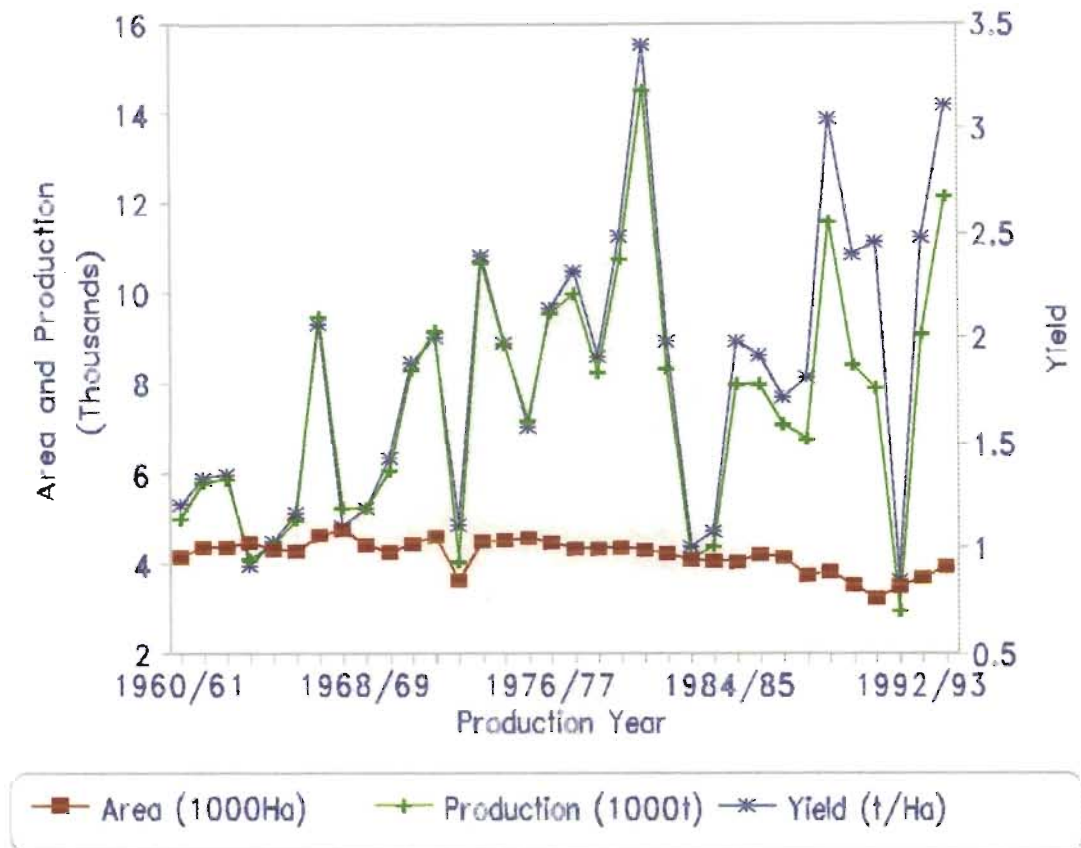
### STRUCTURE OF THE SOUTH AFRICAN MAIZE INDUSTRY

#### 2.1 ECONOMIC IMPORTANCE

Maize is the most important field crop in South Africa comprising 45% of all arable land (about 3.5 m hectares<sup>1</sup>), annually producing on average 7 million tons, and accounting for 40% by value of all field crops. Gross value of production was approximately R3 billion or 13% of total agricultural output and 25% of GDP in 1990/91. Maize (mainly white maize) is the staple food for the majority of the population (some 4 million tons per annum) and there are about 1.1 million workers with 7 million dependents on the approximate 16000 commercial maize farms. Yellow maize is also the most important intermediate input into the livestock industry which uses about 3 million tons per annum. When shortages of white maize have occurred, admixing of yellow and white maize has been practised. South Africa is the major supplier of maize to Botswana, Lesotho, Swaziland, and Namibia (*Directorate Agricultural Economic Trends, 1995; Cownie, 1992 and Financial Mail, 1991*). **Figure 4** provides physical time series information on maize cropped in South Africa.

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<sup>1</sup> Mean figures for the production seasons 1989/90 - 1993/94 (*Directorate Agricultural Economic Trends, 1995*).



**Figure 4** Maize Production, Area and Average Yield in RSA, excluding the TBVC States (Source : Directorate Agricultural Economic Trends, 1995).

The area under maize production has remained fairly constant since 1960/61, with 4 118 000 Ha planted in 1960/61 and 3 904 000 Ha planted in 1993/94. Maize production and yield have shown relatively large variation which is due mainly to weather variability. The average yield for the period was 1.8 t/Ha.



## 2.2 THE SOUTH AFRICAN MAIZE INDUSTRY, 1931 - 1987

After promulgation of the Mielie Act in 1931, the Maize Board was established as a statutory body in 1935 to advise the State on the marketing of maize. The Marketing Act of 1937 (since amended) gave the Maize Board statutory power as a controlling body over maize marketing, responsible for buying, selling, storing and delivering the whole South African (SA) maize crop. In 1944 undersupply of maize due to drought and the Second World War resulted in traders storing and withholding maize apparently in order to manipulate price (*Mieliestudiegroep, 1993*). The Single Channel Fixed Price Marketing Scheme was thus established with the main objective to stabilize producer maize prices in order to stabilize the selling prices of white and yellow maize products (*Swart, 1994*). The Maize Board fixed the selling and producer prices of maize according to a formula based on mean annual production costs obtained from producer surveys. Between 1981-1987, the Maize Board fixed selling price and producer price of maize on an *ad-hoc* basis which lead to great uncertainty (*Mieliestudiegroep, 1993*). Essentially, price formation was open to political manipulation from producer groups as the government fixed price using the cost of production formula. Farmers had the incentive to inflate their cost estimates knowing that these were to be used for price determination. These cost estimates are subjective, making it difficult for an outsider to measure them, as each farmer faces differing opportunity costs, has different expectations, risk aversion and goals. Furthermore, cost estimation is distorted by the inclusion of some rents, as returns to assets are partially capitalised into the value of those assets, for example land (*Pasour, 1990; Nieuwoudt, 1983*). During this period, the Maize Board strictly controlled market access through the Single Channel Fixed Price Scheme and effectively limited contestability due to the statutory powers outlined below.



Statutory Maize Board powers in terms of the Marketing Act of 1937 (since amended) acted as legal barriers to entry and impeded contestability at each industry level. The regulations, punishable by law if contravened (*Regulation 45 (42), Government Gazette No.6349 - 16/03/1979*), included : Price fixing (prohibiting any person acquiring, selling or disposing of any maize or maize products at any price other than at a fixed price); Restrictive trading and permits (prohibiting any person from selling or purchasing maize except to or through Maize Board agents in controlled areas (A and B) which accounted for 95% of the total annual crop (*Louw, 1995*)); Compulsory levies imposed on maize of any class, grade or quality sold and payable by maize producers, millers, feed manufacturers, stock feeders, importers and exporters to finance the General, Reserve and/or Special Funds; and Compulsory registration (each person dealing in the course of trade with maize had to register with the Board and comply with its requirements). These restrictive regulations which acted as legal barriers to entry are set out more fully below :

- a) **Price fixing** (*Regulation 45 (37), Government Gazette No.6349 - 16/03/1979*).  
Whereby the Board may prohibit any person from acquiring, selling or disposing of any quantity of maize or maize products at any price other than or below or above a fixed price.
- b) **Restrictive Trading** (*Regulation 45 (38),(39),(41), Government Gazette No.6349 - 16/03/1979*). By which the Board prohibits any producer from selling maize except to or through its agents and, only for purposes as defined by the Board, and prohibits the purchase or sale, by any person, of maize or maize products except under the authority of the Board. (*No. R.779, Government Gazette No.14785 - 01/05/1993*).

- c) **Levy** (*Regulation 45 (23), Government Gazette No.6349 - 16/03/1979*); (*No. R.792, Government Gazette No.14795 - 04/05/1993*). The Board may impose levies upon maize of any class, grade or quality which is (i) sold to or through the Board, (ii) imported into or exported from the Republic, and (iii) utilized by the producer thereof for any purpose other than his own household consumption or farming operations. Levies are payable by maize producers, seed maize producers (*No. R.791, Government Gazette No.14795 - 04/05/1993*), maize millers (*No. R.964, Government Gazette No.7565 - 01/05/1981*), feed manufacturers, industrial processors, stock feeders, importers and exporters; and may be imposed to finance the General (*No. R.45 (25), Government Gazette No.6349 - 16/03/1979*), Reserve (*No. R.45 (26), Government Gazette No.6349 - 16/03/1979*) and/or Special Funds (*No. R.45 (27), Government Gazette No.6349 - 16/03/1979*).
- d) **Special levy** (*Regulation 45 (23), Government Gazette No.6349 - 16/03/1979*); (*No. R.792, Government Gazette No.14795 - 04/05/1993*). Applies *mutatis mutandis* (with the necessary changes) to the persons and conditions laid down for the ordinary levy.
- e) **Compulsory Registration** (*Regulation 45 (36), Government Gazette No.6349 - 16/03/1979*); (*No.R.780, Government Gazette No.14785 - 01/05/1993*). Each producer or person dealing in the course of trade with maize must be registered with the Board and comply with the requirements prescribed. Furthermore the Board may appoint agents as it sees fit, for such functions and on the conditions determined by it (*Regulation 45 (32), Government Gazette No.6349 - 16/03/1979*).

- f) **Permit** (*No.R.1975, Government Gazette No.10900 - 11/09/1987*). The Board can prohibit any importation into or exportation from the Republic, of maize without a permit from the Board. The issuing of which is at the discretion of the Board.

Regulations (a) and (b) were relaxed in practise during this period although they were still statutory law. Some marketing reforms during this period eased some of the constraints on contestability. For example, abolition of controlled prices for maize products at retail/merchant (1960) and wholesale/milling (1971) levels and a movement away from limited registration of maize processors in 1977 which allowed for the emergence of small processors called "*bosmeulens*". The prohibition on the erection of grain silos was repealed and the Grain Silo Committee and price control on maize meal were also scrapped (*Rees, 1979; Financial Mail, 1991; Cowrie, 1992*).

