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Maize Milling, Market Reform and Urban Food Security: The Case of Zimbabwe

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Summary. — Government policy in much of Eastern and Southern Africa has encouraged the development of highly centralized, large-scale milling facilities, which has in turn promoted the consumption of highly refined and expensive maize meal compared to that produced by small-scale hammer mills. Policies to develop competitive small-scale milling facilities in urban areas are apparently neglected because of the conventional perception in Eastern and Southern Africa that urban consumers strongly prefer the refined, industrially milled meals, and are not responsive to price differences between various types of maize meals. Results of consumer and miller surveys in Zimbabwe call into question the validity of these perceptions. Simulation analysis also indicates that the elimination of policy constraints that block small-scale millers' access to grain would reduce overall marketing costs, thereby allowing higher producer prices, lower consumer prices and/or lower government subsidies. The case of Zimbabwe suggests that market reform may considerably reduce the magnitude of the tradeoff between governments' food security and budget minimization objectives.

1. INTRODUCTION

Structural adjustment throughout Africa has usually been associated with the removal of controls on a wide range of commodities, including consumer prices of staple foods. In the short run, this has often caused sharp increases in food prices, falling real incomes, especially among the poor for whom staple food may comprise up to 50% of total expenditures, and political unrest.[1] These concerns obviously make governments reluctant to eliminate policies that keep consumer prices low. At the same time, many governments strive to keep producer prices high enough to generate adequate food supplies, especially in landlocked countries with weak infrastructural links to world markets and where the staple commodity is thinly traded on world markets. With these conflicting pressures on producer and consumer food prices, governments have often found that the most straightforward and politically expedient solution is to subsidize the marketing board's margin between the producer and consumer price of the staple food. This solution, however, has become less viable under the recent wave of structural adjustment programs throughout Africa, since a major objective of structural adjustment is the reduction of marketing board trading deficits.

In the long run, growth in farm productivity and nonfarm employment may reduce the severity of the food price dilemma which is how to simultaneously maintain affordable consumer prices and remunerative producer prices (Timmer, 1986). In the short run, however, governments' options to relieve the food price dilemma are limited. Yet it is in the short run that the need to cushion the poor from potentially adverse impacts of structural adjustment is arguably the greatest.

This article addresses the immediate question commonly asked by African governments facing structural adjustment: How can food prices be kept at tolerable levels for the poor at a time when subsidies must be reduced and substantial

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increases in producer prices are necessary to generate adequate food supplies? It is commonly perceived that state marketing boards throughout Africa have imposed heavy costs on their grain sectors, causing producer prices to be lower and consumer prices to be higher than would prevail if regulations on transport and storage — the tasks normally performed by state marketing boards — were relaxed to provide greater incentives for private trade.[2]

There may be opportunities, however, to substantially reduce marketing costs at other stages in the system not controlled by parastatals but which are nevertheless circumscribed by parastatal behavior and market regulations. In particular, government pricing and marketing regulations in Zimbabwe, Kenya, Zambia, South Africa and other maize-oriented countries of Southern Africa have encouraged the development of highly centralized and concentrated maize-milling facilities, which have in turn promoted the distribution of highly refined and expensive maize meal compared to that produced by small-scale mills (Bagachwa, 1992; Rubey, 1992; Jiriyengwa, 1991; Stewart, 1977). This paper examines the effect of these regulations on urban food security and the potential for market reform to ease the food price dilemma in spite of subsidy reduction, using the case of Zimbabwe.

These issues were addressed through surveys of 300 urban consumers and a census of millers operating in and around Harare, the capital of Zimbabwe. Survey results were used in tandem with a dual-market spatial equilibrium model using secondary regional and national data to simulate the effects of market restructuring on trade flows, prices, and the marketing board's trading account and stock levels.

Results indicate that the structure of Zimbabwe's maize marketing system hurts both rural smallholders and urban consumers, by forcing the bulk of surplus maize production to be processed through the relatively high-cost industrial milling system. While milling margins of small hammer mills range from 25% to 45% of the large-scale industrial mills, the former is blocked by policy from procuring maize grain in urban areas, such that consumers with a preference for hammer-milled meal are forced to purchase more costly industrially milled meal. Surveys of urban consumers suggest that whole meal would account for a much higher share of the urban maize meal market if it were available at a price discount. Evidence also suggests that the poor are the main consumers of such meal, when it is available. Policy reforms to improve small-scale millers' access to grain would reduce milling margins in the short run, thereby allowing higher producer prices, lower consumer prices, and/or lower government subsidies. While governments' food security and budget minimization objectives present obvious tradeoffs, we argue that selected market reforms may considerably reduce the magnitude of these tradeoffs.

2. GRAIN MARKET ORGANIZATION IN ZIMBABWE

Maize marketing systems in East and Southern Africa have typically been characterized by highly controlled and centralized distribution, storage and milling facilities. State maize procurement and milling are either vertically integrated in a single agency, or the state marketing board serves as a *de facto* procurement agent for the private industrial milling sector.[3] These systems are designed to ensure a consistent flow of maize meal to urban consumers at prices which are capable of being controlled and stabilized by government.

