MSU International Development Working Papers

An Analysis of Alternative Maize Marketing Policies in South Africa

by

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MSU International Development Working Paper No. 50
1995

Department of Agricultural Economics
Department of Economics
MICHIGAN STATE UNIVERSITY
East Lansing, Michigan 48824

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This paper is published by the Department of Agricultural Economics and the Department of Economics, Michigan State University (MSU). Funding for this paper was provided by the Development Bank of South Africa and by the Food Security II Cooperative Agreement (AEP-5459-A-00-2041-00) between MSU and AID/Global Bureau, Economic Growth Center, Office of Economic and Institutional Development. The report has also benefitted from comments of John Strauss, Charles Machethe, David Tschirley, and Michael Weber.

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ISSN 0731-3438

Published by the Department of Agricultural Economics and the Department of Economics, Michigan State University, East Lansing, Michigan 48824-1039, U.S.A.

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1. INTRODUCTION

The maize-oriented agricultural economies throughout Southern Africa are in fundamental transition. Increased recognition of the costs of historical controls on pricing and marketing already has led to partial maize market liberalization in several countries in the region. However, there is still intense debate over the appropriate scope and implementation of future food market reform. Much of the debate derives from uncertainty over the consequences of comprehensive and politically risky changes to domestic markets, especially at a time when regional market conditions are also in flux due to agricultural restructuring in neighboring countries. There is currently little information on the direction and magnitude of grain trade between South Africa, Zimbabwe, and other countries in the region under a deregulated external trading environment. There is also a lack of information on the regional consequences of alternative domestic maize policy scenarios currently under deliberation in South Africa.

The purpose of this research is fourfold. First, we consider the role of food market reform in affecting future economic growth and food security in South Africa, and discuss the congruence between the government's food policy objectives and the existing marketing and pricing system. Second, trends in maize production, trade, prices and marketing costs in South Africa and Zimbabwe, the two largest maize traders in the region, are presented. Third, we present four alternative maize policy scenarios in South Africa, and then estimate their effects on maize production, gross revenues, consumer prices, and trade flows under various weather and pricing scenarios in Zimbabwe. A comparison of results across four policy scenarios clarifies the gainers, losers, and extent of income transfers between various regions and socio-economic groups within each region. The final section identifies means by which national food policy objectives in South Africa may be more cost-effectively achieved through harmonization of policies between South Africa and its regional neighbors.

Four policy scenarios are examined: (1) the existing system of government-controlled maize prices in South Africa and Zimbabwe; (2) deregulated maize trade within South Africa, under a range of controlled price levels in Zimbabwe; (3) deregulated maize trade within and between South Africa, Zimbabwe, and the world market; and (4) a protected regional market, i.e., Scenario 3 with alternative tariff levels on imported yellow maize from the world market.

The study's findings are based on an econometrically-parameterized spatial equilibrium model. The model includes 13 geographic regions: Western Cape, Northern Cape, Orange Free State, Eastern Cape, KwaZulu/Natal, Eastern Transvaal, Northern Transvaal, Gauteng (former PWV), Northwest; Zimbabwe (commercial farming sector); Zimbabwe (smallholder sector); other major maize producing countries in the SADC region (Mozambique, Botswana, Malawi, and Zambia); and the world market.

2. THE ROLE OF MAIZE POLICY REFORM IN AFFECTING FUTURE ECONOMIC GROWTH AND FOOD SECURITY

History indicates that the development process in most regions of the world has occurred through structural transformation (Johnston and Mellor 1961; Mellor 1976; Staatz 1994). Structural transformation involves a process of increased specialization of labor, a transition from subsistence production to exchange-based economies, and a relative shift in resources from farm to non-farm sectors. Structural transformation is typically driven by technical change and institutional innovation in the food system, thereby raising labor productivity, real wages, and incomes. Because 12 million of South Africa's 16 million people living under the poverty line are in rural areas, most of whom are engaged in agriculture, productivity growth in agriculture is likely to be a precondition for injecting purchasing power into rural areas and hence stimulating demand and employment growth in the broader economy. The empirical record of Europe and Asia convincingly demonstrates the importance of agricultural growth in stimulating broad-based rural income growth and economic transformation (e.g., Johnston 1951; Ashton and Mingay 1965; Mellor 1973).[1]

A related process, involving the relationship between the price of staple wage goods and economic growth, also has been observed throughout the world, starting with Ricardo in early 19th century England. One of the most important ways of transferring resources inter-sectorally is to reduce the price of food relative to non-agricultural products through productivity growth in the food system (Mellor 1973; Timmer 1988; Staatz 1994). A fall in consumer food prices relative to other goods has the effect of transferring resources from the food system to other parts of the economy, as it now takes fewer resources from the non-food sectors to buy a unit of food. This allows industrial firms to hold down money wages, making their firms more profitable and competitive internationally (Staatz 1994; Delgado 1992).[2] However, there is a major difference whether a decline in real food prices are achieved through cost-reducing productivity growth or through taxation of farmers (Binswanger 1994; Schiff and Valdes 1992).

Beside these indirect effects of food prices on employment and income growth, consumer food prices directly affect the level of food security and disposable incomes of the poor.

Food policy reform in Southern Africa is likely to critically affect both of these economy-wide processes: the degree of intersectoral income transfers, and the cost of food/industrial competitiveness relationship. Given the importance of maize in human diets, farm incomes, and agro-industries in Southern Africa, maize market reform has the potential to affect (a) consumer food prices, and therefore the real incomes of South Africa's 16 million people living in poverty;

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[1] In South Africa, Vink (1993) highlights the importance of agriculture's backward and forward linkages to the broader economy.

[2] Labor productivity is also determined by skill levels (in addition to labor costs), but this aspect is less directly affected by agricultural policy.

(b) the extent of decentralization and de-concentration in the food system, with implications for patterns of investment and economic growth; (c) future surplus maize production levels over and above domestic demand, which would affect rural/urban terms of trade; (d) incentives for private firms to develop viable input delivery systems to black smallholder areas, thus affecting future production costs and agricultural viability in these areas; and (e) regional comparative advantage and potential gains from trade in Southern Africa. For these reasons, maize policy reform in Southern Africa has importance far beyond the food sector; it is likely to be a determinant of future economic growth and food security throughout the region (Groenewald 1991).

2.1. Policy Objectives and Current Maize Marketing Systems: A Means-Ends Consistency?

The objectives of agricultural policy typically involve: (1) income growth for farmers (especially those with political representation); (2) food security for consumers; (3) food price and supply stability; (4) the minimization of treasury outlays arising from government maize marketing activities; and (5) environmental sustainability. There are obvious trade-offs between these objectives. The political power of various stakeholders has greatly influenced how these trade-offs have been resolved.

Before 1980, the structure of maize marketing and pricing was remarkably similar in South Africa and Zimbabwe (formerly Southern Rhodesia). An elaborate system of trading regulations were instituted to protect European farmers from the competition from African farmers. State marketing boards (i.e., the Maize Board and Grain Marketing Board in South Africa and Zimbabwe, respectively) were designed to provide assured market outlets for mainly European farmers at stable prices generally held above export parity levels. This relatively high-price policy generated surplus production in both countries and trading losses on exports. The system of controls blocked potentially profitable trade between African farmers and mines, livestock operations, commercial farms and urban consumers. Because of these controls, surplus production in communal areas was channeled by default to the Board or its agents, which offered considerably lower prices relative to European farmers. This differential pricing structure was used, primarily in Southern Rhodesia to partially offset the trading account losses associated with setting prices to European farmers that were too high to break even on exports (Keyter 1975).

Once in the hands of the Boards or their agents, maize was normally transported onward to a small group of industrial millers and animal feeders. These large-scale buyers became, by regulation, vertically linked to the Boards; procurement of maize from other sources was illegal. At the same time, unlicensed or "informal" traders and millers were typically restricted from procuring maize from the Boards. The combination of movement controls and selective access to the Boards' maize stocks effectively reserved the bulk of the white maize in both countries for the industrial millers, distributors, and retailers in the official marketing channel and consequently assured their oligopolistic position in the maize meal market. Thus, as in much of Eastern and Southern Africa, grain marketing in South Africa and (prior to 1992) Zimbabwe had been dominated by a single-channel flow of grain from rural areas into the state/urban milling system, providing preferential access to selected buyers and impeding the development of a more decentralized and lower-cost system (Jayne and Chisvo 1991; Groenewald 1991; van Zyl and Kirsten 1992; Jayne, Takavarasha, and van Zyl 1994).

Upon independence in 1980, the Zimbabwean government rapidly expanded market outlets for surplus grain production in smallholder areas. Smallholder output rose dramatically, but this was confined mainly to the high-potential Mashonaland maize belt (Amin 1990). The structure of the market had changed little in terms of improving access to grain in urban and grain-deficit rural areas until 1992, when controls on informal maize trade were relaxed and then eliminated in 1993. Large subsidies on maize meal distributed through the industrial milling system were also abolished. Within one year, these policy changes have induced a large shift in urban maize consumption patterns, from the refined meal produced and distributed through the official marketing channel to the less-refined and less expensive whole meal produced by informal small-scale millers (Rubey 1993).

Zimbabwe's Grain Marketing Board (GMB) continues to set uniform prices that do not vary within the marketing year or across regions. This supports farm incomes in maize surplus areas facing high transport costs to urban markets (mainly smallholders in the Mashonaland and Midlands areas). Yet the GMB's status of residual buyer offering fixed buying and selling prices does not allow the Board to respond to changes in market conditions. To the extent that GMB prices exceed those in parallel channels, the Board bids away grain from informal trading channels and incurs large losses associated with surplus stocks.[3] When GMB prices are lower than informal market prices, GMB intake will fall, causing difficulty for the Board to defend its selling prices without importing and releasing sufficient grain onto the market to drive down prices to the desired level. Past experience also indicates that this is a costly undertaking. Some commentators have stated that Zimbabwe's uniform pricing and associated supply management policies represent the "cost of food security." Evidence suggests, however, that these policies are not the least costly means of achieving food security (Masters and Nuppenau 1993).

In South Africa, private maize trade is still heavily regulated by the Government. Since 1987, the system effectively operates as a single channel pooling scheme. The Government sets the price at which maize will sell in domestic markets. Prices differ between various "market segments," i.e., the human market, the animal market, the industrial market, and the international market, in order to achieve the objective of maximizing revenue (price times volume) in the long-term" (Willemse et al 1994, p. 10). Producer payouts are determined by subtracting the Board's operating costs from the Board's sales revenue. In this way, the system is designed to avoid treasury losses associated with state maize trading. While this pricing mechanism has depressed real producer prices since 1987, it is widely believed that the system still transfers income from low-income black consumers to white commercial farmers (Groenewald 1991; Meyer and van Zyl 1992; Wright and Nieuwoudt 1993).

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[3]In 1993/94, GMB's budget deficit amounted to 5% of national GDP.

Maize processing and retailing in South Africa is still dominated by an oligopoly of large-scale, vertically-linked private firms. However, recent relaxation of licensing has increased the market share of small-scale millers in South Africa to about 10%.

An important difference in the market structure of South Africa and Zimbabwe is the scale and sophistication of private maize trading firms. This difference is largely attributed to policy. South Africa's Maize Board has primarily served as a coordinator and director of maize movement and pricing, leaving the physical distribution and storage activities to private firms (although still controlled by the Maize Board), whereas Zimbabwe's Grain Marketing Board (GMB) historically has performed all of these functions directly.

The major stakeholders in maize market reform are:

(a) governments, concerned primarily with the effects of reform on political support from various socio-economic groups and their ability to retain influence over strategic factors such as price levels; (b) taxpayers, comprised of a quite narrow base in both South Africa and Zimbabwe; (c) commercial large-scale farmers; (d) smallholder farmers; (e) urban consumers; (f) rural households dependent on the market for maize; (g) the state marketing boards; (h) private firms involved in maize storage and distribution; (i) animal feeders; (j) large-scale maize processors, wholesalers, and retailers involved in the milling and distribution of maize meal through the official marketing channel; and (k) small-scale or informal traders and millers outside of the official marketing system.

The raison d'etre of marketing boards has always been, and continues to be, an instrument of governments for transferring incomes to particular groups, and for promoting economic and political stability. In South Africa, the transfer has been from consumers (and taxpayers, prior to 1987) to commercial farmers, but this may change given a different ranking of priorities within the new Government. In Zimbabwe, government's primary concern is over the tradeoff between state deficit reduction and the protection of smallholder maize sellers' interests. The central problem is that the current and unsustainably large GMB trading deficit (5% of GDP in 1993/94) is largely a result of a high-priced and pan-territorial pricing policy that, while serving the interests of smallholder maize sellers far from urban demand centers, is often inconsistent with underlying market conditions and contains no mechanism for the GMB to flexibly respond to these conditions (GMB 1991). In both South Africa and Zimbabwe, the landlocked position of many urban centers and the thinness of the international white maize market have elevated governments' concern over maize price stability and the preservation of state marketing boards in order to operationalize this objective.[4] There are compelling economic, social and political reasons for continued price stability, and an important task for government is to determine how to continue this -- to some degree -- in a financially sustainable way.[5]

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[4]Typically through stockholding operations to defend fixed buying and selling prices.