### 2.3 THE MAIZE MARKETING SCHEME AND INDUSTRY STRUCTURE, 1 MAY 1987 - 1 MAY 1995

After May 1987, a Fixed Pool Pricing Scheme was adopted, whereby the producer price was determined from the pooled net export and domestic income accruing to the Maize Board. The producer price therefore varied inversely with the size of the local crop, although imports in years of undersupply limited the extent of producer price rises (*Cleasby et al., 1993*). This scheme was negotiated between NAMPO (National Maize Producers' Organization) and the Minister of Agriculture. The Maize Board was given the responsibility to fix domestic market prices, *apparently* for the long term benefit of the producer (*Kassier, 1992; Mieliestudiegroep,*

1993; Van Zyl and Nieuwoudt, 1990 and *Financial Mail*, 1991).

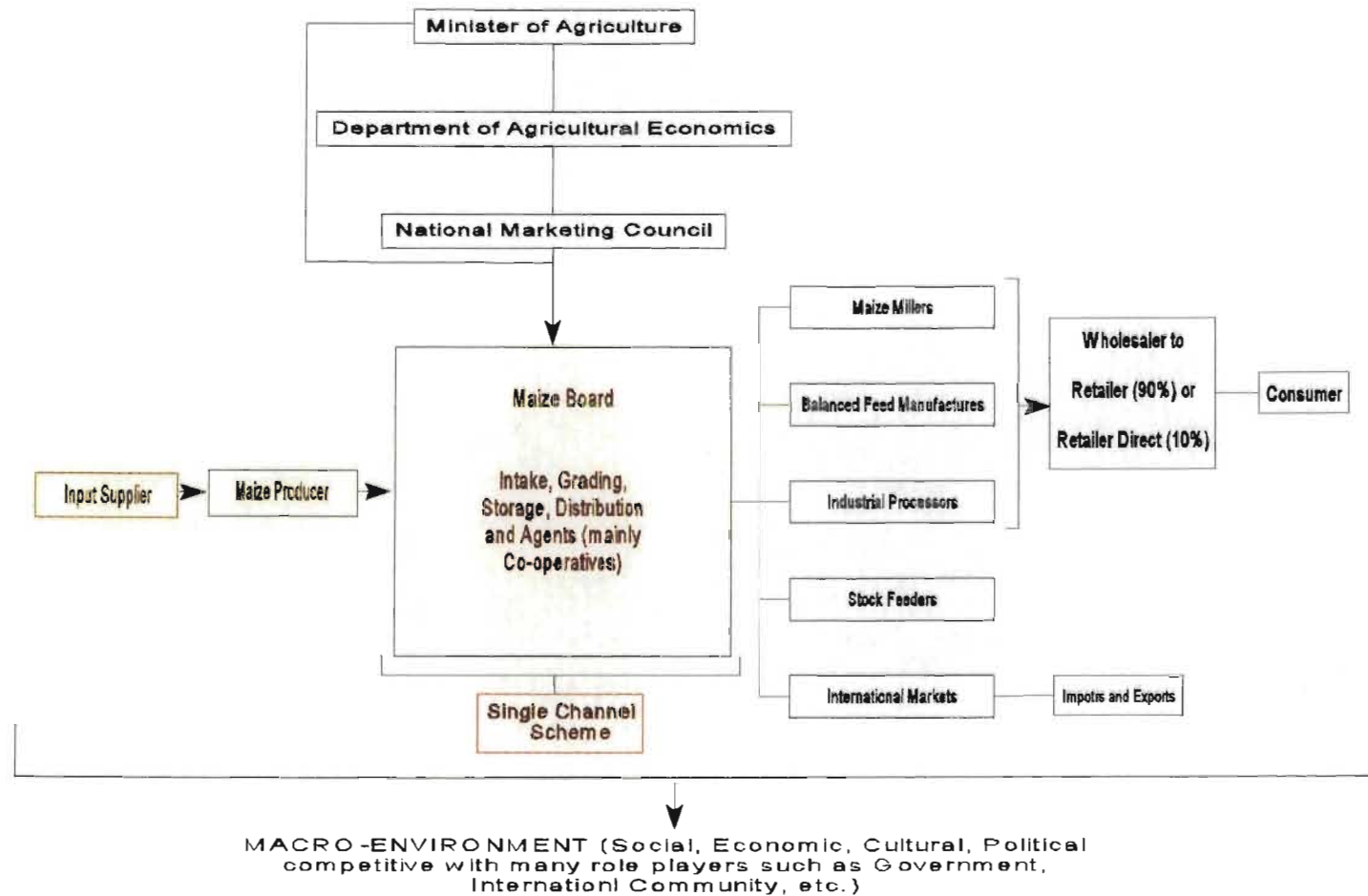
Separate producer prices were quoted for both white and yellow maize according to grade and quality and producers were paid a premium of R10-R15/t for early delivery if Board stocks needed to be boosted (*Van Zyl and Nieuwoudt, 1990; Elliott, 1994; Groenewald, 1989 and Financial Mail, 1991*). **Figure 5** shows the structure of the industry during this period when the Maize Board was pivotal to the system, since all grain produced in controlled areas had to be marketed through the Board or its agents (producer co-operatives).

Deregulation occurred in 1987 when the Board shifted away from price determination at Cabinet level to a market-based, pool type pricing scheme. Annual subsidization of the Maize Board's handling and storage costs was phased out, and permission granted for free transactions between farmers and processors/consumers subject to the payment of Maize Board levies (*LAPC, 1993a; LAPC, 1993b; Financial Mail, 1991; Cowrie, 1992 and GATT, 1993*). These reforms promoted contestability within the Industry as the Single Channel Fixed Price Scheme prevented direct trade in maize grain between producers and users of maize grain. Removal of subsidies on maize production and debt write-offs to farmers and cooperatives of R3.4 billion also occurred in the 1992/93 season.

*Wright and Nieuwoudt (1993)* used public choice theory to explain how the producer majority on the Maize Board had influenced maize pricing decisions and benefitted producers at the expense of consumers. They estimated that in 1990, producer welfare gains were significantly smaller (R384 million) than consumer welfare losses (R1181 million), causing a net social loss to society of R797 million. Since the number of commercial maize producers (about 16000)

is much smaller than the number of consumers, the rent per individual farmer is significantly larger than the cost to the individual consumer (benefits are concentrated and costs dispersed). The average rent per farmer was some R23000 in 1990, compared to the loss per consumer of about R26. Income transfers for previous years were even greater, and the aggregate estimates may understate the distortions as income distributions among farmers and consumers are highly skewed. These distortions reflect the outcome of constrained contestability within the industry and explain why producers continue to lobby via NAMPO for a tariff of 35% on the price of all maize imports (*Payne and Efrat, 1994*).

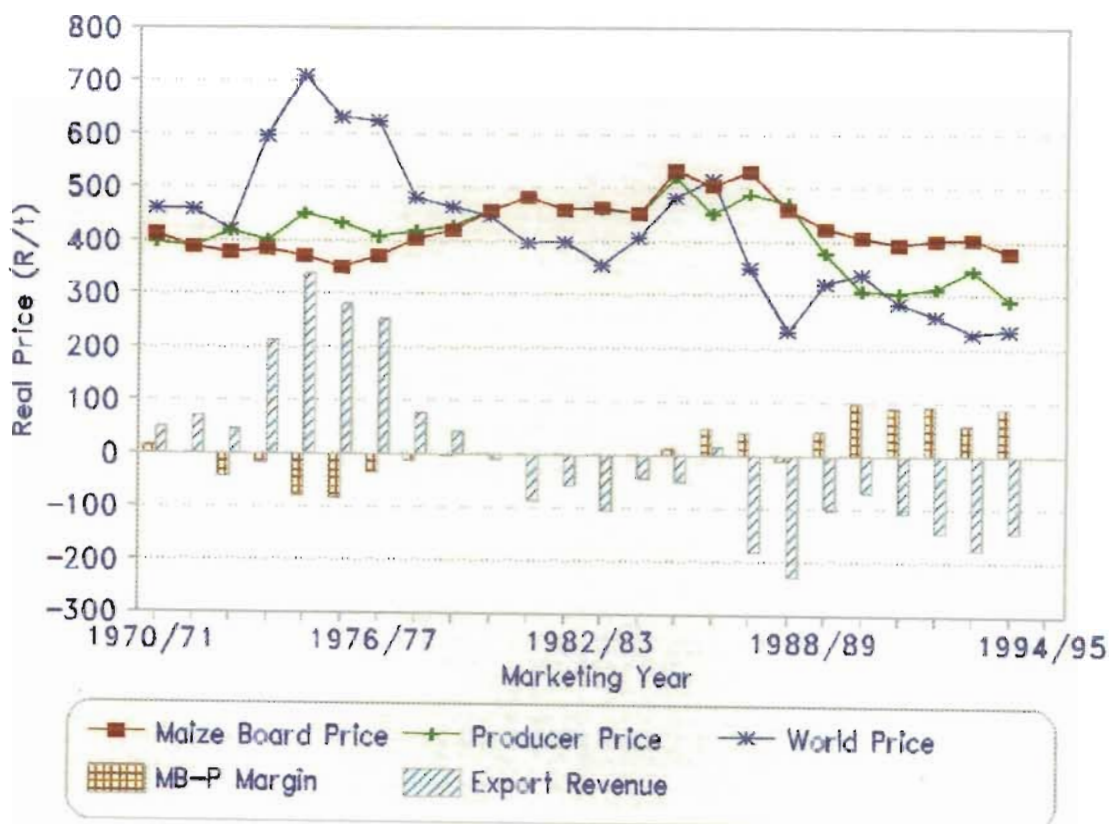
The producer lobby may not retain its political clout if the new South African government focuses more on consumer interests in future. The past distribution of access to resources, inputs and information in the Industry which has dual marketing (formal and informal markets) and production (capital intensive commercial farmers and subsistence orientated farmers) has concentrated the benefits of the Single Channel Scheme mainly on commercial farmers. However, if small-scale, emergent maize farmers are represented on the Board in future, their lobbying power may retain some influence for maize farmers on future maize pricing despite the change in food policy focus.