The ability to successfully defend these prices often requires associated controls on private grain movement. For example, Zimbabwe is divided into "Zone A" areas, which include all urban and large-scale (mostly European) farming areas, and "Zone B," or African smallholder areas. The Zone B areas are geographically scattered throughout the country. Restrictions on private grain movement across zone boundaries have impeded direct private trade from surplus to deficit areas, and have effectively forced the bulk of marketed output in the surplus zones into the Grain Marketing Board (GMB) system. Once sold to the GMB, maize is normally transported onward to urban silos, where it is subsequently processed by urban industrial buyers. Unlicensed, or "informal" traders and millers are restricted from procuring GMB-held maize.[4] The combination of movement controls and selective access to GMB maize effectively reserves the bulk of the nation's marketed maize surplus for the industrial millers and consequently assures their oligopolistic position in the maize meal market (Figure 1). Not surprisingly, large urban millers, stockfeeders, brewers and government food aid programs have accounted for 77%, 8%, 7% and 6% of GMB sales since 1980. Less than 2% of GMB's total maize intake has been sold to private small-scale traders or millers. Thus, as in much of East and Southern Africa, grain marketing is dominated by a single-channel, unidirectional flow of grain from rural areas into the GMB/urban milling system, providing preferential access to selected buyers and impeding the

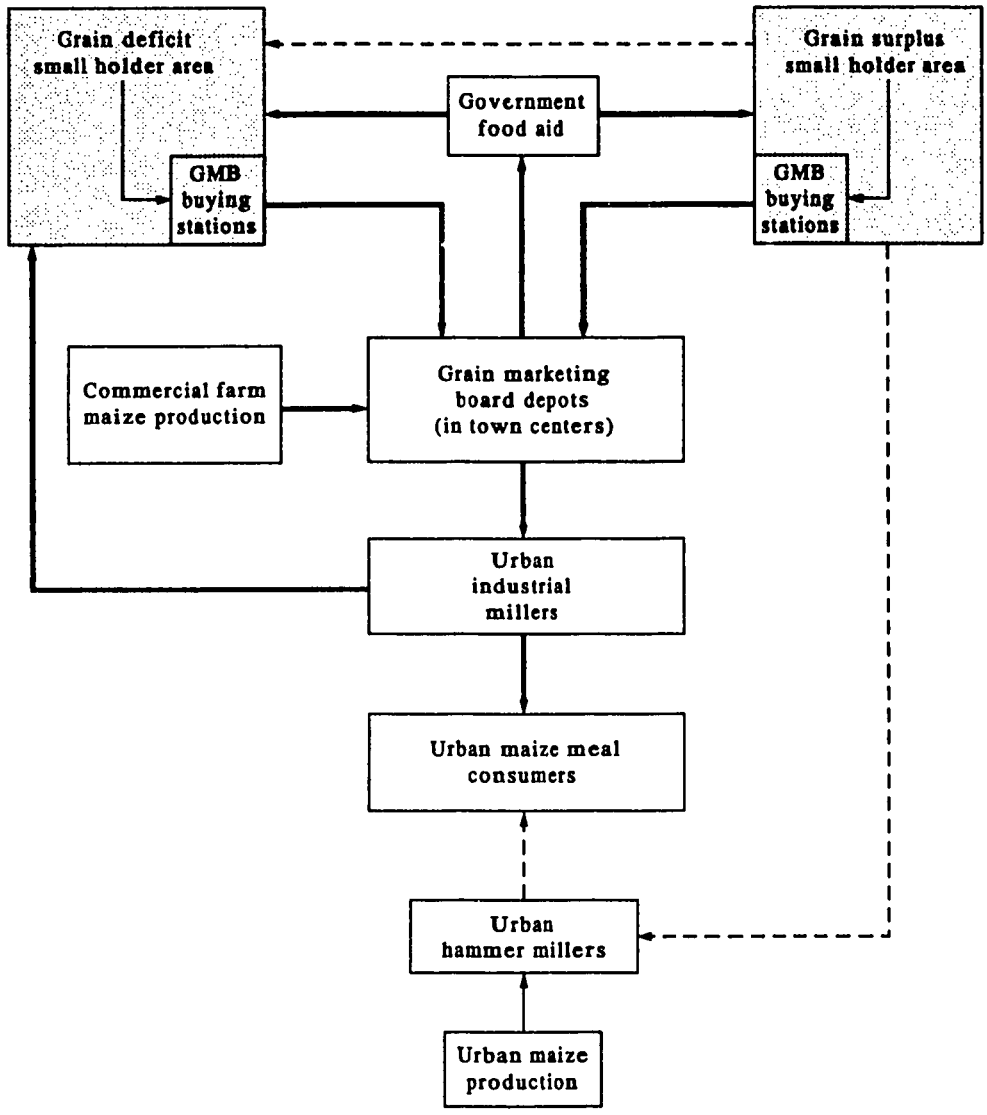

Figure 1. *Official and unofficial maize distribution channels in Zimbabwe.*

development of alternative maize-marketing channels.[5]

This system is based largely on the implicit assumption that rural farming communities are self-sufficient in grain. There is now, however, overwhelming evidence that, in a average rainfall year, the majority of smallholders in the semi-arid regions of Zimbabwe are in fact net buyers of grain (Hedden-Dunkhorst, 1990; Sunga *et al.*, 1990; Jayne and Chisvo, 1991). Because direct private trade between surplus and deficit rural areas is blocked by policy, a circuitous flow of grain has evolved in which marketed surpluses flow out of rural areas through the official marketing channel to be processed by large-scale urban millers, and then flow back into grain-deficit rural areas in the form of expensive refined maize meal. This transport-intensive

system has effectively reduced incomes among poor rural consumers by as much as 30% (Jayne and Chisvo, 1991).