[5]A lengthy presentation of these political, social and economic reasons can be found in Jones (1994).

The relative power and influence of these stakeholders differs across countries. For example, the interests of black smallholders have been incorporated more fully into maize policy in Zimbabwe over the past decade compared to South Africa, resulting in different pressures on the evolution of maize policy reform. In both countries, a relatively small but well-represented group of smallholder farmers (5% of the total) receive most of state expenditure on maize purchases from the smallholder sector (Table 1). These farmers count on the continued provision of close market outlets that the Boards currently provide, and oppose any withdrawal of those benefits. These benefits are responsible for much of the GMB's deficits *under the current pricing policy*. The smallholder farm lobby group in Zimbabwe is actually dominated by large-scale African farmers, whose interests tend to dominate over the much larger group of food-deficit smallholders who are most likely hurt by higher maize prices (Jayne and Rukuni 1993). Most smallholders in both countries sell little or no maize.

2.2. Food Self-Sufficiency vs. Food Self-Reliance

Most states in Southern Africa have pursued a policy of food self-sufficiency. Food self-sufficiency involves meeting domestic demand through production and stockholding. Food self-reliance involves meeting a country's requirements through a combination of production, stocks, and trade, with the mix depending on the relative costs of procurement from each source.

A fundamental issue guiding the management of a national food economy is identifying the least costly way to secure national food requirements. Food self-sufficiency is beneficial to farmers, consumers, and the government treasury alike if it can be achieved at prices below import parity levels and surplus production can be exported without a loss. To the extent, however, that consumers can acquire maize more cheaply from other sources, or exports must be underwritten by the government, self-sufficiency imposes costs on consumers and/or taxpayers, and in some cases, even farmers (e.g., animal producers, farms with large labor requirements, and most importantly, smallholders who are net food buyers).

On the surface, the pursuit of maize self-sufficiency in Zimbabwe and South Africa, and the associated controls on food pricing and trade, appears to have reflected the interests of selected farmers at the expense of consumers (Mosley 1983; Wright and Nieuwoudt 1993; Jayne and Rukuni 1993; Groenewald 1991). This is especially true where imports could supply a particular area more cheaply than domestic production. Prices in South Africa,especially in the coastal regions, have clearly been driven up beyond those that would prevail if import controls were relaxed (NAMPO 1994). In the case of Zimbabwe, Jayne and Rukuni (1993) found that a policy of food self-reliance, involving a relatively small amount of imports, would have reduced the cost of maize to consumers by 1% to 16%, depending on the weather, compared to a pricing policy geared consistently to achieve food self-sufficiency.

Yet these findings, while important, do not necessarily mean that the pursuit of food self-sufficiency is misguided, because of potential dynamic linkages between domestic food production growth and non-farm sectors. As mentioned earlier, because most of the rural poor are engaged in agriculture, stimulating rural incomes through agricultural growth is likely to fuel the demand for agricultural wage labor and for goods in non-farm sectors. Yet there is a major difference whether such agricultural growth occurs through new technology and increased productivity, or through protecting farmers from external competition.

The magnitude of growth linkages also depends on the skewness of productive resources in rural areas, because the potential of money to be widely recycled through the economy depends in part on how narrowly concentrated the first round of beneficiaries of a direct income effect would be. South Africa's agricultural system is highly concentrated. About 60,000 white farmers own 85% of the country's arable land, while one million black smallholders farm 15% of the land and produce mainly for subsistence. It is estimated that 12,000 white farmers produce almost 80% of the total agricultural output (Louw 1990). Even in the former homeland areas, black agricultural production is equally skewed (van Zyl and Kirsten 1992), and rural black households are increasingly dependent on externally-produced food supplies.

In Zimbabwe, rural resources are equally skewed. One percent of the African smallholder farms received 48% of the revenue paid by the state to smallholders for maize purchases (Table 1). One percent of all farms in the country (including European commercial farms) received 70% of the state's outlays on maize purchases (Jayne and Rukuni 1993). Evidence in both countries indicate that most rural smallholder households in both South Africa and Zimbabwe are net buyers of food (Stack and Chopak 1990; Jayne and Chisvo 1991; Hedden-Dunkhorst 1990; Dankwa 1992; Kirsten and Sartorius von Bach 1992). A skewed concentration of resource ownership and marketing grain output is typical throughout Africa, though generally to a lesser degree (Weber et al 1988).

Table 1. Concentration of Income from Maize Sales to Zimbabwe's Grain Marketing Board (1985/86 to 1991/92)

category	total number (approx.)	number of farmers that sell maize to GMB	GMB maize purchases (annual average)			% of total GMB expenditures on maize purchases accruing to
			tonnes	tonnes per family that sells maize	tonnes per all families within category	
	(A)	(B)	(C)	(D)	(E)	(F)
Commercial farms	4,000	1,652[a]	490,902	297.2	122.7	46
Smallholder households						
top 1% of maize sellers	9,000	9,000	254,182	28.2	28.2	24
top 2%-10% maize sellers	81,000	81,000	275,556	3.4	3.4	26
remaining households	810,000	24,000	47,948	2.0	0.06	4
all smallholders	900,000	114,000	577,686	5.1	0.6	54
All farms	904,000	115,652	1,068,588	9.3	1.18	100

Row D = C/B; Row E = C/A; Row F = C/total GMB maize purchases

[a] based on 1985/86 to 1990/91 marketing year.

Source: Jayne and Rukuni 1993.

Two major conclusions may be drawn from these findings. First, maize pricing policy in South Africa and Zimbabwe have extremely concentrated direct benefits. Most rural smallholders derive little or no direct benefit from higher maize prices.[6] Second, many farm households, as well as urban consumers, are directly hurt by higher maize prices, at least in the short run. Given the skewed concentration of assets among the rural sector, and without a major redistribution of productive resources in rural areas, it is doubtful that the objective of broad-based rural income growth is compatible with the historical practice of holding maize prices at or above import parity levels (Kirsten and Sartorius von Bach 1992).

This point should not be construed as an argument for altering the rural-urban terms of trade against agriculture. This strategy, pursued in much of Africa through controlled marketing systems during the 1970s and 1980s, has strongly depressed household food security in these countries (World Bank 1981; Schiff and Valdes 1992). However, the opposite approach of raising farm prices above market levels has led to the same result in South Africa. Empirical results elsewhere indicate that in countries characterized by a large gap between import and export parity (such as Zimbabwe and South Africa), high food prices drive up wage costs and the real exchange rate, making these countries less competitive in international trade and slowing overall economic growth by raising production costs in the non-agricultural sectors. Examples of this Ricardian "food bottleneck" have been documented by authors such as Mellor (1976) and Delgado (1992) to analysis of growth strategies in India and the Sahel.[7] Because of important backward and forward linkages, the price of maize undoubtedly influences the general level of prices in the economies of much of Southern Africa (Blackie 1987). Efforts to reduce the cost of procuring national food requirements could help increase disposable income in urban and grain-deficit rural areas and also promote competitiveness in labor-intensive non-farm sectors of the economy (Delgado 1992; Reardon, Delgado, and Matlon 1992). While these general-equilibrium concepts are not formally modelled below, we stress their importance in the development of appropriate maize marketing policies in the region.

The trade-offs between domestic production incentives and food affordability may be relieved by measures to reduce food production and marketing costs and increase incomes. Over the long run, this requires sustained support for input and credit delivery systems, agricultural research and extension to generate and disseminate new technology, efficient product distribution and processing systems, and in some cases, a reallocation of productive resources. But all of these will be critically affected by policies on pricing, infrastructure, and technology, which, over time, alter income distribution, effective demand, and household food security. As observed by Johnston and Mellor over three decades ago (1961), economic growth is constrained by a skewed income distribution. The skewed distribution of assets and productive potential among

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[6] Although higher maize prices could, other things equal, contribute to the incomes of low-income smallholders by stimulating the demand for agricultural wage labor, household survey data indicates that wage labor income is marginal for most smallholder families in both South Africa and Zimbabwe (see Sartorius von Bach, Kirsten, and van Zyl 1994; Stack and Chopak 1990).

[7] See Staatz (1994) for a concise synthesis.

the rural population in many African countries underscores the need for a clearer understanding of how agricultural pricing and trade policies may be re-designed to stimulate broad-based rural income growth.

3. MAJOR TRENDS IN THE MAIZE SECTORS

3.1. Production and Trade Trends

South Africa and Zimbabwe are the largest producers of maize in the Southern Africa region (Table 2). However, South Africa typically produces more maize (including yellow) than the combined production of Zimbabwe, Zambia, Swaziland, Lesotho, Mozambique, Malawi, Botswana, and Namibia. Hence, policy reforms with non-marginal effects on domestic market conditions in South Africa are likely to influence food market conditions and/or government treasury outlays in the rest of the region, given a freer external trade regime.

Market restructuring in Zimbabwe and Zambia may alter food market conditions in the smaller countries in the region, but would be expected to have only moderate effects on the South African market. Marketed maize output in Zimbabwe and Zambia combined amounts to about 20% to 30% of marketed maize output in South Africa. When considering white maize only, this figure rises to 35%-45%.

Maize production has been stagnant or declining over the 1982/83-1993/94 period in all of the countries listed in Table 2. In per capita terms, maize production has been declining in all countries. This has been deliberate in South Africa since 1987, and in Zimbabwe during the late 1980s, due in both cases to surplus production and subsequent export losses. Yet in the other countries, falling per capita production represents increasing reliance on South Africa, Zimbabwe, and the limited supplies of white maize on international markets, for residual white maize requirements.

In both South Africa and Zimbabwe, maize yields have been stagnant over the last quarter-century, with the exception of Zimbabwe's smallholder sector between 1980 and 1985 (Figure 1). Linear time trends regressed on a five-year centered moving average of maize yields were statistically insignificant over the 1972-1993 period for Zimbabwe's large-scale commercial sector and for all nine regions of South Africa. However, input use per hectare has declined in commercial maize production in both South Africa and Zimbabwe since the early 1980s, and hence total factor productivity of maize production may well have risen (Thirtle et al. 1993a; 1993b).

In Zimbabwe's smallholder sector, the moving average of yields grew at an average annual rate of 76 kgs/hectare from 1979-1986 (significant at the 5% level), but the trend has since reached a plateau. Fertilizer use among smallholders has declined since 1986, and the hybrid seed varieties currently used by most smallholders are almost 20 years old. Total factor productivity of smallholder maize production has stagnated since 1985 (Jayne et al. 1994).

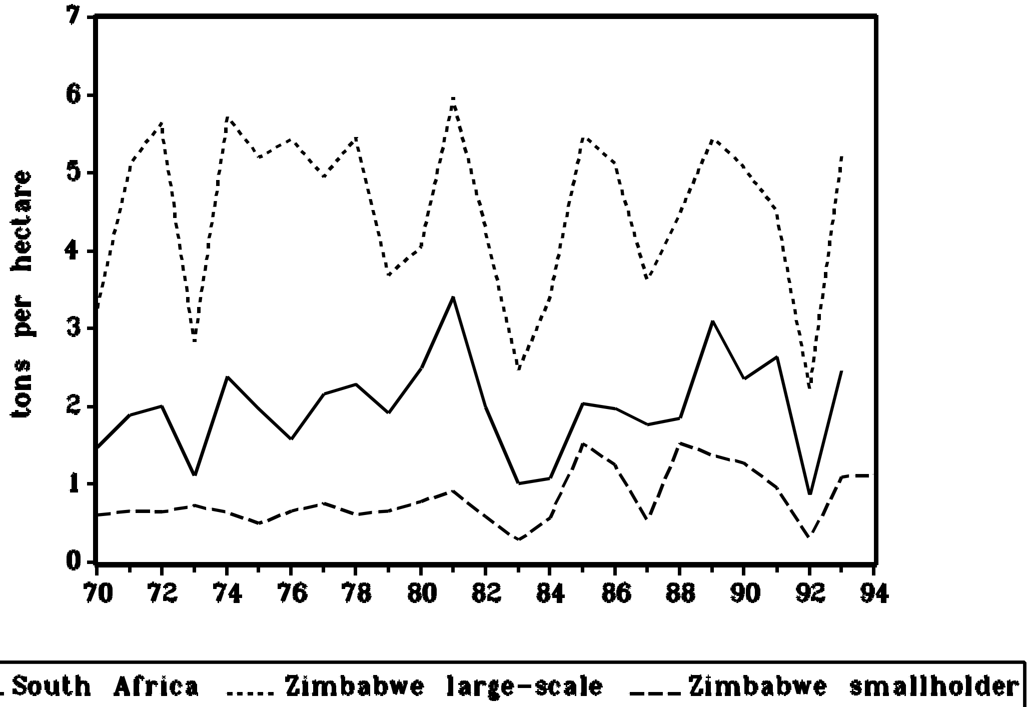
Table 2. Maize Production and Net Exports, 1982/83-1993/94, Selected Southern African Countries

	Mozambique		South Africa		Swaziland		Zambia		Zimbabwe	
	Production[2]	Net exports	Production white/yellow	Net exports[3]	Production[4]	Net exports[4]	Production	Net exports	Production white/yellow	net exports white and yellow
	'000 tonnes									
1982/83[1]	350	-91	4,200/4,000	5,007				-112	1,762/25	492
1983/84	330	-71	2,100/2,000	-1,556	32	-50	867	-99	881/23	252
1984/85	350	-215	1,750/2,800	1,364	149	-46	930	-95	1,223/24	-269
1985/86	400	-403	3,500/4,200	980	148	-22	1,214	-97	2,842/118	285
1986/87	459	-111	3,300/4,300	3,504	170	-22	1,427	-14	2,278/110	495
1987/88	271	-132	3,579/3,489	2,326	156	-10	1,003	-63	944/77	393
1988/89	322	-293	3,780/2,951	1,333	100	-28	1,834	0	2,072/150	314
1989/90	330	-261	6,553/4,999	4,906	112	-32	1,997	270	1,885/209	174
1990/91	453	-227	4,365/3,977	1,784	135	-16	1,464	0	1,603/243	410
1991/92	327	-379	3,810/4,016	1,024	153	-11	1,448	-171	1,054/282	150
1992/93	133	-525	1,232/1,690	-3,950	46	-127	486	-720	373/144	-1,625
1993/94	533		4,060/3,974		84		1,600			

Notes: [1]Year are marketing years (April through March, except for South Africa, which is May through April); production occurs in the first year of the split year. [2]Almost entirely white maize. Estimates are drawn from various data sources (below), using different estimation methods. [3] Exports for South Africa include sales to Customs Union members: Botswana, Lesotho, Swaziland, and Namibia, as well as to the independent Black states. During the years 1983/84, 1984/5 and 1992/93, there were no exports outside the Customs Union. South Africa exports and imports both white and yellow maize grain and products. 4Swaziland production and import data does not distinguish between white and yellow maize, although most maize produced or imported in the country has been white.