**Figure 5** Maize Scheme (1987-1995), Production and Distribution Channels for Maize and Maize Products (Source : Cownie, 1992 and Wright, 1992).



Since 1987, the Board's role in price determination increased and it was not allowed to incur debts to support maize prices. As sole marketer of maize, the Maize Board used price discrimination to raise producer incomes. Local producer prices were supported artificially by restricting supply to the local market (price inelastic demand) and selling on export markets (price elastic demand) (Cleasby et al., 1993). **Figure 6** shows that during the 1970's when world prices were relatively high, export earnings were high and the Maize Board - Producer (MB-P) margin was negative. As the world price began to fall relative to domestic prices, "export losses" resulting from price discrimination by the Maize Board grew, so these losses were covered by an increasing MB-P margin (levy) (Faminow and Laubscher, 1991).



**Figure 6** Real White Maize Domestic and World Price Trends, 1970/71 - 1992/93 (Source : *Abstract of Agricultural Statistics, 1995* and *Agricultural Outlook Economic Research Service, USDA, 1994*).

Although the real Maize Board price has fallen since the mid 1980's, the real producer price has fallen more rapidly, thus raising the levy (up to R185/ton for the 1994/95 season) to cover real export losses. Dissatisfaction with these developments led to a Supreme Court lawsuit contested between the Concerned Buyers Group (CBG)<sup>2</sup> and the Maize Board, National Marketing Council and Minister of Agriculture. The CBG refused to pay the Maize Board levy of R185/ton (white maize) for the 1994/95 season because of alleged discriminatory application of existing legislation - some 500 small mills or "*bosmeulens*" had entered the market circumventing official channels and avoiding levy payments without being prosecuted. The Maize Board in response held back R39,5 million in processor guarantees due to non payment of the levy. Judgement was handed down on 2 December 1994 in favour of the Maize Board, National Marketing Council and Minister of Agriculture with the CBG having to pay all outstanding levies and court costs (*Claassen, 1995*). The "*bosmeulens*" (joint processing capacity about 1.25 Mt whereas total annual white maize consumption is 4 - 5 Mt) could represent potential competition (standby authority) to the CBG in rural areas. Entry of these "*bosmeulens*" reflects both "latent" contestability and increased contestability in the sense that regulations were not being enforced on them.

The Minister of Agriculture established a number of committees to investigate maize marketing in South Africa during 1987 - 1995. The Committee of Inquiry into the Marketing Act in 1992 (Kassier Report) recommended the replacement of single channel marketing by market liberalization and voluntary payment of levies (as enforcement and collection are a major problem), based on the principles of individual freedom of choice, efficiency, equity,

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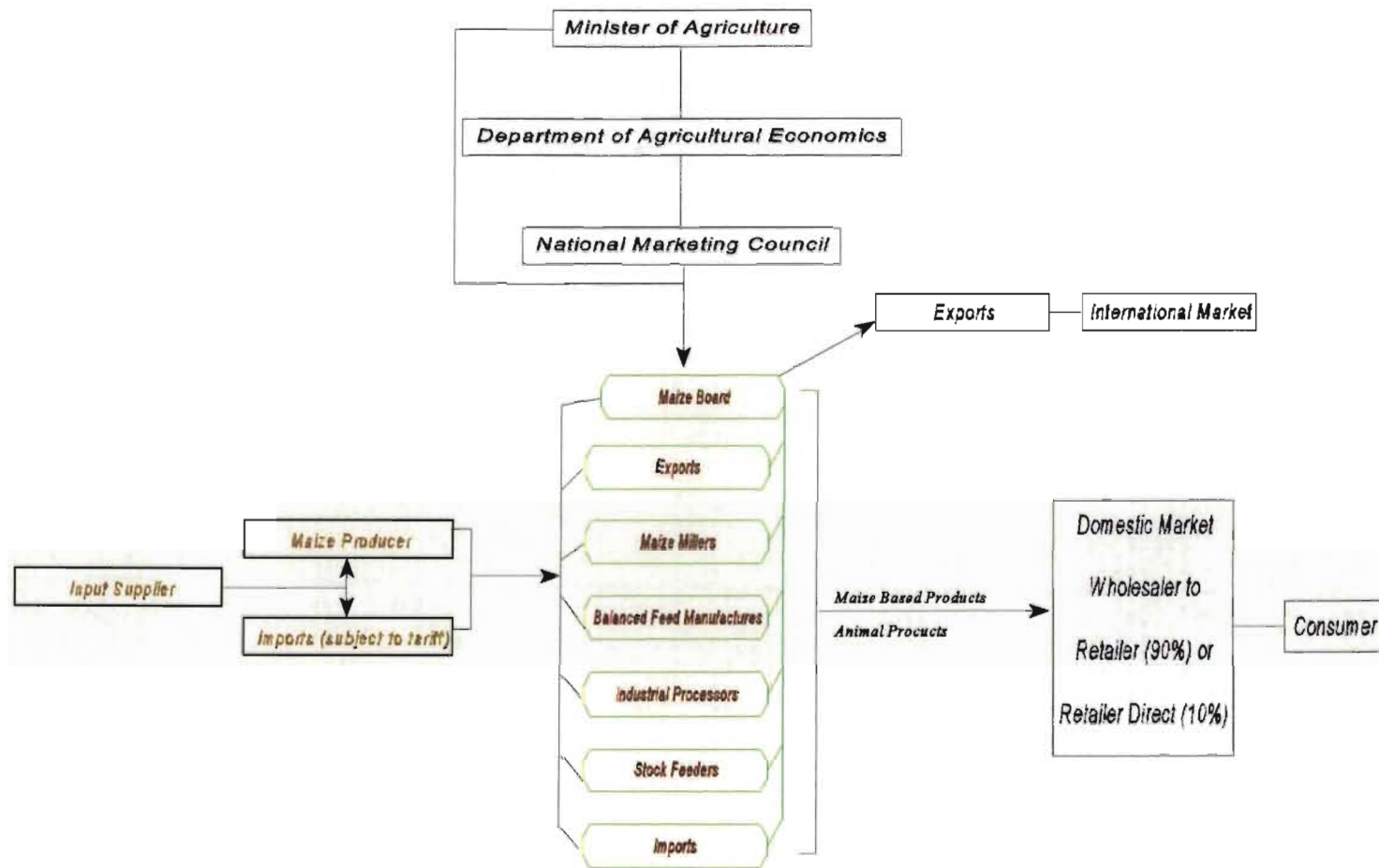
<sup>2</sup> The Concerned Buyers Group consisted of Tiger Foods Ltd, Premier Food Industries Ltd, Epol (Pty) Ltd, Rainbow Chicken Farms (Pty) Ltd, Godrich Flour Mills (Pty) Ltd, Foodcorp Group (Pty) Ltd, Piet Retief Grain and Malt CC, and Hagers Industries CC.



sustainability, food security and comparative advantage. Members of the Agricultural Marketing Policy Evaluation Committee (AMPEC) in 1994 held that deregulation of agriculture should be part of integrated liberalization of the total economy - the marketing scheme should be transparent and free of political interference in line with freedom of economic association. Large scale dissatisfaction with past restrictive regulations and mounting market pressure finally saw the 1994 Swart Committee established to arbitrate between interest groups to formulate a new maize marketing scheme for implementation on 1 May 1995, as described overleaf.

## 2.4 THE "NEW" MAIZE MARKETING SCHEME AND INDUSTRY STRUCTURE (1 MAY 1995 ONWARDS)

The Swart Committee proposed a new scheme which captures much of the goals of market reform as discussed by *Cownie (1992)*, *Van Zyl and Nieuwoudt (1990)* and *LAPC (1993b)*. Proposed amendments to the Summer Grain Scheme were gazetted on the 15 December 1994 and finalized in Government Gazette Notice 16363, No. R.552 of 19 April 1995 with effect from 1 May 1995. In short, the Statutory Single Channel Fixed Price Pool Scheme and storage control are relinquished and producers are allowed "free" trade within the domestic market (as shown in **Figure 7**, compare with **Figure 5**), with a floor price system to support producer prices in so-called "surplus" years through an agreed formula, whereby producers may sell to the Maize Board at the floor price for the export pool. Price fixing and restrictive trading are replaced with free interaction between producers and buyers so that prices are determined in the market place. Producers are now responsible for the storage and transport of their maize. The Maize Board still retains its producer majority composition, statutory powers such as compulsory levies and registration and the sole rights to export maize grain from South Africa.



**Figure 7** Proposed New Maize Scheme (1 May 1995), Production and Distribution Channels for Maize and Maize Products (Source : Government Gazette Notice 16172 of 1994, Regulation 2205 and Swart, 1994).

A Compulsory Producer Levy is still payable to the Maize Board to fund the General Fund which covers administration, promotional services and the Reserve Fund. For the 1995/96 marketing year the levy totals R10.51 (R9.22/t + 14% VAT (R1.29) and is composed of : Board's Administration costs (R6.43); Promotional services (R0.64); Product Development and maize grain research (R0.08); Foreign visits and entertainment of foreign guests (R0.20); Image-building programme (R0.20); Operational budget of NAMPO (R0.97); and a contribution to the Summer Grain Centre by NAMPO (R0.70). A general levy for SAAU (South African Agricultural Union) of R0.09 is also payable (*Leisegang, 1995*).

A Statutory Stabilization (Special) Levy is also to be imposed for a stabilization fund. This levy is payable on all maize sold commercially and is not payable on maize delivered to the export pool (*Leisegang, 1995*). The fund will support producer prices in so-called "surplus" production years. The stabilization levy is calculated annually prior to the start of the financial year taking average annual commercial domestic consumption, railage and harbour costs into account according to equation (5) :

$$Z = \frac{[30\%(A + B) * (C + D)]}{A} \quad (5)$$

where Z = The amount (R/t) of the special levy to be calculated (exclusive of VAT),

A = Average annual commercial domestic consumption of maize (R/t) during the immediately preceding three (3) years,

B = One (1) million tons,

- C = Railage costs (R/t) of maize over a distance of 935 km on date of calculation, and
- D = Harbour costs (R/t) in relation to the export of maize, as agreed upon between the Board and suppliers of services concerned for each particular year.