The effects of this "surplus-extraction" system on food security in urban areas have received less attention. This may be because the extractive nature of the marketing system has been perceived to benefit urban consumers by funneling the bulk of surplus production into the hands of the state, enabling it to control and subsidize the price of food to urban consumers. Analysts have typically contended that Zimbabwe has pursued a "cheap food policy," evidenced by the heavy direct and indirect subsidies put on industrial maize meal.[6]

Large subsidies on consumer food prices, however, do not necessarily mean that prices are lower than they would be in a restructured and more competitive market. Regulations or inefficiencies at certain stages of the system may impose additional marketing costs that overwhelm the effect of direct government subsidies. This hypothesis is examined below.

Maize milling in Zimbabwe, as many countries in East and Southern Africa is dualistic, with a large-scale industrial milling sector operating alongside a small-scale milling sector. Urban maize milling is dominated by four large private firms using roller mill technology.[7] The largest firm handles 65% of all industrial meal sales, while the largest two handle 85%. These millers produce two types of maize meal: super-refined meal (62% extraction rate) and roller meal (85% extraction rate). The industrial millers are technically miller-distributors. They buy maize grain from the GMB at subsidized prices and distribute the meal to retailers at government-controlled prices. Maize milling margins are based on cost of production data supplied by millers.

Small-scale millers, by contrast, are characterized mainly by hammer mill technology.[8] These mills manufacture two products: *mugayiwa*, a 98% extraction rate whole meal for human consumption and a coarse maize stockfeed. As mentioned above, small-scale millers are restricted from procuring grain in urban areas because the GMB has in practice reserved its grain for the large industrial buyers, and because controls on maize movement prevent private traders from legally transporting grain into urban zones. Thus, urban hammer millers have only two sources of maize supplies: local production on small plots within or around urban areas; and illegal inflows of maize grain from nearby farming areas. As a result, government regulations and pricing policy appear to perpetuate the distribution of heavily subsidized industrial meal in urban areas at the expense of whole meal and the development of the small-scale milling industry.

This system is based on an important assumption about the structure of the maize system. First, it has become somewhat of a truism in Southern Africa that urban consumers strongly prefer the highly refined, industrially milled maize meals. If this hypothesis were true, it would follow that there should be little hammer milling capacity in urban areas. Negligible demand for whole meal would also indicate that urban consumers are not adversely affected by the existing regulations that restrict small-scale millers' access to maize. These issues are empirically examined in the following two sections.

3. DEMAND FOR WHOLE MAIZE MEAL

To determine the level and seasonality of demand for whole meal manufactured by urban hammer mills, two different types of surveys were conducted in Harare and its high-density suburbs. First, a census of small-scale urban hammer mills was undertaken in March 1992. By systematically searching all neighborhoods and inquiring from potential consumers, 57 small-scale hammer mills were located in or within walking distance of these urban neighborhoods. Information regarding milling throughput, financial aspects of the milling operation, breakdowns, milling charges, and employment patterns was obtained from mill owners and operators. Data on monthly maize meal throughput and the proportion of throughput destined for human consumption were used to estimate the annual consumption of hammer-milled whole meal in the city.[9] Second, 301 urban consumers waiting in maize meal queues in Harare and its high-density suburbs during the same time period were surveyed to reveal preferences for whole meal at various price relationships to the more refined meals. This survey, while nonrandom, was designed to provide an order-of-magnitude estimate of the latent demand for whole meal after abstracting from policy-related constraints that restrict urban consumers' access to it.

(a) *Consumer demand for whole meal*

The findings of these surveys revealed four salient points. About 20% of the urban hammer mills, mainly those owned by commercial farmers on the periphery of urban boundaries, tended to focus on producing stockfeeds, while whole meal for human consumption was the major product processed by small-scale millers near densely

populated neighborhoods. Based on records kept by millers and recall data, monthly milling throughput was reconstructed. In the 1991–92 marketing year, small-scale urban mills produced over 11,000 tons of whole meal, or about 8% of the maize meal consumed in the area during this year.

A more striking finding was the seasonal nature of demand. Demand for hammer milling services peaked in June, July and August (Figure 2). This pattern coincides with the April harvest in the Harare area and the subsequent drying of maize before it may be processed by hammer mills. By October, milling throughput had fallen off considerably and reached its lowest point in February, at just over a quarter of peak levels.