Sources: Swaziland: Economic Planning Office, Ministry of Economic Planning and Development (1993), *Development Plan 1993/94 - 1995/96*, Mbabane; and Early Warning Unit of the Ministry of Agriculture and Cooperatives database for 1992/93 data. South Africa: Maize Board (1992), Maize Board Annual Report 1991/92; Arcadia, Pretoria, and US Embassy unpublished data for 1992/93 - 1993/94. Mozambique (1982/3 - 1989/90) FAO Agrostat 2.0 (1993) computer database, provisional data. Mozambique (1990/91 - 1992/3: Ministry of Commerce, DSA Bulletins, 1992/93. Zambia: Howard (1994). Zimbabwe: Agritex/FAO Early Warning Unit, Ministry of Land, Agriculture, and Water Development, Government of Zimbabwe, Harare for the production data 1985-1992, Commercial Farmers Union data files, Harare. for the yellow maize production data, Central Statistics Office, Ministry of Finance, data files, Harare for the yellow maize production 1982-1985, and Grain Marketing Board, 1993, Annual Report 1992, Harare for import and export data.

Figure 1. Yield Trends for White Maize, South Africa and Zimbabwe, 1970-1994



3.2. Maize Yield Correlations

One important indicator of the potential for mutually beneficial maize trade in the region is the degree of correlation between maize yields in the major production areas. Most of the year-to-year production variability in both South Africa and Zimbabwe is due to fluctuations in yields as opposed to area planted. Moreover, the major actors in the region (South Africa, Zimbabwe, and Zambia) do not always produce a surplus, but tend to fluctuate from net exporter to net importer depending on rainfall.[8] A positive correlation between the major production regions would indicate similarity of weather patterns, and raise the probability that countries would experience surpluses or deficits at the same time. Such a finding would, ceteris paribus, reduce the potential for the development of a durable, consistent pattern of regional maize trade. On the other hand, a low or negative correlation of maize yields among major production regions would indicate that deficits in one area might be filled by surplus production in other countries.

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[8]Historically, this has been least true of South Africa, but is likely to become more common due to the current structural reduction in maize production, and apparent climatic change in the Southern Africa region (Magadza 1994).

Table 3 presents the correlation coefficients between major maize production areas in the region over the period 1982-1993. Maize yields are positively and highly correlated in the region. Among the major producing regions (Orange Free State, Eastern Transvaal, Northwest, Zimbabwe commercial, Zimbabwe smallholder, and Zambia smallholder), the lowest correlation coefficient among any particular pair was 0.31, while the average correlation coefficient was 0.66.[9] These results suggest that the ability of regional trade to stabilize regional supplies and consumption is limited by rather similar weather patterns in the region. However, because the quantity of white maize available on a consistent basis from other regions of the world is limited, it is still important to explore unexploited opportunities for meeting residual white maize requirements within the region.

3.3. Pricing Trends

Much attention has been devoted to anticipating the flow of agricultural trade in Southern Africa that might occur under regional comparative advantage (van Rooyen et al 1994; Kingsbury 1989; Koester 1986). The concept of comparative advantage involves many factors: consumer preferences, technology, factor endowments, transactions costs, and the rules underlying market exchange that determine costs (Bromley 1994). These factors are somewhat policy-driven. For example, policy in Southern Africa have clearly shaped labor flows and costs, maize demand patterns, and technology investment in agriculture. It is questionable, therefore, that there is some objective underlying structure of costs and preferences that can be used as the basis to determine comparative advantage.[10] An examination of historical relative price trends between countries in Southern Africa is not likely to give an accurate view of future trade flows if the structure of the markets changes significantly. However, a comparison of farm prices and marketing margins across countries provides insights into the potential gainers and losers under a less controlled regional trading environment.

Figure 2 presents trends in white maize producer prices in South Africa and Zimbabwe, denominated in US$ at official exchange rates.[11] Since 1987, producer prices in South Africa have been determined as a function of domestic and export market conditions. Crop input use has declined and total factor productivity has increased in South Africa

[9]Because of a general absence of common yield trends over the sample period, taking correlation coefficients of the first differences in yields gave essentially the same results.

[10]Markets and other forms of exchange (from which costs are derived) do not exist without rules to set the framework for exchange and to determine what gets counted as a cost (see Bromley 1993; Schmid 1992; Samuels 1992).

[11]Official exchange rates are used to examine potential trading incentives under the prevailing macroeconomic policy regimes in the two countries. Further analysis is necessary to examine the implications of less regulated exchange rate regimes in the region.

Table 3. Correlation Coefficients of White Maize Yields Between Major Production Regions in Southern Africa, 1980-1993*

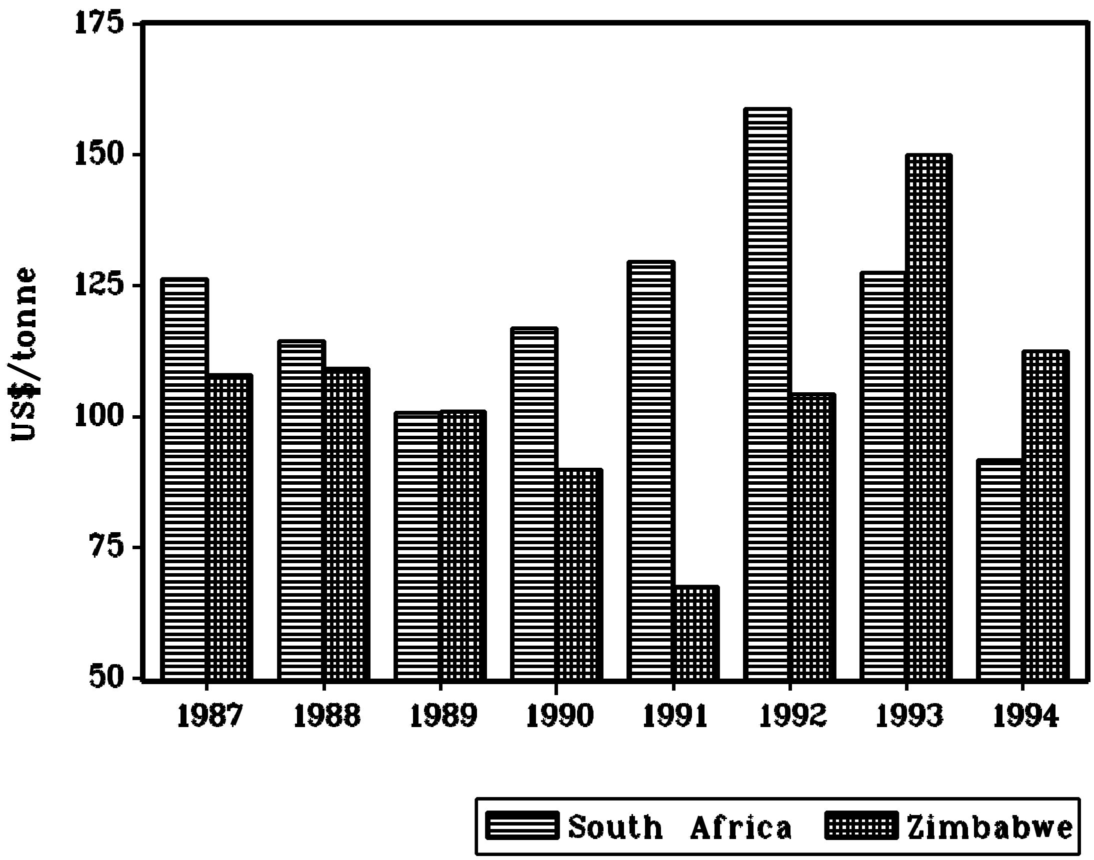
	Eastern Transvaal	Northern Transvaal	Northwest Region	Zimbabwe, Commerical Sector	Zimbabwe, Smallholder Sector	Zambia, Smallholder Sector
Orange Free State	.58	.30	.46	.90	.64	.67
Eastern Transvaal		.38	.48	.77	.47	.51
Northern Transvaal			.29	.52	.18	.12
Northwest Region				.59	.31	.65
Zimbabwe, Commercial Sector					.81	.69
Zimbabwe, Smallholder Sector						.70

Source: Calculated by authors from data from Maize Board (South Africa); Central Statistics Office (Zimbabwe); and Howard (Zambia).

since the mid 1980s, suggesting increased competitiveness of South Africa's farm sector (Thirtle et al 1993a). It is anticipated that maize producer prices will remain near their historically low current levels as long as large surpluses of maize continue to be produced and exported at a financial loss. But a further decline in excess capacity, while increasing the likelihood of shortfalls and imports, would cause expected producer and consumer price of maize to rise.

Zimbabwean producer prices, on the other hand, have increased sharply since the 1992 drought to restore domestic production incentives. For the past two years, Zimbabwean producer prices have exceeded those in South Africa. While it is difficult to predict how government-determined producer prices in Zimbabwe will evolve in the future, several trends in Zimbabwe are noteworthy: (a) maize area, both within the commercial and smallholder farming sector, have declined steadily since 1985, (b) government-supplied credit to stimulate smallholder production has declined steadily in real terms since 1986; (c) the expansion of Grain Marketing Board buying stations in smallholder areas has actually declined in recent years due to both poor harvests and budget considerations; (d) recent liberalization of Zimbabwe's maize marketing system will make it difficult and costly for the government to continue offering producer prices inconsistent with long-run market conditions; and (e) the productivity gains achieved by Zimbabwean smallholders through hybrid seed and fertilizer adoption in the early 1980s have been largely exhausted. A new technology package

Figure 2. Maize Producer Prices in South Africa and Zimbabwe, 1987/88-1994/95



(especially one appropriate for semi-arid conditions where 60% of Zimbabwe's maize area is situated) is necessary to appreciably reduce maize production costs.

Moving down the food system, there are at least two relevant margins in the official marketing channel: The first is the margin between the selling price and the producer price (which accrues to the marketing board), and the second is the margin between the retail price of meal and the selling price of maize (which accrues to millers and distributors). The formulae used to calculate these margins were:

Marketing Board margin: *PS - PP + S1*

Mill-to-retail margin: *PMM/z - PS + [(z-1)/z]PB + S2*

where *PS* is the selling price (price at which millers buy maize grain from the relevant marketing board); *PP* is the marketing board's producer price, and *S1* is the net trading loss per tonne of maize handled by the Board, if applicable. *PS - PP + S1* thus represents the operating cost required by the Board to handle one ton of maize.

PMM is the retail price of maize meal; *z* is the average extraction rate (i.e., tonnes of grain required to manufacture one tonne of meal, 1.176 for both countries); *PB* is the value of maize by-product per tonne of grain used for processing; and *S2* is the direct subsidy given to millers, if applicable. The mill-to-retail margin thus represents the margin which millers, distributors, and retailers receive for processing one ton of maize into meal and distributing the meal to retail shops. Both margins are expressed in terms of tonnes of grain handled.

These margins were added to the producer prices presented in Figure 2 to derive the total financial value of maize meal in South Africa and Zimbabwe, i.e., farm price + marketing board margin + miller/distributor margin (Figure 3).[12] Despite an unclear picture with regard to relative farm production costs in the two countries, cost comparisons at the retail level are very stark. South African consumers and taxpayers paid about twice as much on average, over the 1987-1994 period, for commercial sifted maize meal (85% extraction rate, converted to US dollars at official exchange rates) than Zimbabwean consumers. The differences in retail maize meal prices substantially outweigh differences in transport costs between Harare and a number of major urban areas in South Africa.