For the 1995/96 marketing year it totals R52.63/t (R46.17/t + 14% VAT (R6.46)). The Board's export pool is funded form the Stabilization Fund and the price support is calculated according to (6) :

$$Y = C + D + E \quad (6)$$

- where Y = The amount (R/t) to be calculated
- C = Railage costs (R/t) of maize over a distance of 935 km on date of calculation
- D = Harbour costs (R/t) in relation to the export of maize, as agreed upon between the Board and suppliers of services concerned for each particular year.
- E = Maize Board costs (R/t) in connection with handling, fumigation, storage and financing of maize to be exported, as determined by the Board prior to the commencement of the financial year concerned.

The total amount payable in levies in the 1995/96 marketing year is therefore R63.23/t (R46.17 + R9.22 + 14% VAT + R0.09). The 1994/95 season dispute over levy payments indicates that major market participants are opposed to the current regulation.

The Maize Board remains the sole exporter of whole maize and will administer an export pool. In times of domestic undersupply the Board may supply the domestic market with maize from the export pool sold on a tender or auction basis and will be responsible to pay the special levy. The price will be free-on-rail and shall after addition of transportation costs from the silo concerned, not be lower than the estimated landed cost of USA #2 yellow maize on the buyer's premises plus R20/t, so as to prevent unnecessary imports (*Leisegang, 1995*). The Maize Board is thus able to compete directly with importers. Maize or maize products may only be exported by persons authorized under permit from the Maize Board.

Compulsory registration, submission of returns and record maintenance is still in place. The Board also retains the right of inspection, seizure and entrance to property, vehicles, information, books and documents relating to maize or maize products. Failure of which may, on conviction result in a maximum fine of R5000 or two years imprisonment or both. In practice, for example with mill registration, if an applicant fulfils the necessary requirements of the mill being erected on a fixed premises, allows inspection and completes all the necessary forms, the Board cannot (and has not since 1978) refused registration (*De Nysschen, 1994*).

The Maize Board will operate an information service concerning marketing conditions. Maize can be imported by anyone subject to phyto-sanitary conditions laid down by the Minister of Agriculture and an import tariff determined by the Board of Tariffs and Trade (the tariff is

currently zero).

The effects of the "new" scheme on contestability of maize grain marketing are discussed in Chapter 4. The next section describes trends in miller structure and maize marketing margins since 1971.

## 2.5 TRENDS IN MILLER STRUCTURE AND MAIZE MARKETING MARGINS IN SOUTH AFRICA SINCE 1977/78

### 2.5.1 Miller Structure

Table I gives descriptive statistics of maize millers in the South African Milling Industry for the period 1977 - 1993. The Industry is dominated by about five large Millers who in any one year will each individually process more than 100 000 tons of maize. The number of small millers (processing less than 1000 tons per annum) more than doubled between 1989/90 - 1993/94, from 101 to 251. The number of new "*bosmeulens*" (small mills not registered with the Maize Board) increased by more than 500 (joint processing capacity about 1.25 Mt) in the 1994/95 season, due mainly to their being able to bypass official channels and so avoid paying the current levy of R185/t on maize purchases from the Maize Board (*Payne et al., 1994*). The three largest firms in the industry (three firm concentration ratio - CR3) accounted for 52% of the market in 1977/78 and 47% in 1993/94. This compares with the CR3 of 50% found by *Ahmadi-Esfahani and Jensen (1994b)* in the Australian Wheat Processing industry. Although there has been a relative decline in the level of concentration over the study period,



concentration is still relatively high.

Table I South African Maize Miller Structure, 1977 - 1993

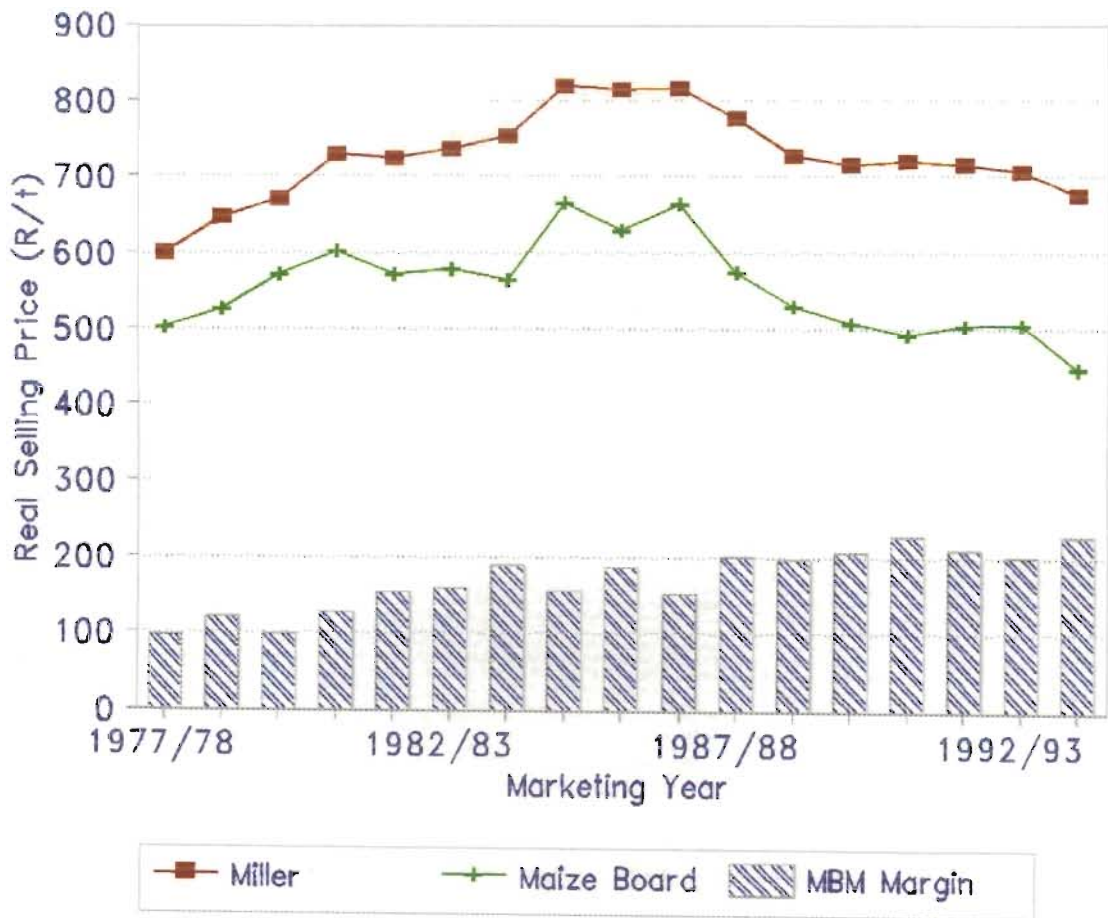
Year	Number of Millers	Number of Registered Millers Processing Different Maize Tonnages					CR3 Ratio
		>100000 tons	50000-99999 tons	10000-49999 tons	1000-9999 tons	1-999 tons	
1977/78	174	7	2	19	75	71	0.52
1978/79	155	2	2	4	31	116	0.56
1979/80	167	7	2	17	60	81	0.53
1980/81	170	6	4	14	56	90	0.53
1981/82	160	7	2	13	53	85	0.55
1982/83	171	7	3	15	44	102	0.54
1983/84	153	5	4	14	44	86	0.52
1984/85	148	5	1	11	38	93	0.50
1985/86	146	7	3	16	42	78	0.51
1986/87	155	6	3	16	39	91	0.49
1987/88	162	7	3	16	51	85	0.49
1988/89	167	8	2	17	54	86	0.47
1989/90	187	7	2	16	61	101	0.48
1990/91	202	7	2	14	51	128	0.50
1991/92	227	6	4	13	55	149	0.50
1992/93	267	3	3	9	47	205	0.49
1993/94	348	6	6	18	67	251	0.47

(Source : Maize Board, 1994).

### 2.5.2 Maize Board—Miller Marketing Margins

Figure 8 shows a rising real Maize Board—Miller (MBM) margin in South Africa since 1977. Between 1977/78 and 1986/87 both real Maize Board ( $P_{MB}$ ) and Miller ( $P_M$ ) selling prices rose, but since 1986/87 both  $P_M$  and  $P_{MB}$  have declined. The margin has, however, risen overall due to  $P_{MB}$  declining faster than  $P_M$ . Possible explanations include increased demand for services, higher real variable costs (such as wages and electricity) per ton of milled maize or costs being passed on because of market power due to already entrenched market concentration amongst

millers. An additional factor could be adoption by the Maize Board of a new pricing policy in the 1987/88 marketing year, whereby losses on export sales were reflected in a lower net or blend price for farmers - and hence lower real  $P_{MB}$  paid by millers - despite a higher nominal levy.



**Figure 8** Time Trend of Real Maize Board - Miller Margin (1990 = 100) (Source : Central Statistical Services, 1994; Directorate Agricultural Economic Trends, 1995).

## CHAPTER 3

### RESEARCH METHODOLOGY

#### 3.1 CONTESTABILITY ANALYSIS

The principles of contestability theory outlined in Chapter 1 will be applied to analyze regulations affecting the handling and storage of maize grain at the producer/Maize Board level. The intention is to assess trends in contestability at this market level in the Industry since 1931, given changes in the structure of maize grain marketing described in Chapter 2. The results of the contestability analysis are given in Chapter 4.