This seasonal pattern would be consistent with two alternative explanations: there may be either a seasonal demand for whole meal; or there is a seasonal demand for milling services that corresponds to the seasonal availability of grain from local plot production. The former explanation does not appear consistent with the consumption patterns of food secure households in Zimbabwe (Chisvo, 1992). When available and accessible, maize meal appears to be the dominant staple food at all times of the year. The other explanation — that maize grain is not accessible to small private buyers in urban areas after local production is depleted — is supported by the census of urban millers. When asked about the availability of maize grain, 90% of millers said grain was "readily available" in April–June and none said it was "not available." Conversely, in January–March, 35% said maize grain was not available while only 2% said it was readily available. Restrictions on private grain movement into urban areas appear to impede the availability of whole meal in urban areas after urban and peri-urban maize production is depleted, leading to the observed seasonality of hammer mill throughput.

While current whole meal consumption may be only 8% of total, a potential consumption figure can be extrapolated assuming that the seasonal peak is maintained for the whole year. If consumers had access to maize grain year-round and maintained post-harvest levels of whole meal consumption for the entire year, total whole meal consumption would be over 17,000 tons, or 13% of annual maize meal consumption.

Yet this probably still understates the true potential demand for whole meal. During the post-harvest period of peak demand for hammer milling services and whole meal consumption, access to grain is still constrained by the production potential of urban households. Maize cultivation usually takes place on extremely small garden plots between houses or on vacant municipal land. In recent seasons, municipal authorities have attempted to suppress informal cultivation on public lands by slashing maize before it reaches maturity.[10] The hypothesis that latent demand for whole meal exceeds urban plot production even directly after harvest is supported by the consumer survey results. Over two-thirds of the 301 respondents chose whole meal when it was offered at an 8% price discount to roller meal.[11] Of those who chose whole meal, over 80% cited its lower price as their reason. The rapid increase in the prices of basic commodities and services under Zimbabwe's structural adjustment program has caused a sharp decline in the real incomes of middle- and low-income

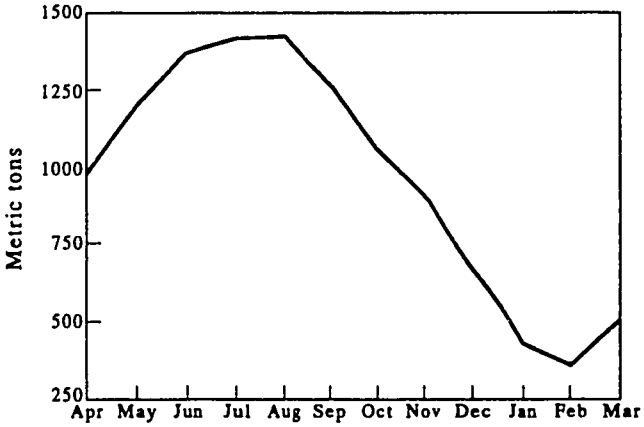

Figure 2. *Estimated throughput of maize meal by private small-scale hammer millers in Harare and Chitungwiza, 1991–92 marketing year.*

urban consumers (Economist Intelligence Unit, 1992), which may have induced greater price sensitivity between different types of maize meal. This survey compares with a rapid appraisal conducted in 1991 which indicated that 35% of the 587 urban consumers surveyed would prefer to buy whole meal if it were eight percent cheaper than roller meal (Jayne *et al.*, 1991).

While price is the main consideration in consumer selection, nutritional differences among different types of meal must also be acknowledged. Whole meal produced from a hammer mill contains 8% and 20% more protein, 17% and 150% more thiamin, 62% and 100% more riboflavin, 25% and 127% more iron, and 71% and 100% more calcium, respectively, than the moderately- and superrefined products from a roller mill (West *et al.*, 1987). Finally, given the severe drought during the 1992–93 marketing year, increased consumption of whole meal could reduce the volume of imported maize required to meet domestic needs. Since the extraction rate of straight-run meal (98%) is considerably higher than that of industrial produced meal, one ton of maize grain destined for whole meal will yield a greater quantity of maize meal available to consumers, saving scarce foreign exchange.[12]

(b) *Milling charges*

There are substantial differences between hammer mill and roller mill technology. In Zimbabwe, milling costs per unit of output vary widely between the four industrial firms using roller mill technology and the numerous small urban hammer millers. As of February 1992, the gross margin obtained from processing one ton of meal was Z$487 for superrefined and Z$348 for roller meal (Table 1).[13]

The operating margins of small hammer millers, by contrast, are about one-fourth of this. Most small-scale millers specialize in "custom milling," whereby the raw grain and container is provided by the customer. Due to perceived and actual restrictions, very few hammer millers sell already-processed meal. Thus, the equivalent cost per unit of output for small-scale millers is simply the milling charge. For the 57 mills in the survey, milling margins averaged Z$63 per ton. Bag costs averaged Z$50 per ton for the few hammer millers who sold in bags. Therefore, if the GMB allowed sales to small-scale buyers, then whole meal could be available at about Z$60–115 above GMB selling prices (plus transport costs), compared with Z$350–500 above GMB selling prices for unsubsidized industrial meal (again plus transport costs). Given the 1992–93 GMB selling price, this suggests that a 15–25% reduction in maize costs are possible. Naturally, a complete cost accounting would have to consider customers' opportunity cost of time in visiting the miller.