The difference between maize meal costs in Zimbabwe and South Africa have become even more accentuated since the decontrol of private grain trade into urban areas of Zimbabwe in 1993. The decontrol of private maize trading has created a rapid shift in throughput from the large-scale industrial milling firms (which previously had a virtual monopoly on the urban market) in favor of the small-scale hammer mills.[13]

Table 4 shows the evolution of costs for roller meal (produced by the large-scale commercial processing firms) and custom-milled whole meal (produced by small-scale informal mills) in Harare, Zimbabwe. The data indicate that the real cost of roller meal has declined since maize market reform in 1993, due to both favorable harvests in 1993 and 1994 and increased competition from the informal milling sector. Table 4 also shows that, for Zimbabwean consumers, the monetary cost of purchasing maize grain and then custom-milling it at a local hammer mill was substantially cheaper than the price of roller meal in 1993 and 1994.[14] Therefore, for those consumers relying on informal hammer mills for custom-milling), the cost of meal was actually lower than those represented for Zimbabwe in Figure 3.

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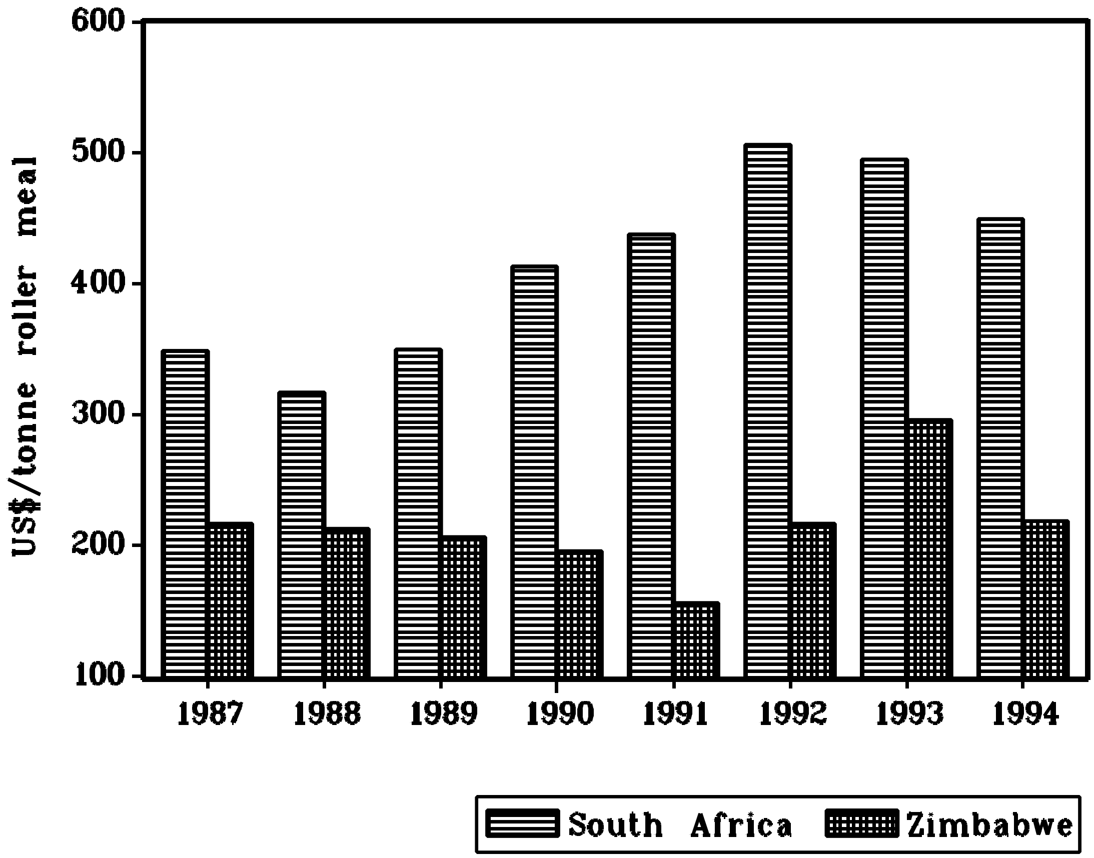
[12]These values are clearly shaped by numerous policies and are not purported to reflect some underlying notion of comparative advantage.

[13]The large-scale millers' monopoly on urban markets was due to the Grain Marketing Board's difficulty in selling maize to households in small quantities, and the policy barriers on maize trade into urban areas, which thus confined custom-milling to the limited quantities of maize grown on urban plots (Jayne and Rubey 1993).

[14]A more comprehensive analysis would need to account for the time cost for a family member to procure the maize and wait in the milling queue (see Rubey 1993).

Figure 3. Retail Maize Meal Prices in South Africa and Zimbabwe, 1987/88-1994/95



The major factor explaining the divergence in retail maize meal costs in the two countries is the difference in maize mill-to-retail margin (Figure 4). These margins in South Africa have been about three times higher than the margins through a comparable official distribution system in Zimbabwe, and over ten times higher than the margins charged by small-scale custom millers in Zimbabwe.

Figure 5 indicates that, after retail maize meal prices in South Africa were deregulated in 1971, the inflation-adjusted miller/distributor margin rose 80% between 1970 and 1980. Price deregulation of an oligopolistic maize milling and retailing industry led to increased maize meal prices at least partially because of a failure to stimulate greater competition by removing major entry barriers on small-scale milling and retailing. Further licensing restrictions on small-scale millers between 1985 and 1992 led to even higher milling margins. Over the 1990-94 period, milling margins in real terms have risen 60% above their 1970-74 average. This is significant since the miller/retailer margin in both South Africa and Zimbabwe accounts for about 50% of the total cost of maize meal to consumers. Since 1992, there has been an increase in the licensing of small-scale informal mills, which, if continued, may exert significant downward pressure on maize processing and distribution costs, as it has in Zimbabwe since 1993.

These cost comparisons suggest that, while the direction of trade in maize grain would be somewhat ambiguous, there are clear incentives for maize meal (especially maize meal produced by relatively efficient small-scale mills) to flow from Zimbabwe to South Africa under the existing domestic maize marketing system in South Africa. Similar incentives may also exist in Zambia, where it is frequently alleged that maize production costs are low relative to both Zimbabwe and South Africa.

Table 4. Comparison of Roller Meal and Whole Meal Costs in Zimbabwe, 1992-1994

Year	Type of meal (a)	Cost of meal (Z$/t)* (b)	Consumer Price Index (1994=1)** (c)	Maize Meal Cost (1994 Z$/mt) (d)=(b)/(c)	Exchange rate (Z$/US$) (e)	Maize Meal Cost (US$/mt) (f)=(b)/(e)
1992	Roller meal	1,775	0.64	2,773	8.0	222
	Whole meal (custom milled)	na		na		na
1993	Roller meal	1,810	0.80	2,262	8.0	226
	Whole meal (custom milled)	1,156	0.80	1,445	8.0	145
1994	Roller meal	2,050	1.00	2,050	8.2	250
	Whole meal (custom milled)	1,406	1.00	1,406	8.2	171

* Cost of roller meal represented by retail price of meal plus direct subsidy to millers.
Cost of whole meal (custom milled) is the informal retail price of maize grain in Harare plus milling fee; the figures used were:

1993: Z$16.50 per 16kg bucket maize grain plus Z$2.00 per bucket milling fee = Z$18.50 per 16kg bucket, or Z$1,156 per tonne
1994: Z$20.00 per 16kg bucket maize grain plus Z$2.50 per bucket milling fee = Z$22.50 per 16kg bucket, or Z$1,406 per tonne

** Consumer price index, standardized for 1994, assumes 25% inflation rate in 1993 and 1994.

Figure 4. Mill-to-retail margins for manufacture of commercial roller meal and custom-milled meal in US$ per tonne, South Africa and Zimbabwe, 1987/88-1994/95

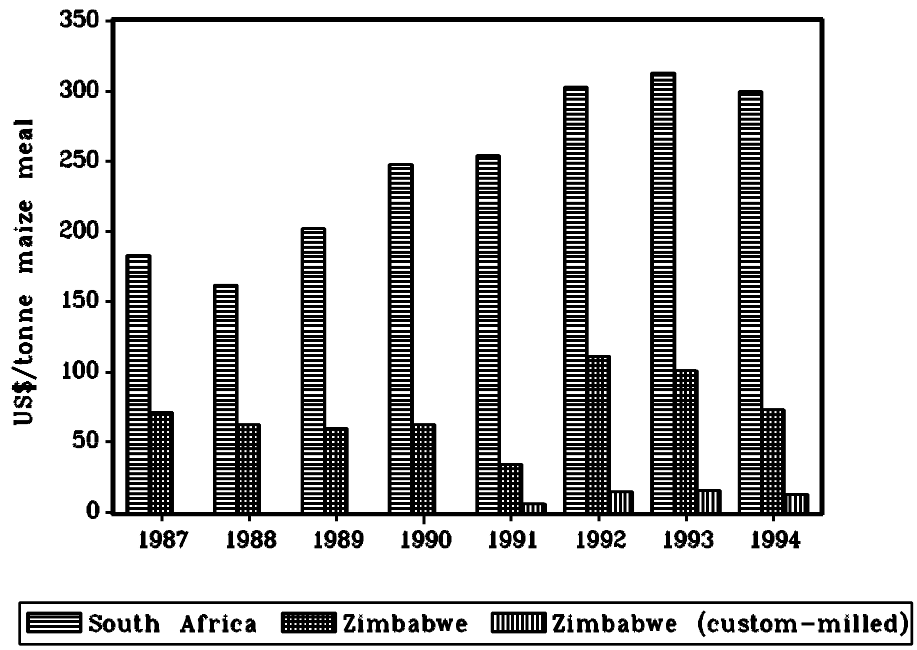
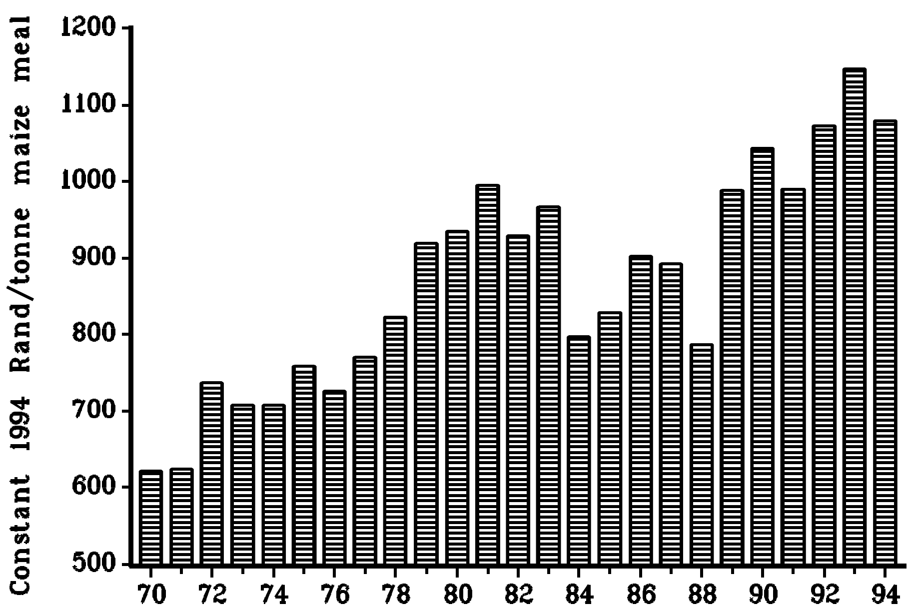


Figure 5. Evolution of Real Mill-to-Retail Margins for Manufacture of Roller Meal in South Africa, 1970-1994



However, numerous factors need to be assessed in detail before these results may be considered useful for policy purposes. The foregoing does suggest that the welfare of maize farmers in South Africa is critically tied to the efficiency of its distribution and processing industries — embodied in the margin between the producer price of maize grain and the retail price of maize meal. This discussion does not preclude the possibility that the South African maize processing, wholesaling, and retailing industries earn only normal profits on their investments. Yet their margins are high compared to those in neighboring countries. Under unregulated regional trade, the relatively high marketing margins in South Africa are likely to depress the demand for South African maize as trading firms would have strong incentives to satisfy the maize meal requirements of South African consumers through cheaper foreign sources. The strongest incentives for importation of maize meal would be in the northern and north-eastern parts of the country, where transport costs from northern neighbors are relatively low. However, the incentives to import maize meal may be largely erased if domestic market reform in South Africa were able to reduce maize marketing costs and retail prices of maize meal for the majority of South African consumers by the time that restrictions on private cross-border trade were eliminated.

4. METHODS AND DATA

This section presents the econometrically-parameterized spatial-equilibrium model to simulate the effects of alternative marketing policies for maize on production, consumption, trade and pricing outcomes. We present (a) the supply and demand functions and estimation procedure underlying the model; (b) the structure of the regional spatial-equilibrium simulation model; (c) data sources; and (d) limitations of the model.