#### 3.2 EMPIRICAL MODEL OF DETERMINANTS OF THE MAIZE BOARD—MILLER MARGIN

##### 3.2.1 Product Equivalent

Margin analyses relying upon comparisons between prices at successive stages from the farmer to ultimate consumer must establish comparable physical units, as the product undergoes tremendous changes in form, composition, processing and packaging before it reaches the ultimate consumer (*Tomek and Robinson 1990*). For this study, fixed proportions are assumed whereby 1 ton of maize meal at miller selling price will be converted using an accepted conversion factor (80% extraction) to an equivalent tonnage at the producer level (*Elliott, 1994*). That is, 1.25 ton of raw maize grain is equivalent to 1 ton of maize meal. Price data

were collated from a number of sources - *Maize Board (1994)*, *Central Statistical Services (1994)*, *Directorate Agricultural Economic Trends (1995)* and *Millers Association (1994)*. The data obtained have severely limited the scope of the study as only 17 years of aggregate mill data for the period 1977-1993 was available on an annual basis. Following *Faminow and Laubscher (1991)*, price related variables are deflated using the CPI (1990=100).

### 3.2.2 Empirical Model

Past work by *Gardner (1975)*, *Heien (1977)*, and *Wohlgenant and Mullen (1987)* on margin determinants showed how simultaneous shifts in retail food demand and farm product supply affected marketing margins using a relative price model. Assuming perfectly competitive conditions and fixed proportions in production, they found marketing costs, quantity processed and output prices to be important margin determinants. The *Azzam et al., (1989)* and *Schroeter and Azzam (1991)* margin models of the non-competitive U.S. hog packing industry outlined in Chapter 1 provided a framework for analysing price spreads by decomposing the margin into different components. Their principal finding was that the farm - wholesale pork margin consistently tended toward competitive performance.

They decomposed the margin into cost and market power components by applying iterated Three Stage Least Squares (3SLS) to quarterly data. Using their approach, the following demand model for maize meal (equation (7)) was estimated as a basis for estimating the effect (if any) of miller marketing power on the MBM margin :

$$LNQP = a_0 + a_1 LNRMP + a_2 LNRPBB + a_3 LNURB + a_4 LNIP \quad (7)$$

where :	$LNQP$	=	natural log of quantity consumed per capita (weighted sifted meal equivalent) (t),
	$LNRMP$	=	natural log of real miller white maize meal selling price (R/t),
	$LNRPBB$	=	natural log of real brown bread flour selling price (R/t),
	$LNURB$	=	natural log of urbanization proxy variable (% of total RSA population which is urbanized),
	$LNIP$	=	natural log of real gross domestic income per capita (R), and
	$a_1$	=	Own price elasticity of demand for milled white maize at miller level.

The variable  $LNRMP$ , is expected to be negatively related, and  $LNIP$  positively related, to  $LNQP$  if maize meal is perceived as a normal good (the reverse holds for  $LNIP$  if maize meal is perceived to be an inferior good by consumers). Although potatoes and rice are observed to be maize meal substitutes, *Sartorius von Bach and Van Zyl (1994)* found brown bread to be the most consistent substitute for maize meal over 1984 - 1990 in South Africa. This implies that  $LNRPBB$  would be positively related to  $LNQP$ . A negative relationship between  $LNURB$  and  $LNQP$  is anticipated as consumers are expected to switch away from foods which are time consuming to prepare (like maize meal based dishes) with increased urbanization. The double-log model (*Gujarati, 1988*) enables direct estimation of the own price elasticity of

demand for milled white maize at miller level ( $a_i$ ). This statistic is used in the marketing margin model to derive an estimate of miller marketing power.

The maize margin model utilizing information on  $a_i$  was adapted from *Azzam et al., (1989)*. Assume that the input (maize grain) is processed into a single homogeneous product (white maize meal). Each miller uses a production technology such that the production relationship between input and output is one of fixed proportions. Non-farm inputs ( $C$ ) such as labour and electricity, useable in variable proportions, are used to convert maize grain into maize meal. The Industry (maize millers) faces a supply function for the farm product under *competitive* conditions :

$$Q = G(P_F, Z_1) \quad (8)$$

and a demand function for its output :

$$Q = H(P_M, Z_2) \quad (9)$$

where  $P_F$  and  $P_M$  are the prices of the farm product (maize grain) and processed item (white maize meal), respectively, and  $Z_1$  and  $Z_2$  are the vectors of exogenous variables ( $Z_2$  equivalent to  $LNRPBB$ ,  $LNURB$  and  $LNIP$  in equation (7)).

An individual processing firm's profit maximization position under the given industry supply

and demand conditions would be achieved by processing the quantity which would maximise equation (10) :

$$P_M Q^j - P_F Q^j - C^j \quad (10)$$

- where  $P_M$  = Price of processed food item,  
 $P_F$  = Price of farm product,  
 $Q^j$  = Quantity processed by  $j^{\text{th}}$  processing firm, and  
 $C^j$  = Marginal cost of  $j^{\text{th}}$  processing firm.

The first order necessary condition for optimal output is equation (11) :

$$P_M \left(1 + \frac{\theta^j}{\mu}\right) - P_F \left(1 + \frac{\theta^j}{\epsilon}\right) - \frac{\partial C^j}{\partial Q^j} = 0 \quad (11)$$

- where  $\mu$  =  $(\partial H / \partial P_M) P_M / Q$ , the elasticity of industry demand,  
 $\epsilon$  =  $(\partial G / \partial P_F) P_F / Q$ , the elasticity of agricultural input supply, and  
 $\theta^j$  =  $(\partial Q / \partial Q^j) Q^j / Q$ , the  $j^{\text{th}}$  firm's conjectural elasticity.

The conjectural elasticity is an index of the firm's market power. If the firm is a price taker under purely competitive conditions,  $\theta^j$  would equal zero.



Equation (11) can be rearranged to give equation (12) as the marketing margin model :

$$M \equiv P_M - P_F = -\frac{P_M \theta'}{\mu} + \frac{P_F \theta'}{\epsilon} + \frac{\partial C'}{\partial Q'} \quad (12)$$

where  $M$  = Farmer - Miller marketing margin.

Assuming that the  $j^{\text{th}}$  firm possesses some market power (that is,  $\theta' > 0$ ) the marketing margin will exceed marginal costs by two positive terms,  $-P_m \theta' / \mu$  (positive because  $\mu$  is negative) and  $P_f \theta' / \epsilon$ , which are respectively the monopoly/oligopoly and monopsony/oligopsony price distortions.

The study MBM margin model, adapted from equation (12) is :

$$MBM = b_1 RMP + b_2 RTVCOP + b_3 DI \quad (13)$$

where :

- $MBM$  = Real Miller-Maize Board margin (R/t),
- $RMP$  = Real miller white maize meal selling price (R/t),
- $RTVCOP$  = Real total miller variable cost of production (R/t),
- $DI$  = Dummy variable for 1987 Maize Board maize grain price policy change ( $DI = 0$  for 1977-1986 and 1 for 1987-1993), and
- $b_1$  =  $-(\theta/a_1)$ , as  $a_1$  is negative.

The Maize Board—Miller margin is a better representation than the Farmer—Miller margin of the South African maize grain marketing situation, as the Maize Board was officially the sole buyer of maize from producers (monopsony) and sole seller (monopoly) of maize to millers over the study period. This was also the rationale for dropping the monopsony term, since the Maize Board as sole seller could restrict any input oligopsony power by millers. The dummy variable  $DI$  was added to show the effect of the Maize Board maize grain pricing policy change which occurred in May 1987. The coefficient  $b_j$  should equal  $-(\theta/\mu)$ , that is, the  $j^{\text{th}}$  firm's conjectural elasticity divided by the miller level price elasticity of demand for maize meal. However, given that only aggregate industry data was available,  $\theta$  is replaced by  $\theta$  (industry conjectural elasticity) and  $\mu$  estimated by  $a_j$  from equation (7). The industry market power ( $\theta$ ) can be estimated in absolute terms as :

$$\theta = b_j * a_j . \quad (14)$$

It is expected that  $MBM$  would be positively related to  $RMP$ ,  $RTVCOP$  and  $DI$ . The results in Chapter 4 show how the above model is used to estimate the determinants of the  $MBM$  margin.

## CHAPTER 4

### RESULTS

#### 4.1 TRENDS IN CONTESTABILITY OF MAIZE GRAIN MARKETING SINCE 1931

Contestability of maize grain marketing after 1931 was largely restricted through the statutory powers of the Maize Board acting as legal barriers to entry. The regulations (explained in Chapter 2) included : Price fixing (prohibiting any person acquiring, selling or disposing of any maize or maize products at any price other than at a fixed price); Restrictive trading and permits (prohibiting any person from selling or purchasing maize except to or through Maize Board agents in controlled areas; Compulsory levies imposed on maize of any class, grade or quality sold and payable by maize producers, millers, feed manufacturers, stock feeders, importers and exporters to finance the General, Reserve and/or Special Funds; and Compulsory registration (each person dealing in the course of trade with maize had to register with the Board and comply with its requirements).

Marketing reforms prior to the "new" scheme in 1995 eased some of the constraints on contestability. For example, abolition of controlled prices for maize products at retail/merchant (1960) and wholesale/milling (1971) levels and a movement away from limited registration of maize processors in 1977 which allowed for the emergence of small processors called "*bosmeulens*". The prohibition on the erection of grain silos was repealed; and the Grain Silo Committee and price control on maize meal were also scrapped (*Rees, 1979; Financial Mail, 1991; Cowrie, 1992*). In 1987 the Board shifted away from price determination at Cabinet

level to a market-based, pool type pricing scheme. Annual subsidization of the Maize Board's handling and storage costs was phased out, and permission granted for free transactions between farmers and processors/consumers subject to the payment of Maize Board levies (*LAPC, 1993a; LAPC, 1993b; Financial Mail, 1991; Cownie, 1992 and GATT, 1993*). Removal of subsidies on maize production and debt write-offs to farmers and cooperatives of R3.4 billion also occurred in the 1992/93 season.