In addition to milling costs per unit of output, there are a number of relevant criteria in the evaluation of small-scale hammer mills versus roller mills used by the industrial miller sector, including employment generation, capital utilization, capacity utilization, generation of backward and forward linkages, and relative profitability. Bagachwa (1992) found that in Tanzania, hammer mills were superior to roller mills with respect to each of the above criteria, with the exception of capacity utilization. Hammer mills were found to operate at below capacity due to insufficient grain supplies, power failures and a lack of spare parts. In Kenya, Stewart (1977) found that the roller mill is technically inferior to the hammer mill, requiring more capital, labor and foreign exchange costs in relation to output.

In essence, the Zimbabwean government has conferred a *de facto* monopoly to industrial millers, even though their margins are three to four times higher than those of small-scale millers. Lacking any major threat of competition from hammer millers, the industrial millers are able to operate a higher cost system without losing market share.

(c) *Investment in hammer milling*

For all urban small-scale millers, milling is a secondary occupation. The policy-induced seasonality of the business precludes an entrepreneur from entering into milling as a primary enterprise. Naturally, due to the seasonal demand for milling services, most hammer mills are operating severely below capacity. Holding current working hours constant and factoring in the time needed for periodic cooling of the electric motors, it is estimated that the existing capacity in the sector is over 60,000 tons per year in the census area. Presumably, capacity is even greater since most millers said they were willing to expand their hours of operation to meet consumer demand. This indicates that small-scale mills have the capacity to increase maize meal production from its current share of 8% up to about 38% of the population's maize meal requirements in the Harare area.

(d) *Summary of survey findings*

The findings of the miller and consumer

Table 1. *A comparison of gross margins for maize milling between industrial roller mills and hammer mills, as of February 1992*

	Industrially milled meals			
	Superrefined meal (62% outturn)	Roller meal (85% outturn)	Straight-run meal (99% outturn)	Whole meal (98% outturn)
a. government-controlled selling price of maize grain (Z$/ton)	690	298*	690	na
b. quantity of maize grain required to manufacture one ton of maize meal (tons)	1.61	1.18	1.01	1.02
c. cost of maize grain required to produce one ton of meal (a × b = Z$)	1,111	352	697	na
d. government-controlled price of maize meal, *ex mill* (Z$/ton)	1,445	646	942	na
e. gross margin on maize meal (d − c = Z$)	334	294	245	57†
f. quantity of by-product in process of manufacturing one ton of maize meal (tons)	0.61	0.18	0.01	0.02
g. approximate market value of maize by-product for livestock feed (Z$/ton)	300	300	300	300
h. gross margin on maize by-product generated in the manufacture of one ton of maize meal (f × g = Z$)	183	54	3	6
i. total gross margin on one ton of meal plus by-product (e + h = Z$)	487	348	248	63‡

Source: Authors' calculations based on information supplied by Grain Marketing Board and by National Foods, Ltd.

*Includes subsidy of Z$392 conferred to industrial millers for maize grain purchased for the manufacture of roller meal.

†Average custom-milling margin from survey of 57 urban hammer mills.

‡This figure refers to custom-milling only; for strict comparability, bagging charges of approximately Z$50 per ton must be added. na, means not applicable.

surveys are four-fold. First, contrary to the prevailing beliefs, there is already considerable consumption of whole meal in the urban areas examined during the months in which maize grain is locally available, despite the severe contraints under which the small-scale milling sector operates. Second, there is considerable unmet demand for whole meal due to procurement constraints that block consumers' and small millers' access to grain in urban areas. After local production is depleted, consumers have little choice but to consume more expensive industrial meal. Third, differences in milling margins suggest that whole meal from hammer mills could sell at a 15–25% discount relative to unsubsidized industrial roller meal. Fourth, there is substantial excess capacity in the small-scale milling sector in the urban areas examined. Urban hammer mills could produce over 35% of the populations's maize meal requirements in the urban areas examined without additional investment in milling equipment.

4. SECTORAL EFFECTS OF ELIMINATING CONTROLS ON MAIZE MOVEMENT[14]

The foregoing suggests that the elimination of controls on private grain trade between smallholder and urban areas could relieve the constraints on small hammer mills' access to grain, and thus allow consumer preferences for whole meal to be articulated through the market. To the extent that overall marketing costs would be reduced by bypassing the GMB/industrial milling system, gains would be passed on to both producers and consumers. The magnitude of these gains, however, and the broader sector-wide effects of this policy change on the performance of the system are as yet unresolved. For example, elimination of movement controls across zones would affect the volume sold to, and purchased from, the marketing board. This could affect the GMB's trading account and its ability to perform price stabilization functions. To quantitatively estimate these effects, a dual-market spatial equilibrium model was developed, based on Roemer's (1986) market segmentation model, to capture interactions between the official and informal maize marketing systems.