4.1. Supply and Demand Functions

To distinguish between policy-induced and weather-related variations in maize production, particular attention was devoted to the processes determining variation in maize area. Area cultivated is considered more representative of farmers' behavioral intentions than production. Although cultivated area is affected by weather, it is less subject to noise from stochastic yield effects than either production or marketed output (Askari and Cummings 1976). We hypothesize that maize area is a function of the expected producer price of maize, input prices, prices of the major substitute crop in production, and other "shift variables" known at the time of planting and considered exogenous from the farmer's standpoint. One such variable in South Africa is land set aside under the Land Conversion Programme (LCP). The intent of the LCP has been to pay farmers for not planting maize, primarily on marginal land, in order to reduce both environmental degradation and instability of maize production. While the aggregate area under the LCP can reasonably be considered exogenous to any individual farmer, estimates of area under the LCP was reported by government before planting, and can hence be considered part of the information set at planting time.

We also hypothesize that an important "shift variable" for maize area in Zimbabwe's smallholder sector is the number of Grain Marketing Board buying stations accessible to smallholders. The expansion of market infrastructure to smallholders was a major feature of the post-independence government's effort to expand maize production incentives (Rohrbach 1989; Amin 1990).

Letting i denote cross-sectional observations for region i, and t represents time periods ranging from 1 to T, yellow and white maize equations for the nine regions of South Africa can be expressed as:

$$A_{it} = a_0 + a_1 \; PMZ_{it}^{*} + a_2 \; PS_{it-1} + a_3 \; LC_{it} \qquad (1)$$

where A_t is area planted in crop season t, PMZ_t^* is the farmer's expectation, at planting time, of the producer price of maize that will prevail at harvest time; PS_{t-1} is the price of the major substitute crop (either sorghum, sunflower, tobacco, or cotton, depending on the region); and LC_t is the quantity of land reserved under the Land Conversion Programme in each region. All prices were deflated by the farm input price index.

Expressing equation (1) in first-difference form yields:

(2) $$_{-1} = a_1(PMZ^*_{it} - PMZ^*_{it-1}) + a_2(PS_{it-1} - PS_{it-2}) + a_3(LC_{it} -$$

Over the sample period, farm prices in South Africa and Zimbabwe typically have been announced after planting.[15] In such a case, it is not appropriate to model area as a function of the producer price that will prevail in the next marketing season since this information is not known at the time of planting. For this reason, we model area in each region as a function of the expected maize price that will prevail at harvest. However, this price is not directly observable. One method for modelling expectations is to use lagged producer prices ("naive expectations"), but this assumes that farmers disregard the recent history of maize prices in previous years and form their expectations about the future price based only on the current price. A more realistic alternative is provided by the adaptive expectations hypothesis, which has been frequently used in such cases to approximate farmers' price predictions (see Askari and Cummings (1976) for a survey). The adaptive expectations hypothesis models expected price in period t as a weighted average of the price in t-1 and the expected price in 0period t-1:

(3) $$PMZ^*_{it} - PMZ^*_{it-1} = \gamma(PMZ_{it-1} - PMZ^*_{it-1})$$

where PMZ* is the expected maize producer price in real terms, and $0 \le \gamma \le 1$. Such a formation is based on the idea that current expectations are derived by modifying previous expectations in light of recent experience.[16] Assuming that farmers in South Africa form their price expectations adaptively, and then substituting (3) into (2), we have

(4) $$= a_1[\gamma(PMZ_{it-1} - PMZ^*_{it-1})] + a_2(PS_{it-1} - PS_{it-2}) + a_3(LC$$

Re-writing (1) in price-dependent form gives:

(5) $$PMZ^*_{it-1} = \frac{A_{it} - a_0 - a_2\ PS_{it-2} - a_3\ LC_{it-1}}{a_1}$$

[15]The main exception to this was in Zimbabwe from 1976-1981, and in 1993, when pre-planting prices were announced by the government. In South Africa, there was a tacit understanding up until the mid-1980s that gross revenue from maize sales, in nominal terms, would not fall below that of the preceding year.

[16]Note that the adaptive expectations model also can be viewed as a rational expectation model if it can be assumed that X is stochastic and its values are generated according to the scheme $X_t = X_{t-1} + u_t - \lambda u_{t-1}$ where u_t is a stochastic disturbance that satisfies all the normal assumptions (Kmenta 1986).

which is then substituted into (4) to give:

$$A_{it} = -\gamma a_0 + (1 - \gamma)A_{it-1} + (\gamma a_1)PMZ_{it-1} + a_2 PS_{it-1} + a_3 LC_{it} - a_2(\gamma - 1)PS_{it-2} - a_3(\gamma - 1)LC_{it-1} \quad (6)$$

or, in reduced form:

$$A_{it} = \pi_0 + \pi_1 A_{it-1} + \pi_2 PMZ_{it-1} + \pi_3 PS_{it-1} + \pi_4 LC_{it} + \pi_5 PS_{it-1} + \pi_6 LC_{it-1} \quad (7)$$

where:

$$\pi_0 = -\gamma a_0$$
$$\pi_1 = (1 - \gamma)$$
$$\pi_2 = \gamma a_1$$
$$\pi_3 = a_2$$
$$\pi_4 = a_3$$
$$\pi_5 = -a_2(\gamma - 1)$$
$$\pi_6 = -a_3(\gamma - 1)$$

Short-run and long-run elasticity estimates can be obtained by recovering the coefficients from the structural equation (1) for each region i. For example, the short-run own price elasticity is $\pi_2 = \gamma a_1$, while the long-run own price elasticity is simply $a_1 = \pi_2 \div (1 - \pi_1)$.

Equation (7) was estimated simultaneously for both yellow and white maize across the five major maize-producing regions in South Africa, in first-difference form. First-differencing the data controls for unobserved time-invariant regional differences (e.g., differences in soil conditions or infrastructural development between regions). The system of 10 equations were estimated using Seemingly Unrelated Regression Estimation (SURE), which increases estimation efficiency by exploiting information in the cross-equation error covariance matrix. A likelihood ratio test could not reject (at the .05 level) the hypothesis that all coefficients for each of the six predetermined variables in (7) were the same across regions.

For Zimbabwe, first-differenced area equations for the commercial and smallholder farming sectors are estimated separately using OLS due to presumed differences in farm structure and behavior.

Production levels were simulated through a random weather variable, based on the distribution of yields over the 1970-94 period. This yield outcome is then multiplied by expected area evaluated at the simulated values of the predetermined variables. Estimates of marketed output are then derived as a linear function of production. Quadratic specifications were tested (based on the hypothesis that the proportion of production that is marketed may increase with production), but the assumption of linearity could not be rejected at the 5% level in any case.

Next, demand equations for white and yellow maize were specified for the nine regions in South Africa. Two demand equations were specified for Zimbabwe, one for maize meal and one for industrial uses (including stockfeed). White maize is considered destined for human consumption (primarily maize meal), while yellow maize demand has almost always been for animal consumption, except during droughts. Simultaneity between price and quantities are not an issue because prices were controlled over the estimation period in both South Africa and Zimbabwe. Consistent with standard consumer demand theory, yellow maize and per capita white maize demand in region i is specified as

(8) $DY_{it} = b_0 + b_1(PB_{it}) + b_2(PSY_{it}) + b_3(Y_{it}) + b_4(D_{it}) + b_5(T) + v_{it}$

(9) $DW_{it} = d_0 + d_1(PC_{it}) + d_2(PSW_{it}) + d_3(Y_{it}) + d_4(D_{it}) + d_5(T) + e_{it}$

where PB_t and PSY_t are the marketing board's selling price of maize and sorghum, respectively, in region i; PC_t is the retail price of maize meal (demand for maize by processors is a derived demand for maize meal by consumers); PSW_t is the retail price of the major substitute in consumption (potatoes or wheat, depending on the region), Y_t is per capita income in region i; D_t is a drought dummy for region i (designed to capture shifts in consumption from white to yellow maize during drought years); and T is a time trend to account for slow-moving omitted variables such as changes in consumer preferences. All monetary variables were deflated by the consumer price index. Equations (8) and (9) were first-differenced, again to account for the effects of time-invariant regional differences. First-differencing also has the effect of transforming the time trend variable into a constant term.

The first-differenced yellow and white maize demand equations were estimated simultaneously for all ten consuming regions, using SURE estimation. However, a likelihood ratio test rejected the hypothesis that the coefficients of these demand equations were equal across regions, and unrestricted models were re-estimated for (8). Likelihood ratio tests indicated that the major source of parameter variation across regions was on the income (*Y*) and drought (*D*) variables. This is not surprising since some analysts have suggested that maize may be an inferior good in some regions and a normal good in others (Elliott 1991; Sartorius von Bach (1993). Also, the degree of substitution of yellow for white during droughts does not appear to be uniform across regions. When the parameters on *Y* and *D* were allowed to vary regionally, a likelihood ratio test could no longer reject at the 5% level that the remaining price coefficients were equal across regions. Thus, these partially-restricted forms were estimated for (8) and (9).

4.2. National and Regional Maize Policy Scenarios

The direction of maize trade between Zimbabwe and South Africa, and the welfare of consumers, farmers, livestock feeders, and agro-industries in these countries, will depend greatly on future agricultural pricing and marketing policies in the two countries. These policies may evolve in a number of ways. For example, controls on domestic trade and pricing may be abolished while still maintaining tariff barriers on private cross-border or international trade. Alternatively, governments may legalize private cross-border trade while still defending national floor and ceiling prices through the continuation of state trading operations. The evolution of national maize policies may have important external effects on the operation of maize sectors in other countries in the region. This is particularly true of South Africa due to its size relative to the regional market.
Four policy scenarios are simulated over the 1994/95-1997/98 marketing years:

Scenario 1: The existing system of government-controlled maize prices in South Africa and Zimbabwe. Maize Board prices are set at the following levels through the four-year simulation period:

a. Maize Board selling price: R505/t (white); R485/t (yellow)
retail/miller margin: R1,085/t (white)
Zimbabwe GMB prices: Z$900 (producer); Z$1,170 (selling price).

b. Maize Board selling price: R505/t (white); R485/t (yellow)
retail/miller margin: R814/t (white)
Zimbabwe GMB prices: Z$900 (producer); Z$1,170 (selling price).

c. Maize Board selling price: R575/t (white); R555/t (yellow)
retail/miller margin: R814/t (white)
Zimbabwe GMB prices: Z$900 (producer); Z$1,170 (selling price).

Scenario 2: Deregulated maize trade within South Africa, given 1993 controlled price levels in Zimbabwe (as in Scenario 1).

Scenario 3: Deregulated maize trade within and between South Africa, Zimbabwe, and the world market; and

Scenario 4: A protected regional market, i.e., Scenario 3 with alternative tariff levels on imported yellow maize from the world market.

4.3. Structure of the Simulation Model

Results are simulated using a regional spatial-equilibrium model. The model is essentially structured as follows: In each year, yellow and white maize area is predicted based on the values of the predetermined variables in the area equations. These values are updated in each succeeding simulation year based on the simulated outcomes from the previous year. Yields are determined exogenously through a randomized weather variable.[17] For scenarios involving controlled marketing and restrictions on private trade, each region is in autarky; all marketed supplies are delivered to the respective country's marketing board. In keeping with current arrangements in South Africa, producer prices in Scenario A are calculated as a residual after average Maize Board costs (including domestic purchases and stockholding) are deducted from average revenues (including domestic sales and export sales). In Scenarios B, C, and D, maize price, production, and consumption levels in South Africa are determined endogenously, based on external trading possibilities, weather outcomes, and domestic marketing costs.

Maize selling prices to animal feeders (exogenous for South Africa in Scenario A and for Zimbabwe in Scenarios A and B, along with the predetermined variables in equation (8), determine stockfeed demand. Analogously, maize consumers face fixed prices of commercial maize meal (determined administratively under the controlled-price scenarios).[18]

When trade and price controls are relaxed, prices become endogenous, and the model is similar to standard spatial-equilibrium models where excess supply and demand functions are determined from supply and demand conditions in the respective regions. Equilibrium prices, consumption, and production are simultaneously determined in each region, modified by relevant transport and processing/retailing margins. Finally, by aggregating across regions, national trade flows and government budget outlays are derived.

Deregulation of maize trade in South Africa is expected to remove the major policy-related barriers to entry in maize processing and maize meal distribution. It is reasonable to assume that deregulation would reduce the maize mill-to-retail margin to about the same level, in standardized currency units, as those in Zimbabwe, Kenya, and Zambia after market reform in those countries. In these countries, market reform has stimulated new investment in small-scale mills in urban areas for custom milling (Rubey 1993; Mulinge and Jayne 1994). In response to increased competition, the mill-to-retail margins in the official marketing channels have declined in real terms (see Table 4 for information on Zimbabwe). In the simulation scenarios involving market reform in South Africa, we assume that the mill-to-retail margin will decline by 25%,

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[17]The hypothesis of stochastic yields was examined by regressing regional yields on a time trend and maize/nitrogen fertilizer price ratio. In only one region (Zimbabwe smallholder sector) was a time trend found to be statistically significant; in no cases was the maize/nitrogen fertilizer price ratio significant.