The "new" maize marketing scheme introduced on the 1 May 1995 promoted contestability in allowing free interaction between producers and buyers on the domestic market. However, the retention of Maize Board control over maize grain exports, and certain remaining statutory powers (compulsory levy and registration), still constrain contestability. The producer, under a freer market will be faced with greater price uncertainty (implying greater financial risk) as he is now responsible for storage, transport and the marketing of his crop. Sentraalwes Co-operative initiated electronic maize marketing in conjunction with the Agricultural Marketing Exchange (AMEX) in August 1995 with an auction price of R793.43/t for Grade 1 white maize on 16 August 1995. Besides selling direct to the processor or auctioning his crop via AMEX, the producer may via the South African Futures Exchange (SAFEX) enter into either (i) forward contracts introduced in July 1995 (*SAFEX, 1995*) or (ii) manage price risks by hedging in futures contracts on SAFEX which began on 26 February 1996. A futures market can provide opportunities to hedge risk and provide useful public information on prevailing prices (*Frank, 1992*). The lifting of foreign exchange controls could also open up international commodity exchanges (eg. Chicago Board of Trade) to local traders and infuse liquidity into SAFEX (*Gravelet-Blondin, 1996*).

Any restraints on market exit discourage entry and thereby reduce the competitive threat posed by the availability of potential entrants (*Bailey and Baumol, 1984*). There are about 220 grain silos in South Africa owned by the Maize Board's agents, mainly agricultural cooperatives, with a storage capacity of some 14.5 million tons (*Financial Mail, 1991*). These storage forms require substantial, virtually irreversible capital investment - implying considerable sunk cost, costly exit and limited contestability. The current replacement cost of these silos is estimated at a conservative R3 billion or about R207/t (*Financial Mail, 1991*). Alternative technologies, actually or potentially available, may permit cost reductions. Even if the standard technology is least-cost, the availability of these alternatives may provide a competitive constraint limiting the extent to which the cooperatives current monopoly power can be exerted. More on-farm storage could become a viable option as market forces generate a whole range of different storage, transporting and handling facilities and arrangements such as bunker storage, plastic tunnels, steel silos and lease (rental) agreements. For example, it is possible to erect on-farm steel silos (2000t capacity) for approximately R110/t and concrete silos (330t capacity) for about R167/t (*Viljoen and Brink, 1995*).

The leasing of existing silos by producers and maize traders will enhance contestability (reduce burden of sunk costs) and permit ease of entry and exit by limiting exclusive access. Silo space is presently being rented for R38/t from the Natal Agricultural Co-operative (*Natal Agricultural Co-operative, 1995*). Co-operatives which have supplied farmers with production credit may though use their credit power to coerce producers to store maize at the local silo despite on-farm storage possibly being cheaper (*Agri-Africa, 1995*). Many producers are constructing their own silos on-farm, supporting the perception that the 220 silos owned by co-operatives are not economically optimally sited. Any excess capacity which is present may

in reality be "dead capacity" and not contribute to contestability (reduction of sunk costs). Maize silos can be used to store other bulk crops eg. wheat, sorghum, sunflower, soya and cassava. Such alternative uses raise the opportunity cost and therefore increase contestability (ease exit from maize).

Technological change (small truck mounted mills) and the ease with which "*bosmeulens*" have entered the market reflect either (i) a degree of contestability that existed even under restrictive regulatory conditions, or (ii) the perception of small mills that these regulations cannot be enforced. Compulsory payment of levies constrains entry, distorts prices, limits freedom of economic activity and limits contestability. It is expected that large firms (millers) may negotiate growing contracts with maize farmers or vertically integrate by purchasing maize farms so as to internalize the benefits and avoid levy payments. It is difficult to foresee how the Maize Board intends to police compulsory levy payments in a system which allows "free trade" and creates the incentive to avoid levy payments. The costs of policing the system may well exceed the benefits accruing to the Board.

The Maize Board will be the sole exporter of maize grain under the new scheme. Collective export negotiation does not necessarily (and should ideally not) require a monopoly, statutory or otherwise. It is often best done on a voluntary and/or competitive basis which puts additional pressure on the negotiating body to be effective so as to facilitate contestability. For example, South African Avocado Growers have had much success with voluntary collective export negotiation under competitive conditions (*Groenewald, 1989*). The single channel export scheme may also be challenged under the new South African constitution (freedom of association and freedom of economic activity). Furthermore, if a futures market is to be

established and investment from multinational maize trading firms (e.g. Cargill) secured in South Africa, then the single channel export scheme needs to be abolished so that private concerns can trade and hedge in the international market. Continuing opposition to compulsory levy payments, particularly by processors, may well cause the collapse of the present floor price and single channel export scheme which relies on these payments (*Gravelet-Blondin, 1996*).

Phyto-sanitary conditions and an import tariff (currently zero) are the only restrictions on the importation of maize into South Africa. As long as the tariff set remains in line with the GATT and does not constitute a significant barrier to entry preventing actual or potential competition, contestability should not be obstructed. The Maize Board could well use its position as advisor to the Minister on phyto-sanitary conditions as a mechanism to exert control over maize imports. In October 1995, phyto-sanitary requirements were reviewed for a shipment of maize from the USA for the bacterial disease caused by *Erwinia stewartii*. Permits were granted for the importation of the maize subject to strict control over port of import, transport and milling of the uncertified maize (*Blignaut, 1995*).

## 4.2 MARGIN DECOMPOSITION AND MARKET POWER

### 4.2.1 Correlation Matrix

The correlation matrix in Table II shows that *LNQP* (log of sifted meal equivalent consumed per capita) is negatively correlated at the 10% level of significance, with *LNRMP* (log of real



millers white maize selling price) - when the real price of maize meal increases, less maize meal will be consumed. The correlation between *LNQP* and *LNRPBB* (log of real brown bread flour selling price) is highly positive (1% level of significance), as expected, since maize meal consumption is likely to increase as the price of brown bread (substitute) increases. The high negative correlation (1% level of significance) of *LNQP* with *LNURB* (log of percentage of total RSA population which is urbanised) reflects consumers switching to more time saving foods, such as bread, as urbanization increases (*Nieuwoudt, 1994*). The income variable, *LNIP*, is positively correlated (20% level of significance) with *LNQP*, but one would expect a negative correlation if maize meal is an inferior good. *Elliott (1991)*, however, found maize meal to be a normal good for the black segment of the population who consume an estimated 94% of all maize meal produced in South Africa. Multicollinearity may be present as *LNRPBB* and *LNURB* are highly negatively correlated.

Table II Correlation Coefficients Between Demand Model Variables

	LNQP	LNRMP	LNRPBB	LNURB	LNIP
LNQP	1.0000	-0.3179*	0.8384***	-0.9091***	0.1569 <sup>ns</sup>
LNRMP	-0.3179*	1.0000	0.1206 <sup>ns</sup>	0.0689***	-0.1390 <sup>ns</sup>
LNRPBB	0.8384***	0.1206 <sup>ns</sup>	1.0000	-0.8802***	0.0400 <sup>ns</sup>
LNURB	-0.9091***	0.0689***	-0.8802***	1.0000	-0.0855 <sup>ns</sup>
LNIP	0.1569 <sup>ns</sup>	-0.1390 <sup>ns</sup>	0.0400 <sup>ns</sup>	-0.0855 <sup>ns</sup>	1.0000

where \*\*\*, \*\*, \* and <sup>ns</sup> represent respectively the 1%, 5% and 10% levels of significance and no statistical significance.

In Table III, the expected positive relationship between *MBM* (real Maize Board—Miller marketing margin) and *RMP* (real miller white maize meal selling price) is shown, although

only significant at the 15% level. *MBM* is highly positively correlated (1% significance level) with *RTVCOP* (real total miller variable cost), and *D1* (margin rose in response to increased input price risk due to the Maize Board maize grain price policy change in 1987). Multicollinearity may be a problem as *RTVCOP* and *D1* are themselves also highly significantly correlated (0.8108).

Table III Correlation Coefficients Between Margin Model Variables

	MBM	RMP	RTVCOP	D1
MBM	1.0000	0.2934 <sup>ns</sup>	0.9003 <sup>***</sup>	0.8031 <sup>***</sup>
RMP	0.2934 <sup>ns</sup>	1.0000	0.2397 <sup>ns</sup>	-0.1135
RTVCOP	0.9003 <sup>***</sup>	0.2397 <sup>ns</sup>	1.0000	0.8108 <sup>***</sup>
D1	0.8031 <sup>***</sup>	-0.1135 <sup>ns</sup>	0.8108 <sup>***</sup>	1.0000

where <sup>\*\*\*</sup>, <sup>\*\*</sup>, <sup>\*</sup> and <sup>ns</sup> represent respectively the 1%, 5% and 10% levels of significance and no statistical significance.

#### 4.2.2 Regression Models

Ordinary Least Squares (OLS) estimates of the demand and margin models are reported in equations (15) and (16) ((RATS, 1995, GAUSSX, 1995 and SPSS, 1995) :

$$LNQP = -5.5815 - 0.6926 LNRMP + 0.7402 LNRPBB - 3.5461 LNURB + 0.0070 LNIP$$

$$(t=-4.18)^{***} \quad (t=-4.01)^{***} \quad (t=2.58)^{**} \quad (t=-2.87)^{**} \quad (t=0.67)^{ns}$$
(15)

$$\overline{R^2} = 90.91\% \quad F = 41.01^{***}$$

$$MBM = 0.0648 RMP + 1.7310 RTVCOP + 33.8604 DI$$

$$(t=1.08)^{ns} \quad (t=2.22)^{**} \quad (t=1.86)^*$$
(16)

$$\overline{R^2} = 98.93\% \quad F = 529,46^{***}$$

where \*\*\*, \*\*, \* and *ns* represent respectively the 1%, 5% and 10% levels of significance and no statistical significance.

The overall fit of equation (15) to the data is good (high adjusted  $R^2$  and significant F-test). All variables have the expected sign and coefficients are significant at the 1% and 5% levels, except for LNIP. The Durbin-Watson statistic of 1.45370 was inconclusive concerning positive autocorrelation. The non-parametric RUNS test confirmed the model was free of autocorrelation (observed sequence was accepted as being random at the 5% level of significance). As equation (15) is a natural log model, the *LNRMP* coefficient is the estimated own price elasticity demand for white maize at the miller level of -0.69.