The simulation model examines how elimination of controls on grain movement between smallholder and urban areas would affect producer and consumer price levels, the marketing board's stock levels and its trading account. The model is essentially structured as follows: Maize supply functions are estimated econometrically for each producing region (13 smallholder areas and five commercial areas). GMB producer price, chosen exogenously, determines GMB intake and influences the supply of grain in each regional parallel market. Regional parallel market prices are derived endogenously from local supply and demand conditions in each region, which are influenced by government-set prices for maize grain and industrial meal (1991–92 price levels are chosen for the simulation). The price of industrial maize meal serves as a ceiling price in the parallel market. When movement restrictions are in force, each region is in autarky, except for the movement of industrially milled meal to meet demand in deficit regions. When movement restrictions are relaxed, the model is similar to standard trade models where excess supply and demand curves are determined from the supply and demand curves in the respective regions. Excess supply and demand determine unique parallel market prices in each region, which are modified by relevant transport and processing costs. Finally, by aggregating across regions, national supply to GMB and sales of industrially milled meal can be derived. The residual, after adjusting for milling extraction rates and demand for GMB grain from stock-feeders and brewers (which is a relatively small part of the market and treated as a constant), is official marketed surplus, i.e., endstocks plus net exports. The regression equations, trade identities and elasticity estimates used to run the model are presented in the appendix; readers interested in a more detailed discussion of the model, results and policy implications are referred to Jayne and Nuppenau (1993).

The results indicate that elimination of grain movement between smallholder zones and urban areas would produce the following results relative to the existing system:

(a) *Urban consumption, smallholder grain sales and food prices*

Movement decontrol would provide substantial price incentives for smallholders near urban areas and grain traders to bypass the GMB/urban milling system and market grain directly to urban millers and consumers. The exact proportion of urban maize consumption that would be met through private channels is sensitive to assumptions about consumer preferences for whole meal at various price discounts to that of industrial roller meal. Based, however, on results of the urban consumer survey discussed in the previous section, at least 30% of urban maize meal would be processed through the small-scale milling sector. Low-income urban consumers would pay 10–20% less for their staple meal due to the ability of small-scale millers to procure maize directly from smallholder areas and mill it at lower cost than the industrial millers. Lower milling costs through parallel channels are partially passed on to smallholder farmers in the form of higher producer prices, especially for those located near urban centers.

(b) *Grain Marketing Board trading deficits*

Elimination of movement controls is estimated to reduce the GMB's maize trading losses by 15% on average relative to the existing system. This is because movement decontrol would relieve the GMB of buying in smallholder areas where it currently operates at a loss. Volumes traded through parallel markets would increase, not because they are more efficient than the GMB in transport and storage, but because they can incur substantially lower milling costs through small hammer mills. Demand for GMB grain, on the other hand, is a derived demand for

industrial meal. As a greater portion of consumers acquire meal through parallel trading/milling networks, the demand for commercial meal, and consequently for GMB grain, would fall. Since the GMB operates at a loss in almost all smallholder areas, reduced throughput would reduce its financial losses.

(c) *GMB stock levels and trade implications*

The expected net GMB surplus (intake minus sales under average rainfall conditions) is estimated to rise by 6% if controls on trade between smallholder zones and urban areas are relaxed. While the stimulation of private trade reduces smallholder sales to the GMB, this is overwhelmed by the reduction in demand for industrial meal, which in turn reduces the demand for GMB grain.

Because of the availability of less-expensive whole meal in urban areas under movement deregulation, national consumption is estimated to be 8% higher than under the existing system. Lower marketing margins (both from more direct transport routes to grain-deficit rural areas and a shift to lower-cost hammer millers) and the opening up of urban markets to private trade would therefore create higher producer prices in many smallholder areas and stimulate national maize supplies without adversely affecting urban consumer prices and household food security.

(d) *Rural food security*

As surplus production in smallholder areas is bid away by urban demand, decontrol of grain movement is estimated to raise maize prices by 5–10% in smallholder zones near urban centers. This would exacerbate food insecurity among low-income, grain-deficit households in these selected rural areas. Model results indicate that elimination of movement controls generates very little trade between surplus and deficit smallholder areas. This is because transport infrastructure linking surplus and deficit smallholder areas is poorly developed. Therefore, maize market liberalization would have greater potential to reduce food prices in grain-deficit rural areas if it were accompanied by investments in transport and communication infrastructure between surplus and deficit smallholder areas.

The foregoing examines only one form of partial grain market liberalization under active consideration by the Government of Zimbabwe: elimination of controls on maize movement between smallholder and urban areas. More comprehensive reforms would include the legalization of trade between all areas of the country and/or allowing the GMB to set floor and ceiling prices, allowing private trade to take place within this price band (Child, Muir and Blackie, 1985). These reforms may produce more widespread changes in income distribution, trade flows and the government's ability to continue its influence over price levels and stability. Several of these more comprehensive policy scenarios are examined explicitly by Masters and Nuppenau (1990) and Jayne and Nuppenau (1993).