[18]Retail maize meal prices and Maize Board selling prices for yellow maize were based on their average levels over the 1990-1993 period.

from current levels of about US$450/mt to US$360/mt. This is a conservative estimate of the degree of margin reduction, as the current mill-to-retail margins for the large-scale milling and retailing firms in Zimbabwe and Kenya are in the range of US$140 to US$180, about half that of what we assume for South Africa under market reform. Therefore, Scenarios B, C, and D should be considered to provide conservative estimates of the benefits of maize market reform for both producers and consumers in South Africa.

The world market is modelled as a residual supplier of yellow maize, with perfectly elastic supply, and a vent for surplus production of both white and yellow maize. However, due to high domestic and international transport costs associated with exports, the export parity price is considerably lower than historical domestic selling price levels in both South Africa and Zimbabwe. Due to unreliable and sparse data for other countries in the region, the remainder of the Southern Africa region (Swaziland, Lesotho, Zambia, Botswana, and Mozambique) is aggregated into one region, which enters the model as a importer of white maize, with a random weather variable determining import requirements in a given year. Whether this import demand is exported from South Africa, Zimbabwe, or the world market depends on relative prices in the two countries, and availability of white maize supplies. In situations where neither South Africa nor Zimbabwe have a white maize surplus, such as 1992, import demand for the rest of the region is filled by yellow maize from the world market.

Modelling the Land Conversion Programme in South Africa is difficult because the quantity of land set aside by farmers cannot reasonably be considered a constant, but rather fluctuates with evolving supply and demand conditions. Clearly, the downsizing of the maize sector has narrowed the structural surplus between domestic maize production and utilization, and therefore, the target area under the programme has likely been reduced. Thus, the predicted area under the land conversion program was modelled as a partial adjustment process with respect to the previous years' net surplus (production minus consumption), with the hectares registered falling as the country's net maize surplus falls.

4.4. Data

All price and quantity data from South Africa was obtained from the Maize Board and from Department of Agriculture Abstracts of Agricultural Statistics. Zimbabwean price and quantity data was obtained from the Grain Marketing Board, Central Statistics Office, and the Agritex/Early Warning Unit of the Ministry of Lands, Agriculture and Water Development. South African and Zimbabwean rainfall data was from the South African Weather Bureau and from Masters (1994). Inter-regional transport costs used in the simulation model were obtained from the South African Department of Transportation.

4.5. Limitations

Data accuracy determines the validity of economic prediction. This is the case for both qualitative and quantitative analyses. The agricultural data for South Africa and Zimbabwe is considered fairly reliable. Data for Mozambique, Zambia, and the other countries in the region were not considered reliable, and we refrain from estimating supply and demand equations for these countries. Rather, we treat these countries as a bloc, and simulate outcomes in South Africa and Zimbabwe based on alternative scenarios about import demand for this bloc. While a full regional analysis would be desired, it was deemed that the data for the other countries in the region could not support such an analysis.

Neither South Africa nor Zimbabwe's maize economies have operated under unregulated trading conditions at any time during the estimation period. While it would be preferable to predict producer and consumer responses using data from the structural conditions being simulated, such data obviously does not exist. The unavoidable alternative is to use available knowledge of agent behaviors and operating environments to make informed assumptions about how future behavioral responses may differ from historical responses. It is noteworthy to point out that this problem arises for all ex ante analyses, qualitative as well as quantitative. Here, we assume that the price and income elasticities estimated under the 1970-94 period are the best available indicators of expected farm and consumer behavior under a less regulated market environment. In the absence of observed behavioral information under the various alternative policy scenarios, it would seem reasonable to view farm and consumer responses to price changes to be similar whether those prices are generated from private buyers or the official marketing system, as long as transactions costs do not differ greatly between the two sectors.

It must also be stressed that the model is partial-equilibrium. For example, the effects of market reform on farmers are assessed only insofar as they affect farm revenue from maize, and do not capture the effects of maize market reform on changes in farm revenues from substitute commodities. Likewise, policy changes in the maize sector may affect variables outside the sector that subsequently have feedback impacts on the variables of interest in the sector. For example, a change in the price of maize may be expected to change real income levels for some consumers, although income is considered exogenous in this model. A comprehensive general-equilibrium model of the agricultural and non-agricultural sectors in the region was beyond the scope of this analysis.

5. RESULTS

This section presents econometric results and simulation outcomes for the four policy scenarios described above.

5.1. Econometric Estimation Results

Estimation results for the maize area equations indicate low short-run area response to producer price changes (Tables 5 and 6). At mean price levels, the estimates of short-run price elasticity of yellow maize area were in the range of zero to 0.5, and were in all cases statistically insignificant even at the 0.20 level. At mean yield levels, this translates into short-run price elasticities of supply on the order of zero to 0.65. The negative and insignificant coefficient on lagged maize area indicates very little additional response to price beyond its short-run effect. Supply response for the major yellow maize production regions, Orange Free State, Eastern Transvaal, and Northwest are particularly low.

White maize area elasticities ranged from 0.08 to 0.61 in the main producing regions of South Africa. These estimates are statistically significant at the 1% level. Long-run responses are slightly higher. When evaluated at mean yield levels, the price elasticities of supply for the major production regions of South Africa ranged from 0.10 to 0.78 in the short run, and from 0.15 to 1.0 in the long run. For Zimbabwe's commercial and smallholder sectors, the short-run price elasticities of area were 0.43 and 0.75, respectively. These estimates are significant at the 5% level only for the commercial sector. At mean yield levels, the short-run price elasticities of supply were 0.60 and 0.95.

These results are consistent with the estimates of van Zyl (1991) and Wright and Nieuwoudt (1993) for South Africa, and of Buccola and Sukume (1988) for Zimbabwe. Inelastic supply response is not surprising in these regions given the dominance of maize in both commercial farmers' and smallholders' cultivation strategies, and very low area devoted to substitute crops such as sorghum and sunflower.

The effect of the land conversion program in South Africa appears to depress production in the short-run, but this effect appears to be largely offset within the second year. Generally, the program appeared to have neither a strong nor significant depressing effect on maize plantings over the long-run.

Price elasticities of demand for white maize are generally significant and higher than price elasticities of white maize supply (Table 8). This implies, for example, that lower white maize prices in the region would increase demand to a greater extent than they would reduce supply. Income elasticities for white maize were generally negative, indicating that maize meal is an inferior good in the diets of most South Africans. In Zimbabwe, white maize appears to be a normal good. The price of potatoes, a major substitute for maize meal, was positively and significantly associated with the demand for white maize in South Africa, indicating that the large supply variability exhibited by this commodity may introduce some

Table 5. Yellow Maize Area Elasticity Estimates, South Africa, 1970-1993

	Region							
Variable	**N. Cape**	**Orange Free State**	**E. Cape**	**KwaZulu/ Natal**	**E. Transvaal**	**N. Transvaal**	**Gauteng**	**North-west**
$PYMZ_{t-1}$								
short-run	0.48 (0.76)	0.02 (0.76)	0.36 (0.76)	0.24 (0.76)	0.02 (0.76)	0.04 (0.76)	0.06 (0.76)	0.01 (0.76)
long-run	0.43	0.02	0.32	0.22	0.02	0.04	0.05	0.01
PS_{t-1}	**-0.25 (-2.40)**	**-0.18 (-2.40)**	**-0.94 (2.23)**	**-0.33 (-2.23)**	**-0.06 (-2.40)**	**-0.34 (-2.23)**	**-0.12 (-2.40)**	**-0.09 (-2.40)**
PS_{t-2}	-0.02 (-0.62)	-0.01 (-0.62)	-0.03 (0.58)	-0.01 (-0.58)	-0.02 (-0.62)	-0.01 (-0.58)	-0.06 (-0.62)	-0.01 (-0.62)
LC_t	na	**-.46 (-4.84)**	**-0.04 (-4.84)**	**-0.02 (-4.84)**	**-0.01 (-4.84)**	**-0.18 (-4.84)**	**-0.03 (-4.84)**	**-0.18 (-4.84)**
LC_{t-1}	na	**0.57 (5.62)**	**0.06 (5.62)**	**0.03 (5.62)**	**0.01 (5.62)**	**0.22 (5.62)**	**0.05 (5.62)**	**0.26 (5.62)**
A_{t-1}	-0.11 (-1.68)	-0.11 (-1.68)	-0.11 (-1.68)	-0.11 (-1.68)	-0.11 (-1.68)	-0.11 (-1.68)	-0.11 (-1.68)	-0.11 (-1.68)
Adj. R^2	.24	.22	.53	.75	.28	.74	.69	.35
F-statistic	2.68	1.98	4.88	14.60	3.03	14.01	8.70	2.19

t-statistics in parentheses

Bolded coefficient estimates indicate statistical significance at the 0.05 level.

Durban-h statistics were below the critical value for rejecting the hypothesis of non-autocorrelated residuals at the 0.10 level except for Northwest Province.

All prices are deflated by a farm-level input price index (1993=1).

PS is price of sorghum for Northern Cape, Orange Free State, Eastern Transvaal and Gauteng (former PWV region); and is price of sunflower for regions Eastern Cape, KwaZulu/Natal and Northern Transvaal.

Source = regression results.

Table 6. White Maize Area Elasticity Estimates, South Africa and Zimbabwe, 1970-93

Variable	Region									
	N. Cape	**Orange Free State**	**E. Cape**	**KwaZulu/ Natal**	**E. Transvaal**	**N. Transvaal**	**Gauteng**	**North-west**	**Zimbabwe**	
									LSC	**Peasant**
$PWMZ_{t-1}$										
short-run	**0.28** **(3.79)**	**0.08** **(3.79)**	**0.21** **(3.79)**	**0.17** **(3.79)**	**0.61** **(3.79)**	**0.95** **(3.79)**	**0.89** **(3.79)**	**0.09** **(3.79)**	**0.43** **(2.51)**	0.75 (1.81)
long-run	0.30	0.09	0.22	0.18	0.65	1.01	0.95	0.10	0.60	0.91
PS_{t-1}	**-0.13** **(-2.40)**	**-0.24** **(-2.40)**	**0.09** **(-2.40)**	**-0.48** **(-2.40)**	**-0.05** **(-2.40)**	**-0.36** **(-2.40)**	**-0.02** **(-2.40)**	**0.25** **(-2.40)**	-0.11 (-1.88)	0.33 (0.48)
PS_{t-2}	-0.26 (-0.62)	-0.07 (-0.62)	0.01 (0.62)	-0.31 (-0.62)	-0.01 (-0.62)	-0.31 (-0.62)	-0.14 (-0.62)	0.16 (-0.62)	-0.02 (-0.43)	-0.17 (-0.22)
LC_t	na	**-0.87** **(-4.84)**	**-0.54** **(-4.84)**	**0.16** **(-4.84)**	**0.12** **(-4.84)**	**-0.80** **(-4.84)**	**-0.07** **(4.84)**	**0.65** **(-4.84)**	**--**	**--**
LC_{t-1}	na	**0.46** **(5.62)**	**0.39** **(5.62)**	**-0.21** **(5.62)**	**-0.18** **(5.62)**	**0.34** **(5.62)**	**-0.08** **(5.62)**	**-1.26** **(5.62)**	**--**	**--**
$Depots_t$									**--**	**0.05** **(2.56)**
A_{t-1}	0.06 (1.94)	0.06 (1.94)	0.06 (1.94)	0.06 (1.94)	0.06 (1.94)	0.06 (1.94)	0.06 (1.94)	0.06 (1.94)	**0.28** **(2.43)**	0.18 (0.79)
adj.R^2	0.45	0.52	0.64	0.75	0.62	0.52	0.45	0.46	0.62	0.68
F-statistic	2.71	1.51	3.81	8.14	5.65	4.30	4.16	3.19	5.21	4.83

t-statistics in parentheses; **Bolded** coefficient estimates indicate statistical significance at the 0.05 level. Durban-h statistics were below the critical value for rejecting the hypothesis of non-autocorrelated residuals at the 0.10 level except for Northwest Province and Eastern Province. All prices are deflated by a farm-level input price index (1993=1). *PS* is price of sorghum for Northern Cape, Orange Free State, Eastern Transvaal and Gauteng region; price of sunflower for regions Eastern Cape, KwaZulu/Natal and Northern Transvaal; price of flue-cured tobacco for Zimbabwe's commercial sector; and price of cotton for Zimbabwe's smallholder sector. Source = regression results.