In equation (16) the variables have the expected signs and the regression was fitted through the origin because theory predicts that marginal cost is linearly homogenous in factor prices (Schroeter and Azzam, 1991). If costs were the sole component of the margin, then when costs of processing are zero, the margin would be zero. This assumption was validated by re-running the regression with a constant term which had a non-significant coefficient. No autocorrelation was detected using the RUNS test. Multicollinearity may, however, be present due to the high adjusted  $R^2$  and small  $t$  value on  $RMP$ , although  $RTVCOP$  and  $DI$  coefficient estimates are significant at the 5% and 10% levels. Multicollinearity is a sample phenomenon and has no unique method of detection or remedy (Gujarati, 1988).

Following Azzam *et al.*, (1989) and Schroeter and Azzam (1991), a 3SLS model, where the endogenous variables ( $RMP$ ,  $LNRMP$ ,  $LNQP$  and  $MBM$ ) are jointly determined, was estimated for the demand (equation (17)) and margin (equation (18)) models (RATS, 1995 and GAUSSX, 1995):

$$LNQP = -6.6866 - 0.3982LNRMP + 0.4524LNRPBB - 4.7284LNURB + 0.0113LNIP$$

$$(t=-4.39)^{***} \quad (t=-1.67)^{ns} \quad (t=1.53)^{ns} \quad (t=-3.73)^{***} \quad (t=1.12)^{ns}$$
(18)

$$\overline{R^2} = 88.54\%$$

$$F = 2.14^{ns}$$

$$MBM = 0.0732RMP + 1.6264RTVCOP + 35.5172DI$$

$$(t=1.15)^{ns} \quad (t=1.99)^* \quad (t=1.96)^*$$

(18)

$$\overline{R^2} = 81.63\%$$

$$F = 1777.8^{***}$$

The system model estimates an own price elasticity of demand for milled maize at the miller level of -0.3982 which is plausible, although anticipated to be higher, as the elasticity is expected to increase with an increase in the number of substitutes (eg. brown bread, potatoes and rice). *Elliott and Van Zyl (1991)* used bar code scanning data to estimate price elasticity of demand for maize meal in urban regions (consumer level) at -0.69. *Van Zyl (1986)* and *Van Zyl and Nieuwoudt (1990)* estimated the own price elasticity of demand of white whole maize at the Maize Board level to be -0.149, and -0.14 (relatively inelastic).

A variable accounting for output price risk in the industry similar to that used by *Brorsen et al., (1985)* and *Faminow and Laubscher (1991)* had a statistically insignificant coefficient and was therefore dropped from the analysis. Input price risk effects are probably captured by *DI* accounting for the 1987 Maize Board pricing policy change (see above).

The estimated conjectural elasticity (0.029) lies within the range found by *Azzam et al., (1989)* of 0.0564 to -0.0004 in the US hog industry. The conjectural elasticity estimate appears to support the millers' claim that the industry is highly competitive despite high miller concentration as measured by the *CR3* of 47% in 1993/94, although the *CR3* has trended downwards since 1977/78 (see section 2.5).

The margin was decomposed into its different components in equation (18) as shown in Table IV. Estimated values (obtained by placing actual data for *RMP*, *RTVCOP* and *DI* in equation (18)) are similar to the actual recorded figures. The cost and policy change components are important determinants as expected, while the oligopoly component, despite low market power, contributes more than the policy change. The low market power measure may reflect

multicollinearity as identified above. A Principal Component analysis using the method of *Kendall (1957)* cited by *Nieuwoudt (1972)* and *Chatterjee and Price (1977)* was therefore carried out on the explanatory variables in the system to purge the data of multicollinearity and re-estimate the conjectural elasticity and margin decomposition.

Table IV Margin Decomposition from 3SLS Regression, 1977/78 - 1993/94

Year	Actual Margin	Estimated Margin	Oligopoly Component ( $-(\theta/a_i)RMP$ )	Variable Cost Component ( $b_2*RTVCOP$ )	Policy Change Component ( $b_3*D1$ )
1977/78	97.61	125.74	43.88	81.87	0.00
1978/79	120.27	134.49	47.18	87.31	0.00
1979/80	98.91	116.68	48.94	67.74	0.00
1980/81	126.96	135.61	53.27	82.34	0.00
1981/82	152.74	135.44	52.90	82.54	0.00
1982/83	158.48	139.54	53.74	85.81	0.00
1983/84	189.07	156.34	54.97	101.37	0.00
1984/85	154.40	167.70	59.95	107.76	0.00
1985/86	185.65	163.29	59.51	103.78	0.00
1986/87	151.39	170.10	59.61	110.49	0.00
1987/88	201.65	201.96	56.69	109.76	35.52
1988/89	197.92	203.13	53.12	114.49	35.52
1989/90	207.31	210.52	52.21	122.80	35.52
1990/91	227.38	214.28	52.57	126.19	35.52
1991/92	210.46	214.69	52.20	126.98	35.52
1992/93	201.21	211.53	51.63	124.37	35.52
1993/94	227.97	217.00	49.36	132.12	35.52

Since "multicollinearity should only be attacked after the model specification is satisfactory (*Chatterjee and Price, 1977:151*)", the residuals were plotted against time to verify the model specification. Correcting for an outlier (1985/86), the plot appeared random and therefore the specification was taken as theoretically and statistically satisfactory. Principal Component

Analysis is justified since "the basis of any analysis of multicollinearity is found in the structure of the correlations among the explanatory variables. Since correlations are unaffected by shifting or scaling the data, it is both sufficient and convenient to deal with standardized variables (*Chatterjee and Price, 1977:160*)".

Four principal components for the demand model (PCD's) and three principal components for the margin model (PCR's) were extracted using *GENSTAT (1995)* as shown in Table V and Table VI.

Table V Principal Components Extracted for Demand Model

Variable	Principal Component			
	PCD1	PCD2	PCD3	PCD4
ZLNRMP	0.16248	-0.87627	0.41251	-0.18865
ZLNRPBB	0.59890	0.17070	0.42666	0.65585
ZLNURB	-0.58412	-0.33679	-0.15518	0.72200
ZLNIP	0.52318	-0.29930	-0.78976	0.11392
Latent Root (Eigenvalue)	2.384	1.129	0.393	0.094
Percentage Variation	59.59	28.22	9.83	2.36



The estimated equations were :

$$ZLNQP = 0.48980 PCD_1 + 0.54417 PCD_2 + 0.16016 PCD_3 \quad (21)$$

and

$$ZMBM = 0.67361 PCR_1 + 0.13832 PCR_2 \quad (22)$$

*Chatterjee and Price (1977)* and *Kendall (1957)* (cited by *Nieuwoudt, 1972*) show the link between the component loadings of  $PCR_1$  and  $PCR_2$ , the  $\alpha$ 's and the coefficient's ( $\beta$ 's) of the standardized model of the *MBM* as :

$$ZMBM = \beta_1 * ZRMP + \beta_2 * ZRTVCOP + \beta_3 * ZDI \quad (23)$$

where

$$\begin{aligned} \beta_1 &= 0.13416 * \alpha_1 + 0.95279 * \alpha_2 \\ \beta_2 &= 0.71492 * \alpha_1 + 0.09729 * \alpha_2 \\ \beta_3 &= 0.68622 * \alpha_1 + 0.28763 * \alpha_2 \end{aligned} \quad (24)$$

and *ZRMP*, *ZRTVCOP* and *ZDI* are the standardised explanatory variables.

Substituting the  $\alpha$ 's obtained in equation (20) into equation (24) gives  $\beta$  values of  $\beta_1 =$

0.22216,  $\beta_2 = 0.49503$  and  $\beta_3 = 0.42246$ . Similarly, standardized demand model parameter estimates can be obtained from the  $\rho$  estimates. The  $t$  values and significance levels for the standardized parameter estimates are found by dividing the coefficients by their standard errors.

The standard errors are obtained from equation (25) :

$$Var (\beta_i) = \sum_{i=1}^2 (PCLoading)^2 * Var \alpha_i \quad (25)$$

where the variance of the  $\alpha_i$ 's is given by :

$$Var (\alpha_i) = \frac{1 - \sum_{i=1}^2 \lambda_i \alpha_i^2}{(n - k - 1) \lambda_i} \quad (26)$$

- where  $\lambda_i$  = Latent root or Eigenvalue,  
 $\alpha_i$  = Coefficients of equation (20),  
 $n$  = Sample size, and  
 $k$  = Number of PC's retained.

The resultant  $t$  values for the standardized coefficients are equivalent to those for the variables in original scale since the correlations of the variables are unaffected by scaling (*Chatterjee and*

*Price, 1977*). Furthermore, the  $\beta$ 's can be transformed back into their original scale (b's) by multiplying by  $(S_y/S_x)$ , the standard deviation of the dependent variable divided by the standard deviation of the explanatory variable. The regression estimates in original scale are thus  $b_1 = 0.15817$ ,  $b_2 = 1.74096$  and  $b_3 = 35.24640$  for the margin model and  $a_1 = -0.69436$ ,  $a_2 = 0.75869$ ,  $a_3 = -3.56436$ , and  $a_4 = -0.10758$  for the demand model.

The demand and margin models in original scale (free of multicollinearity) are thus :

$$LNQP = -0.06 - 0.69436LNRMP + 0.75869LNRPBB - 3.56436LNURB - 0.10758LNIP \quad (27)$$

$(t=-4.04)^{***}$ 
 $(t=7.35)^{***}$ 
 $(t=-11.58)^{***}$ 
 $(t=-0.32)^{ns}$

$$MBM = -69.3623 + 0.15817RMP + 1.74096RTVCOP + 35.2464DI \quad (28)$$

$(t=2.29)^{**}$ 
 $(t=8.85)^{***}$ 
 $(t=7.00)^{***}$

Compared to equations (17) and (18) which are in the same units, the  $t$  values have improved substantially so that all coefficients are now highly significant (except  $LNIP$ ) with the correct signs and the demand elasticity has increased to -0.69436. Under the assumption of fixed proportions, the elasticity of demand for the resource is expected to be similar to that of the final product (*Friedman, 1976*). Thus the estimate confirms the use of this assumption and is consistent with *Elliott and Van Zyl's (1991)* estimated demand elasticity of -0.69. The market power term, using this estimated elasticity, is 0.10983, higher than 0.029 but still low, showing competitive behaviour in the industry. This seems contrary to the concentration ratio level (although the ratio trends down), but may be explained by the possible existence of excess

only a single-shift and shut down at night (*Financial Mail, 1991*). Cost economies could also be realised if the larger millers expand output when plants are not operated at full capacity (*Azzam et al., 1989*). The constant term appearing in the margin model is calculated to correct for the normalization process in determining the principal component loadings of *GENSTAT* (1995) and does not affect the underlying theoretical assumption of fixed proportions.