5. CONCLUSIONS AND POLICY IMPLICATIONS

Much of the literature on grain pricing and marketing policy has stressed the tradeoffs between producer incentives, consumer prices for staple foods, and government budget costs (Timmer, 1986; Pinckney, 1988; Buccola and Sukume, 1988). While such tradeoffs are inevitable, this analysis suggests that selected market reforms may reduce the severity of the tradeoffs, even in the short run. In the case of Zimbabwe, regulatory changes that would facilitate access to grain by small-scale urban millers would substantially reduce milling margins, thereby allowing higher prices to producers, lower prices to consumers, and/or a reduction in grain subsidies.

Structural adjustment has often revealed the stark nature of the tradeoffs under the constraints of the existing marketing system. In Zimbabwe, recognition of the need to increase maize producer prices and cut marketing board deficits has put upward pressure on food prices at a time when, at least in the short run, unemployment is increasing, real income growth is declining, and government is reducing subsidies to education, transport, health and other sectors. To ease the burden on urban consumers, the government has chosen in 1992 to reduce consumer maize meal prices through large subsidies on industrial roller meal rather than through market reform. The subsidy is untargeted because roller meal is widely consumed by middle and upper income consumers as well as the poor. The subsidy is expected to cost about 3% of Zimbabwe's gross domestic product. The magnitude of the subsidy, conferred selectively through the four large industrial millers, is also likely to stifle new investment in private grain trading and hammer milling. Thus, while the subsidy does meet the objective of ensuring that consumers have access to a low-cost source of maize-meal, it comes at the expense of other government objectives: raising producer prices for small-

holders, reducing government budget losses, and promoting small indigenous business enterprises.

The findings of this study indicate that selected grain market reforms may promote the attainment of all four of these objectives. Small-scale millers currently possess the capacity to produce up to one-third of total maize meal requirements in the urban areas analyzed, with no additional investments in machinery. Elimination of restrictions on private grain movement between smallholder and urban areas may thus immediately increase the availability of low-cost and more nutritious maize meal to urban consumers through the small-scale milling sector, while simultaneously reducing the need for huge budget outlays on high-cost industrial roller meal.[15] Simulation results also suggest that the reduction in overall marketing costs would allow higher producer prices to be passed on to farmers, especially those close to urban centers.

To a large extent, these potential gains have been neglected because of the conventional wisdom, built up partly through decades of advertising, that urban consumers in Eastern and Southern Africa have strong preferences for the more refined maize meals produced by industrial roller mill technology. This perception is based on the assumption that consumers are not responsive to price differences between various types of maize meals. Consumer surveys in Zimbabwe, however, call into question the validity of these perceptions, especially in an environment where real urban wages have declined and food prices have risen dramatically. The ability to reduce the severity of the tradeoffs between consumer prices and budget losses hinge on adopting a maize policy that allows consumer preferences to determine the type of maize meals available on the market and the price differences between them, thus capturing potential gains from self-targeting. This contrasts markedly with recent government policy of restricting consumers' access to hammer-milled whole meal and heavily subsidizing the more refined industrial meals.

The realization of these gains will require several important changes to the organization of the grain marketing system. In much of Eastern and Southern Africa, grain systems are organized such that the regulations circumscribing the choice of market outlets open to farmers largely predetermine the subsequent flow of grain and access to it at other stages in the marketing system. The removal of restrictions on small-scale urban milling and the legalization of grain movement between smallholder zones and urban centers would promote consumers' access to whole meal and introduce an element of choice that is currently unavailable. These reforms would allow the private sector to carry out trading, transport, and milling functions that have been historically suppressed. Results of the simulation model of the maize sector presented in section 4 indicate that this partial form of market liberalization would not induce major changes in the Grain Marketing Board's abiiity to stabilize producer and consumer prices within its 1991–92 price band. Thus, it would not create the political risks that a more comprehensive form of liberalization would involve, although it might also forego important benefits.

Secondly, a commitment by government to refrain from sporadically introducing huge subsidies on industrial maize meal would reduce the risks of future investment in small-scale grain milling. While the government's pricing policy during 1986–92 had provided ample incentive for small millers to operate within the controlled producer and consumer prices (although their ability to procure grain was blocked by policy), the huge subsidy on industrial meal in 1992 erased these incentives, and has entrenched the position of the four large, high-cost industrial millers. Ironically, the development of a more decentralized and competitive private trading system is a central objective of the Government's Economic Structural Adjustment Program.

The information required to guide the reorganization of a grain marketing system may be substantial. There is little knowledge in most Eastern and Southern Africa countries about how consumer preferences for maize meal vary by income group. In most cases this lack of information about demand is because state controls on pricing and distribution have prevented consumer preferences from being articulated. The absence of such information has submerged recognition of potential self-targeting mechanisms. This study has examined consumer demand for whole meal versus industrially milled meal as revealed through the actual throughput of hammer mills. A more comprehensive effort may include formal consumer surveys to estimate national demand for various types of meal as a function of relative price and income level. While anecdotal evidence suggests that whole meal may be an "inferior" good in Zimbabwe, a firm conclusion awaits further research.