Table 7. Yellow Maize Demand Elasticities, Seemingly Unrelated Regression Estimates, 1970-1993

	Western Cape	**Northern Cape**	**Orange Free State**	**Eastern Cape**	**Kwa Zulu/ Natal**	**Eastern Transvaal**	**Northern Transvaal**	**Gauteng**	**Northwest**
Constant	0.00	-0.00	0.001	0.005	0.02	-0.002	-0.00	-0.00	-0.00
	(0.58)	(-0.31)	(0.25)	(1.44)	(1.77)	(-0.45)	(-0.17)	(-0.67)	(0.33)
PYM	-.79	-0.39	-.151	-.42	-1.06	-0.75	-0.50	-0.11	-0.79
	(-1.65)	(-1.65)	(-1.65)	(-1.65)	(-1.65)	(-1.65)	(-1.65)	(-1.65)	(-1.65)
PSO	**0.34**	**0.22**	**0.10**	**0.56**	**0.71**	**0.50**	**0.33**	**0.07**	**0.36**
	(2.35)	**(2.35)**	**(2.35)**	**(2.35)**	**(2.35)**	**(2.35)**	**(2.35)**	**(2.35)**	**(2.35)**
Incomepc	**0.89**	0.40	0.23	0.33	0.63	0.24	-0.15	.04	0.41
	(2.45)	(1.56)	(1.74)	(0.74)	(1.13)	(0.46)	(-0.54)	(0.45)	(1.22)
Drought	0.003	0.012	**0.031**	**0.018**	**0.069**	**0.049**	**0.028**	**0.051**	**0.012**
	(1.56)	(1.89)	**(3.21)**	**(2.20)**	**(3.16)**	**(5.50)**	**(7.24)**	**(6.67)**	**(3.47)**
Adj R^2	0.58	0.42	0.26	0.45	.60	.19	.65	.66	.38
F	3.01	2.80	2.93	4.81	9.17	2.28	11.18	11.86	4.92
DW	2.14	2.45	2.25	2.03	2.74	2.40	3.28	2.22	2.52

t-statistics in parentheses

Bolded coefficient estimates indicate statistical significance at the 0.05 level.

All prices and incomes are deflated by the consumer price index (1993=1).

Source = regression results.

Table 8. White Maize Demand Elasticities, Seemingly Unrelated Regression Estimates, 1970-1993

	Western Cape	**Northern Cape**	**Orange Free State**	**Eastern Cape**	**KwaZulu /Natal**	**Eastern Transvaal**	**Northern Transvaal**	**Gauteng**	**Northwest**	**Zimbabwe**
Constant	0.00	0.01	0.00	-0.00	-0.00	0.01	0.00	-0.01	0.00	0.01
	(0.40)	(0.77)	(0.21)	(-0.35)	(-0.07)	(-0.88)	(0.29)	(-1.46)	(0.28)	(0.52)
Pmeal	**-1.21**	**-1.19**	**-3.19**	**-0.98**	**-1.28**	**-0.36**	**-0.56**	**-0.33**	**-0.14**	-0.45
	(-3.32)	**(-3.32)**	**(-3.32)**	**(-3.32)**	**(-3.32)**	**(-3.32)**	**(-3.32)**	**(-3.32)**	**(-3.32)**	(-1.89)
Ppotato	**0.86**	**0.87**	**1.26**	**0.92**	**0.57**	**0.16**	**0.25**	**0.14**	**0.91**	-0.24
	(5.91)	**(5.91)**	**(5.91)**	**(5.91)**	**(5.91)**	**(5.91)**	**(5.91)**	**(5.91)**	**(5.91)**	(-0.39)
Incomepc	0.04	-0.11	-0.27	-0.44	-0.12	0.01	-0.34	-0.01	-0.22	-0.13
	(0.35)	(-0.10)	(-0.25)	(-0.88)	(-0.36)	(0.31)	(-2.95)	(-0.11)	(-1.68)	(-0.23)
Drought	-0.003	-0.021	-0.015	(-0.007)	**-0.019**	**-0.065**	**-0.038**	**-0.063**	**-0.011**	**0.059**
	(-0.68)	(-1.91)	(-1.50)	(-1.59)	**(-4.86)**	**(7.42)**	**(-7.96)**	**(-8.17)**	**(-6.45)**	**(6.31)**
Adj R^2	.51	.49	.46	.55	.63	.75	.90	.88	.39	.70
F	4.88	6.30	5.90	6.12	10.00	16.87	46.64	39.63	11.45	11.58
DW	2.52	2.31	2.90	2.27	2.63	25.50	2.58	2.34	2.61	2.02

t-statistics in parentheses.

Bolded coefficient estimates indicate statistical significance at the 0.05 level.

All prices and income variables are deflated by the consumer price index (1993=1).

Zimbabwe regression estimated separately with OLS.

Source = regression results.

variability into the demand for white maize. For example, in the populous KwaZulu/Natal region, a 20% increase in the price of potatoes is estimated to increase the demand for white maize by 11%, other factors held constant. Finally, drought in South Africa tends to have a negative effect on white maize consumption, and a positive effect on yellow maize consumption, resulting from the processing sector's practice of blending yellow and white maize into meal during years of white maize production shortfalls. These results are consistent with those of Elliott (1991) and Sartorius von Bach (1993).

For yellow maize, price elasticities of demand were also higher than for supply, but these estimates were not statistically significant at the 5% level (Table 7). The price of sorghum, however, appeared to have a significant effect on the demand for yellow maize, presumably as a substitute for livestock feed.

5.2. Simulation Results

Scenario A1: Continuation of 1994 controlled marketing arrangements in South Africa; fixed Maize Board Selling prices of white and yellow maize at R505 and R485, respectively (in real 1994 R);

The scenario represents the status quo situation over the 1987-1994 marketing years. With a continuation in this marketing and pricing policy, the model results indicate that white and yellow maize production, under normal weather, would be about 3.38 and 4.10 million tonnes, respectively (Table 9). This would result in maize self-sufficiency for both grains, under normal weather. The estimated self-sufficiency ratios are 1.14 and 1.04 for white and yellow maize.

However, despite surplus maize production, the model suggests that up to 800,000 tonnes of maize meal from Zimbabwe could be profitably imported, given available surplus production and price levels in Zimbabwe. Incentives for importation of meal are confined to the northern regions in South Africa (Northern Transvaal and Guateng), since high transport costs erode the cost advantage of Zimbabwean meal for the other regions. It is unlikely, however, that Zimbabwe could consistently produce this magnitude of surplus maize, given its other export markets, and due to the declining trend in expected maize production relative to consumption requirements in Zimbabwe. As explained in Section 3, Zimbabwean maize production per capita has declined for the past decade due to a shift out of maize production by commercial farmers into non-regulated crops, declining outlays of government credit to smallholders, stagnant fertilizer use, inability of the private and public agricultural research system to generate new hybrid seeds to promote productivity growth by smallholders (smallholders continue to use hybrids that are 20 years old), and a modest withdrawal of Grain Marketing Board infrastructure in smallholder areas. While higher controlled maize prices in Zimbabwe could raise production to some extent, this would in turn erode the competitive

Table 9. Simulation Results: Estimated Maize Performance Outcomes in South Africa under Alternative Policy Scenarios, Normal Weather

Policy Scenarios:
(A) Status quo situation: Controlled selling prices, internal and external trade in South Africa; 1993/94 price levels in Zimbabwe.
(B) Deregulated maize trade and pricing within South Africa; continuation of external trade barriers, and 1993/94 price levels in Zimbabwe.
(C) Deregulated maize trade within and between South Africa, Zimbabwe, and the world market.
(D) Protected regional market, i.e., Scenario 3 with a 15% tariff levels on imported yellow maize from the world market.

Scenario	A			B	C	D
	1	2	3			
South Africa price setting (R/t)						
white maize selling price:	505	505	575	endogenous	endogenous	endogenous
yellow maize selling price:	485	485	555	endogenous	endogenous	endogenous
wh. maize mill/retail margin:	1085	814	814	814	814	814
weather:	normal	normal	normal	normal	normal	normal
	----- simulation outcomes -----					
White maize production (million tons)	3.38	3.49	3.61	3.43	3.51	3.51
White maize producer/selling price (R/ton)	344/505	374/505	410/575	330/456	359/490	358/489
White maize gross revenue (mill. Rand)	1,163	1,306	1,480	1,132	1,260	1,257
Retail price of roller meal (R/ton)	1,590	1,319	1,389	1,301	1,289	1,289
Self-sufficiency ratio, white maize (%)*	1.14	1.01	1.08	.98	1.04	1.04
Yellow maize production (mill. Tons)	4.10	4.10	4.26	3.75	3.55	3.74
Yellow maize producer/selling price (R/ton)	330/485	330/485	357/555	359/498	340/469	356/501
Yellow maize gross revenue (mill. Rand)	1,353	1,353	1,589	1,346	1,207	1,331
Self-sufficiency ratio, yellow maize (%)*	1.04	1.04	1.12	.98	.86	.98

note: monetary figures are in constant 1994 Rand.

[*] self-sufficiency ratio is defined as: Production/Consumption*100. A value greater than one indicates the degree to which domestic production exceeds consumption (exportable surplus), while a value less than one represents the degree to which domestic production fills total consumption requirements (net deficit).

Table 10. Estimated Maize and Maize Meal Prices under Free Trade (Scenario C) Relative to the Existing System (Scenario A1), Normal Weather

	White Maize		Yellow Maize	
	Producer Price	Roller Meal Price	Producer Price	Selling Price
	------------- Rand/tonne (% change from 1994 prices) ------------			
Western Cape	396 (+16%)	1,332 (-14%)	348 (+ 5%)	425 (-12%)
Northern Cape	324 (- 4%)	1,260 (-19%)	291 (-12%)	387 (-20%)
Orange Free State	347 (+ 2%)	1,270 (-18%)	332 (+ 1%)	428 (-12%)
Eastern Cape	374 (+10%)	1,310 (-15%)	346 (+ 5%)	432 (-11%)
KwaZulu/Natal	378 (+11%)	1,294 (-17%)	343 (+ 4%)	419 (-14%)
Eastern Transvaal	354 (+ 4%)	1,278 (-18%)	340 (+ 3%)	446 (- 8%)
Northern Transvaal	379 (+11%)	1,301 (-16%)	333 (- 2%)	450 (- 7%)
Gauteng	361 (+ 6%)	1,285 (-17%)	362 (+ 9%)	472 (- 2%)
Northwest	329 (- 3%)	1,267 (-18%)	340 (+ 3%)	452 (- 7%)

source: simulation model results

advantage of Zimbabwean exports and exacerbate the operating deficits of the Grain Marketing Board.

Therefore, it appears that, while substantial incentives currently exist for profitable trade in maize meal from Zimbabwe to South Africa under a deregulated external trading environment, numerous factors may in fact impede this from occurring: (a) continuation of controls or tariffs on cross-border trade; (b) insufficient exportable surpluses of white maize in Zimbabwe; and (c) progressive deregulation of maize milling and distribution in South Africa, which is anticipated to reduce marketing costs and thus reduce the cost advantage of Zimbabwean maize meal. This issue is examined further below.

Scenario A2: Continuation of existing controlled marketing arrangements in South Africa; fixed Maize Board Selling price of white maize at R505 (in real 1994 R); and reduction in white maize mill-to-retail margins by 25%.

The estimated impacts of this scenario, relative to the existing regional market situation, are shown by comparing Column A2 with A1 in Table 9. The major simulated change is a 25% reduction in maize processing/retailing costs that may arise from increased competition and decentralization of downstream stages of the maize marketing system associated with deregulated private trade.

Lower mill-to-retail margins simultaneously reduce average consumer prices of maize meal by 19% and increases average producer maize prices by 8.7% (from R344/t to R374/t). This leads to a 17% increase in consumption but only a 3% increase in production. The large increase in consumption relative to production is due to both a larger change in the consumer price than in the producer price, and because of substantially higher estimates of price elasticity of demand than price elasticity of supply for white maize. Therefore, the white maize self-sufficiency ratio (average production divided by average consumption) falls from 1.14 to 1.01, implying a greater frequency of imports during poor seasons. However, gross farm revenue from white maize rises by 12% due to both higher maize prices and marginally higher production levels. These results indicate that South African white maize producers have a stake in reducing costs in the maize milling/wholesaling/retailing sectors, as this would directly increase domestic demand, reduce the level of grain sold on low-realization export markets, and hence increase producer price levels.

Scenario A3: Continuation of existing controlled marketing arrangements in South Africa; reduction in white maize milling/distribution margins by 25%; Maize Board Selling Price increased by R70 for white and yellow maize.

The effects of this scenario, relative to the status quo, can be seen by comparing Columns A3 with A1. The white maize price, which is expected to rise by 8.7% when maize processing/retail margins are reduced (A1 to A2), rises an additional 9.6% from R374 to R410 in Scenario A3. This is an increase of only R36/t even though the selling price is raised by R70/t, i.e., not all of the increase in the selling price is passed through to farmers. This is because the increase in the Maize Board selling price depresses demand slightly, increases output, and increases surplus production that has a relatively low export realization, and thus attenuates the increase in the producer price relative to the increase in the selling price. This highlights a key feature of the existing pricing and marketing system in South Africa: Attempts to raise the Maize Board's selling price for white maize will result in only a partial pass-through to farmers. About half of the additional revenue generated by the Maize Board from higher domestic maize selling prices is required to finance the Board's export losses. A progressively smaller fraction of an increase in the Maize Board selling price is passed through to farmers as the selling price further exceeds export parity.

Moreover, the increase in the selling price detrimentally affects consumers. A R70/t increase in the selling price of white maize is estimated to raise maize meal prices by an average of 5%.

A similar process occurs for yellow maize. Higher Maize Board selling prices are not totally passed through to farmers, because the resulting rise in production and lower quantity demanded generates a higher exportable surplus. Yellow maize exports generally fetch a lower average price than domestic sales. Thus, a rise in exports tends to depress the average realization from yellow maize sales by the Maize Board.