The decomposition of the margin (free of multicollinearity) in Table VII shows that there is a slight improvement in the predictive power of the model when compared to Table IV as the estimated values more closely approximate the actual values.

Table VII Margin Decomposition (free of Multicollinearity) 3SLS Regression, 1977/78 - 1993/94 (where  $b_0 = -69.3623$ )

Year	Actual Margin	Estimated Margin	Oligopoly Component ( $-(\theta/a)RMP$ )	Variable Cost Component ( $b_2*RTVCOP$ )	Policy Change Component ( $b_3*D1$ )
1977/78	97.61	113.13	94.86	87.63	0.00
1978/79	120.27	126.11	102.00	93.47	0.00
1979/80	98.91	108.96	105.81	72.51	0.00
1980/81	126.96	133.96	115.18	88.14	0.00
1981/82	152.74	133.36	114.37	88.35	0.00
1982/83	158.48	138.67	116.18	91.85	0.00
1983/84	189.07	158.00	118.85	108.51	0.00
1984/85	154.40	175.59	129.60	115.35	0.00
1985/86	185.65	170.39	128.66	111.09	0.00
1986/87	151.39	177.79	128.88	118.28	0.00
1987/88	201.65	205.93	122.56	117.49	35.25
1988/89	197.92	203.29	114.85	122.55	35.25
1989/90	207.31	210.20	112.87	131.45	35.25
1990/91	227.38	214.63	113.66	135.08	35.25
1991/92	210.46	214.66	112.85	135.92	35.25
1992/93	201.21	210.65	111.63	133.14	35.25
1993/94	227.97	214.03	106.72	141.43	35.25

Policy implications of the estimated MBM determinants and the contestability analysis are considered in the conclusion.

## CONCLUSIONS

The structure of the South African Maize Industry reflects a complex interaction of political, economic and historical forces since the Industry was first subject to government intervention in 1931. Past studies identify numerous Industry interest groups (producers, consumers, millers, wholesalers, retailers and the Maize Board) and the need for maize market reform. Between 1931 and 1987 the South African Maize Industry lacked contestability in grain marketing due to the Single Channel Fixed Price Marketing Scheme and restrictive regulations including price fixing, restrictive trading, compulsory levies and compulsory registration. Changes which promoted contestability include the abolition of controlled pricing at retail/merchant (1960) and wholesale/milling (1971) levels and movement away from limited registration of maize processors (1977). The increase in small market participants ("*bosmeulens*") since the 1987 reforms when the Board shifted away from price determination on a cost-plus basis to a market-based and pool type pricing scheme, reflects increased contestability.

The "New" Maize Marketing Scheme which moves away from the Single Channel Fixed Price Scheme to free trade within the domestic market, increases grain marketing contestability, but retention of Maize Board control over maize grain exports constrains contestability. The reduction of sunk costs through more on-farm storage and handling facilities such as bunker storage, plastic tunnels, steel and concrete silos, and the leasing of existing silos (possible excess capacity and alternative uses) by producers and maize traders could substantially enhance contestability. The removal of remaining restrictive legislation in the domestic market (compulsory levy payments, registration and return submissions), facilitating access to "sunk -

cost" facilities, and allowing for freer trade in maize exports could well be the most appropriate way for policy makers to further enhance contestability (increase ease of entry and exit) in maize grain marketing. While this section of the dissertation focused on maize grain handling and storage, further research is needed to analyze contestability in maize processing and maize meal marketing.

Study results for the estimated determinants of the Maize Board—Miller (MBM) marketing margin are limited by the small sample size (17 years for 1977 - 1993) and lack of firm specific data. Future research could possibly source firm specific data through a survey of millers/processors in the industry. The maize milling industry is characterized by entrenched, but declining concentration (CR3 ratio fell from 0.52 for 1977/78 to 0.47 for 1993/94 season), and firm specific data are needed to provide more in depth conclusions from empirical work. However, the estimated models show that the MBM margin was positively related to *RMP* (real miller white maize meal selling price), *RTVCOP* (real total miller variable cost), and *DI* (dummy variable for 1987 Maize Board maize grain price policy change whereby export losses were reflected in lower real net producer prices).

The main component of the MBM marketing margin for 1977 - 1993 was variable processing costs. A decrease in the real consumer price of maize could possibly be achieved by reducing the real processing costs of maize meal, particularly with the removal of fixed administered prices of inputs (like electricity) and moderation of real wage (43% of total variable costs for 1993/94) demands in negotiations between trade unions and millers. Foreign exchange and import controls may, however, still result in the costs of imported inputs remaining relatively high if the Rand should weaken further. Maize market liberalization and the resultant increase



in the number of "*bosmeulens*" entering the market shows that mill sunk costs may become less relevant in preventing entry and constraining contestability as the "*bosmeulens*" are able to compete with larger millers without incurring as substantial sunk costs.

The 1987 Maize Board maize grain pricing policy change captured the effect of input price risk on the MBM margin by increasing the margin. Potential changes in pricing policy thus represented an additional source of risk for maize millers to contend with. This source of risk will be replaced by market price risk under the "new" scheme. Millers, producers and retailers will make more use of forward contracts and consider trading in newly established white maize futures contracts to manage this risk. The "oligopoly" component of the MBM margin makes a smaller contribution than the variable cost component. The low industry conjectural elasticity of 0.109 estimated from this component indicates a competitive Maize Milling Industry over the study period. The cost economies obtained by increasing mill throughput may have outweighed the incentives for oligopolistic output restrictions. Miller market power may possibly be exerted on other products (e.g. wheat) with white maize seen as a loss leader. That is, millers may exercise market power and make profits on wheat but use maize meal to increase turnover and liquidity, where the maize market is more competitive. This interrelationship between maize and other grains in miller processing decisions is an area for future research. It remains to be seen whether recent moves to eliminate price setting of maize grain by the Maize Board could lower real maize prices and lower the real MBM margin, as well as opening up new substitution possibilities for mill services. Future research could also focus on the role which the futures market will play in managing maize price risk and how this will affect the MBM margin.

## SUMMARY

Market reform in the South African Maize Industry has important implications for the South African Economy as maize is the most important field crop and forms the staple food for the majority of South Africa's people. The present structure of the Maize Industry reflects a complex interaction of political, economic and historical forces.

Market reform is considered at two levels in the South African Maize Industry : Firstly, the theory of contestable markets is used to assess regulations concerning maize grain storage and handling at the producer/Maize Board level. Secondly, the determinants of the Maize Board—Miller marketing margin are identified to assess the impact (if any) of miller market power on the margin.

The theory of contestable markets (where competitive pressures from potential entrants exercise strong constraints on the behaviour of incumbent suppliers) is reviewed. The history of the Maize Marketing Schemes and Industry structure since the promulgation of the 1931 Mielie Act until April 1995 shows increased contestability (increased ease of entry and exit through the reduction of restrictive legislation). Trends in maize miller structure and the Maize Board—Miller (MBM) margin for the period 1977/78 - 1993/94 show relatively high but declining concentration and a rising MBM margin.

The "New" Maize Marketing Scheme operating from 1 May 1995 fosters contestability by increased "free" trade within the domestic market, but also restrains contestability by retaining Maize Board control over maize grain exports. The reduction of sunk costs through possible

on-farm storage and handling facilities such as bunker storage, plastic tunnels, steel and concrete silos, and the leasing of existing silos (possible excess capacity and alternative uses) by producers and maize traders could substantially enhance contestability. The removal of remaining restrictive legislation in the domestic market (compulsory levy payments, registration and return submissions), facilitating access to sunk facilities and allowing for freer trade in maize grain exports could well be the most appropriate way for policy makers to further enhance contestability (increase ease of entry and exit) in maize grain marketing.

The MBM margin determinants are estimated by Ordinary Least Squares (OLS) and Three Stage Least Squares (3SLS) regression analyses. Principal Component Analysis was also used to purge the data of multicollinearity effects. The MBM margin was positively related to miller market power (proxied by industry conjectural elasticity), the real miller maize price, real variable processing costs, and a change in Maize Board pricing policy after 1987 (input price risk). Reduction of the MBM margin could be achieved by reducing variable costs, particularly wages and electricity. The estimated conjectural elasticity of 0.109 was low (1.0 would reflect perfect oligopoly), indicating competitive milling conditions, although concentration ratios indicate entrenched (but declining) market power. The full effects of the more liberalized maize marketing structure are still to be seen.

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## APPENDIX A

$$\frac{P_{MB}}{P_M} = g(Q ; \frac{RVCOP}{P_M})$$

and since  $M = P_M - P_{MB} \therefore P_{MB} = (M - P_M)$

$$\therefore \frac{-(M - P_M)}{P_M} = g(Q ; \frac{RVCOP}{P_M})$$

$$\Rightarrow \frac{M}{P_M} - \frac{P_M}{P_M} = -g(Q ; \frac{RVCOP}{P_M})$$

$$\Rightarrow \frac{M}{P_M} = 1 - g(Q ; \frac{RVCOP}{P_M})$$

$$\Rightarrow \frac{M}{P_M} = 1 - \frac{P_{MB}}{P_M}$$

$\therefore$  *Relative Price Spread = 1 - Relative Maize Board Price*

$\therefore$  *Rewritten as the Absolute Maize Board Miller Margin :*

$$M = P_M h(Q ; \frac{RVCOP}{P_M})$$

$$\rightarrow M = f(P_M Q ; \frac{P_M \cdot RVCOP}{P_M})$$

$$\rightarrow M = f(P_M Q ; RVCOP)$$

$\therefore$  *The Empirical Specification is :*

$$M_t = \beta_1 P_{Mt} + \beta_2 P_{Mt} Q_t + \beta_3 RVCOP_t$$