The self-sufficiency ratio rises to 1.11, reflecting a greater buffer against the need for imports. However, with an efficient and widely-traded world market for yellow maize, the rationale for self-sufficiency at higher-than import-parity prices is questionable. The increased income for maize farmers is outweighed by the increased expenditures on maize by consumers. This scenario, relative to Scenario A2, transfers income from livestock producers and consumers to yellow maize farmers.

Scenario B: Free trade within South Africa; continued barriers on private import of yellow maize from world market; continuation of external trade barriers and 1993/94 price levels in Zimbabwe.

Unregulated domestic maize trade in South Africa (Column B) is estimated to depress producer prices and gross farm revenue from white maize production in South Africa by 4% and 3%, respectively, compared to the existing system. Retail prices also fall, reflecting assumed lower marketing costs from competition, and lower producer prices. This scenario represents a net transfer of income from farmers and large milling firms to consumers, when compared to the status quo system. These findings are consistent with Wright and Nieuwoudt (1993), who also concluded that consumers (farmers) would benefit (lose) under a transition to border pricing. Wright and Nieuwoudt further conclude that the gains to consumers under deregulated pricing would outweigh the loss to farmers, resulting in a net gain in total welfare.

Price policy in Zimbabwe appears to have only a marginal impact on market conditions in South Africa. The data presented for Scenario B in Table 9 assumes continuation of 1993 price policy conditions in Zimbabwe, (i.e., Z$900/t producer price), which in the past two years has resulted in excess supply and large government stock accumulation. But even when higher controlled prices in Zimbabwe are simulated in the model, the level of surplus production is not large enough, relative to the size of the South African market, to have more than a slight depressing effect on South African prices. However, when combined with a one-standard deviation increase in weather-induced yields in the region, import demand in the Southern Africa region contracts sharply, and both South Africa and Zimbabwe have large surpluses. This is estimated to greatly depress export realizations in both countries, and/or cause large stockpiling costs that exert downward pressure on future prices. If, on the other hand, Zimbabwe's Grain Marketing Board's maize producer price were reduced by 20%, the model estimates that this would create a small (1.6%) increase in white maize prices in South Africa.

A major implication of these results is that if policy makers in either country set maize producer prices at levels in excess of those required for maize self-sufficiency, the resulting surpluses will require greater treasury support for exports both in Zimbabwe and South Africa. This is because a higher exportable surplus in either country will, other factors held constant, increase the region's export supply relative to import demand and exert downward pressure on regional maize prices. However, this may not necessarily apply if there were cooperation or collusion between the two countries in determining white maize exports to the region.

Scenario C: Free trade within and between South Africa, Zimbabwe, and the world market.

The major effect here is on the yellow maize market. Cheaper imports fill about 15% of total yellow maize consumption in South Africa, mainly in the coastal regions. This has a depressing effect on domestic production, but actually involves a 3% increase in producer prices relative to current conditions because the elimination of surplus capacity also eliminates the problem of surplus disposal at low prices on export markets. However, this scenario is estimated to create an 11% decline in gross farm revenue from yellow maize, compared to the estimated results for the continuation of status quo policy (A1).

The model estimates that white maize producers will be moderately better-off under free trade than under the current regime. Average white maize prices would rise by an average of 6% relative to 1994 prices from the existing controlled pricing system, partially due to an assumed decline in marketing costs associated with increased competition, an increase in domestic demand, and a reduction in exports with low average realizations. Consumers gain considerably under free trade compared to the current situation, assuming that the milling, wholesaling, and retailing stages of the system are successfully deregulated to stimulate competition.

Milling/distribution costs in South Africa have already declined somewhat, partly in response to the relaxation of licensing restrictions on small-scale millers, and removal of restrictions on the purchasing of maize directly from producers since 1992/93. These declines in cost and selling prices of white maize are, to some extent, already visible in Figures 2 and 3. Indications are that the number of small-scale milling operations are increasing rapidly in South Africa, particularly in rural areas. While their present market share is small (<10 percent), they do compete with larger millers, distributors and retailers, resulting in lower consumer prices for maize meal in these areas.

While the discussion above is based on average prices, a free trade situation implies different prices for the different regions in South Africa. The extent to which prices will differ between regions, which is largely a function of transport costs, is shown in Table 10. The results indicate that producers in surplus areas facing relatively higher transport costs to major demand areas will be relatively worse off than producers from deficit producing areas. On the other hand, consumers in surplus producing areas gain relatively more than those in deficit producing regions. With the exception of Northwest Region and Northern Cape, the model results indicate that white maize farmers will receive higher prices under market deregulation than under the controlled marketing system. White maize consumers in all regions will benefit from market deregulation. Yellow maize farmers will also receive higher maize prices under deregulation, except in Northern Cape and Northern Transvaal. Yellow maize buyers in all regions of South Africa are anticipated to gain from market deregulation.

Scenario D: Protected regional market, i.e., 15% tariff on yellow maize imports, otherwise free trade within and between South Africa and Zimbabwe.

A 15% tariff on imported yellow maize is sufficient to make domestic production competitive in almost all regions, resulting in virtually no imports of maize. With the 15% tariff, the self-sufficiency ratio for yellow maize is estimated to rise from 0.86 to 0.98. The model estimates that yellow maize producers will benefit under this scenario when compared to free trade (C), with transfers of income from consumers and the poultry/livestock industry, to yellow maize farmers.

The effects of this scenario on the white maize market are small and insignificant when compared to free trade (C). The tariff on yellow maize also has no major impact on maize trade between Zimbabwe and South Africa.

6. POLICY IMPLICATIONS

The direction of white maize trade between Zimbabwe and South Africa will depend on future agricultural pricing, production and marketing policies in the two countries. However, the future regional trade situation is likely to be especially determined by the evolution of production and market policy in South Africa, due to the size of its maize sector in relation to the rest of the region.

The viability of South African white maize farmers is dependent on the efficiency of South Africa's downstream milling and distribution system. South African consumer markets for maize meal may be increasingly filled (to a limited extent) by white maize produced and milled outside South Africa, unless a lower-cost domestic marketing system evolves that can increase the competitiveness of South African maize production, processing, and distribution.

Model results indicate that, under the 1994/95 controlled pricing regimes in South Africa and Zimbabwe, up to 800,000 tonnes of maize meal from Zimbabwe could be profitably imported to the Northern Transvaal and Guateng, given the availability of surplus production in Zimbabwe. High transport costs would erode the cost advantage of Zimbabwean meal in other regions of South Africa.

It is questionable, however, that Zimbabwe will consistently produce this magnitude of surplus maize, given its other export markets, and due to the declining trend in expected maize production relative to consumption requirements in Zimbabwe. Maize production per capita in Zimbabwe has declined over the past decade due to a shift out of maize production by commercial farmers into non-regulated crops, declining outlays of government credit to smallholders, stagnant fertilizer use, inability of the private and public agricultural research systems to generate new hybrid seeds to promote productivity growth by smallholders (smallholders continue to use hybrids that are 20 years old), and a modest withdrawal of Grain Marketing Board infrastructure in smallholder areas. While higher controlled maize prices in Zimbabwe could raise production to some extent, this would in turn erode the competitive advantage of Zimbabwean exports and exacerbate the operating deficits of the Grain Marketing Board.

Therefore, it appears that, while substantial incentives currently exist for profitable trade in maize meal from Zimbabwe to South Africa under a deregulated external trading environment, numerous factors may in fact impede this from occurring: (a) continuation of controls or tariffs on cross-border trade; (b) insufficient exportable surpluses of white maize in Zimbabwe; and (c) progressive deregulation of maize milling and distribution in South Africa, which is anticipated to reduce marketing costs and thus reduce the cost advantage of Zimbabwean maize meal.

Exchange rate policy will also make a difference. Given the current marketing structure in South Africa and Zimbabwe, a relative devaluation in the South African currency of just more than 30 percent will erase the incentives to import maize meal from Zimbabwe.

The recent deregulation of maize marketing in Zimbabwe, featuring a rise in small-scale maize milling activities in urban areas, appears to be a major cause of declining marketing margins and retail costs of maize meal. In South Africa, milling and distribution costs have already declined somewhat, partly in response to the relaxation of licensing restrictions on small-scale millers, and removal of restrictions on the purchasing of maize directly from producers in the last season or two. Indications are that the number of small-scale milling operations are increasing fast, particularly in rural areas. While their present market share is small (<10 percent), they do compete with larger millers, distributors and retailers, putting downward pressure on consumer prices for maize meal in these areas. Continuation of these trends, and increased competition, seems to be a key to greater efficiency and smaller milling/distribution margins.

Viability of South African yellow maize farmers is much more dependent on the external trading environment and the domestic transport sector. When no import restrictions or tariffs apply, cheaper imports fill a portion (<15 percent) of total yellow maize consumption in South Africa, mainly in the coastal regions. This has a depressing effect on domestic production, but actually involves an increase in producer prices relative to current conditions because the elimination of surplus capacity also eliminates the problem of surplus disposal at low prices on export markets. However, there still is a decline in gross farm revenue from yellow maize (<12 percent), compared to the current situation. The adverse effects of trade liberalization on yellow maize producers could be partially offset by efficiency gains in the marketing sector, particularly intra-regional transport costs and storage rates. Reduction in transport costs from the Orange Free State and Transvaal regions to coastal areas where a significant portion of poultry feeders operate would make domestically-produced yellow maize more competitive relative to imports. A major issue is therefore whether a deregulated private trading system would be expected to reduce maize transport and storage costs compared to the existing system where such rates are determined administratively by the Maize Board, the cooperatives, and Spoornet, the national railway system.

The viability of local yellow maize farmers also depends on tariff levels and exchange rates governing imports. A tariff on yellow maize imports, or a relative devaluation in the South African currency, of 15 percent will erase all price incentives to import yellow maize, given the current market structure.

Consumers in general would be major beneficiaries of a deregulated and liberalized marketing policy environment which leads to, among other things, lower costs of downstream milling, distribution and transport activities. Deregulation and liberalization of marketing would be expected to stimulate competition, drive down consumer prices of both white and yellow maize, as appears to have been the case in other countries in the region where the single channel marketing system has given way to a multi-channel system.

This report concludes by highlighting several important conclusions for future policy deliberation in the region:

- Maize production has been stagnant or declining over the past 15 years in all of the major maize producing countries in Southern Africa. In per capita terms, maize production has been declining in all countries. This has been deliberate in South Africa since 1987, and in Zimbabwe during the late 1980s, due in both cases to surplus production and related export losses. Yet in the other countries, falling per capita production represents increasing reliance on South Africa, Zimbabwe, and the limited supplies of white maize on international markets for residual white maize requirements.

  Since 1987, South Africa has adopted a maize pricing policy designed to reduce treasury losses to the maize sector. In practical terms, this has involved lower average maize producer prices and lower expected supplies for export. If this trend continues, South Africa's trade situation will become increasingly similar to the other major white maize producers in the region, Zimbabwe and Zambia, insofar as it will fluctuate more frequently from exporter to importer according to the weather.

  The trend toward smaller expected surpluses in South Africa is particularly relevant in light of the fact that weather and maize yields are highly correlated in the major production areas of South Africa, Zimbabwe, and Zambia. First-differences in yields give essentially the same results. The emerging situation would suggest that droughts and import requirements in one country would coincide with shortfalls in other countries, even those that historically have been maize exporters. In this potential regional market environment, which would lack a consistent and reliable surplus maize exporter, it would be reasonable to envisage that white maize self-sufficiency may become elevated as a policy priority among other countries in the region, especially if the world market for white maize remains thin.

- The welfare of South African white maize farmers is indirectly yet intimately tied to the efficiency of South African maize distribution and processing system. Currently, maize milling-to-retail margins for commercially-produced meal in South Africa are over three times higher than those in Zimbabwe. Without efficiency gains in South Africa, incentives would exist to import meal into parts of South Africa under a decontrolled external trading regime. Failure to reduce costs in South Africa's maize marketing system is likely to depress South African farmers' maize output, farm prices, and share of the South African maize meal market under a less regulated external trading environment. The major beneficiaries would be farmers and marketing agents in Zimbabwe and perhaps other countries such as Zambia and Mozambique.

- Under a less regulated external and internal trading environment, the welfare of South Africa's yellow maize producers will increasingly be tied to exchange rates, the level of the tariff on yellow maize imports, and internal transport and storage costs. Under the existing structure of transport costs, and with no tariff, we predict that yellow maize producer prices in South Africa would rise by 3% on average, but production and gross revenue from maize sales would fall by 14% and 11%, respectively. A 15% tariff on yellow maize imports would be sufficient to make imports uncompetitive, but the same effect could be achieved without adversely affecting consumers and the animal feed industry if reductions in transport and storage costs could be achieved.

These conclusions have important implications, not only for commercial farmers, but also for the development of a Black smallholder farming sector in South Africa. The key issues in adjustment of the maize marketing system, with respect to regional trade, are increased efficiency in the milling, distribution and transport systems, tariffication and exchange rate policy. Policies affecting these issues will set the course for future maize trade and income transfers in the region under freer cross-border trade.

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