Many critiques of official marketing systems have centered on the inefficiency of state marketing boards. The case of Zimbabwe suggests that the official marketing system imposes substantial costs on consumers, not primarily because of technical inefficiency of the parastatal, but rather because of regulations that preclude lower-cost operations from taking place at different stages in

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the system. Selected reforms may thus promote the development of alternative marketing channels capable of providing low-cost staple food without involving a massive drain on the government treasury.

NOTES

1. See Lele (1990), Oyejide (1990), Pinstrup-Anderson (1988) and Cornia, Jolly and Stewart (1987). These studies generally conclude that the short-run effects of structural adjustment have been particularly severe on the urban poor. Among the rural poor, analysis of five African countries undertaken by Sahn and Sarris (1991) indicates that structural adjustment has caused "no unequivocal pattern of increase or decline in the real welfare of the rural poor . . ." It would be inappropriate, however, to conclude that structural adjustment of any type is bad for the poor. To the extent that judiciously selected policy changes are capable of raising (reducing) prices of goods that the poor sell (buy) and stimulating employment opportunities through investment and economic growth, structural adjustment — in some form — would be an integral part of a well-defined strategy to increase the welfare of the poor.

2. See, for example, the case studies in Eastern and Southern Africa by Odhiambo and Wilcock (1990); Amani, Lipumba and Kapunda (1990); Christiansen and Stackhouse (1989); Franzel, Colburn and Degu (1989), Child, Muir and Blackie (1985), and Jayne and Chisvo (1991).

3. Examples of the former may be found in Tanzania and Malawi; examples of the latter, in Zimbabwe, Zambia, Kenya, and South Africa.

4. Although it is theoretically legal for small-scale private entrepreneurs and consumers to purchase maize from GMB depots, in practice such sales are restricted by GMB depot managers. Thirteen out of 15 depot managers interviewed stated that they do not permit sales to such buyers (Jayne and Chisvo, 1991) due to perceptions that they would exploit poor households needing grain. The GMB has recently announced its decision to restrict maize sales to informal private buyers to one 90 kg bag per month.

5. Although countries such as Malawi, Zimbabwe and Zambia have recently undertaken partial liberalization, these efforts have often failed to remove the binding constraints on private grain trading. For example, recent policy changes to promote private grain trading in Malawi and Zimbabwe have been thwarted by the continuation of large subsidies within the marketing board/large-scale milling system, effectively squeezing the margin within which private traders could operate profitably.

6. Indirect subsidies include GMB operating deficits, financed by the treasury. GMB's actual operating costs normally exceed the margin between the controlled producer and selling price by 30–50% (see Jiriyengwa 1991).

7. Roller mills use relatively large-scale, capital intensive processing technology. In Zimbabwe, these mills are capable of milling over 1,000 tons of maize per day. Most of the roller mill equipment is imported from Europe. For details on roller mill technology, see Bagachwa (1991).

8. Hammer mills are normally driven by a single motor and operated by a single attendant. Throughput ranges from one to 20 tons per day. These mills are sold in Zimbabwe by local manufacturers but the motors are largely imported.

9. Most millers kept daily records of actual milling throughput. It was relatively easy for respondents to distinguish between throughput for human consumption and that for livestock because the former requires a different sieve setting and involves a higher milling fee.

10. A possible explanation for this behavior is that informal cultivation and distribution "spoils the image of the modernizing, Western city that the planners wish to convey to the outside world" (Drakakis-Smith, 1991, p. 51).

11. Respondents were presented with a simulated series of choices between whole meal and industrial roller meal at various price differentials. For example, consumers were asked "if both roller meal and whole meal were available at this store right now, which would you buy: 10 kg of roller meal at $7.60 (the current retail price) or 10 kg of whole meal at $7.00." Four choice scenarios between roller meal and whole meal were addressed (orally and with the aid of a printed card). The 8% discount was chosen because that has been the average government-mandated difference between retail whole meal and roller meal prices, even though the former is rarely available for purchase. As discussed below, the actual difference between roller meal and whole meal prices through small-scale mills has been even greater than this.

12. The foreign exchange savings could be as large as US$40 million. If all of the 1.7 million tons of maize to be imported during the 1992–93 marketing year is processed by roller mill technology at an average extraction rate of 72% (based on the manufacture of equal proportions of roller meal and superrefined meal), this will convert into 1.22 million tons of maize meal. On the other hand, if 30% of the 1.7 million tons were obtainable and processed by hammer mill technology, this would convert into 1.36 million tons of maize meal. Thus, the latter option could have avoided the need to import 140,000 tons of meal (i.e., 175,000 tons of grain). At current c.i.f. import prices of US$280 for maize in Harare, this would save US$49 million in

foreign exchange. On the other hand, the more maize is processed through hammer mills, the less by-product there will be for the manufacture of livestock feed and maize oil.

13. This is based on the *ex mill* selling price of industrial meal and does not include the cost of transporting the meal to various urban neighborhood retailers where it would be available to consumers.

14. This section draws from Jayne and Nuppenau (1993).

15. As has occurred in the higher income countries in recent decades with regard to consumption of whole grain breads and cereals, social marketing programs stressing the nutritional benefits of whole maize meal, e.g., through government clinics and mass media, may help overcome its low-status image among certain socioeconomic strata of the population.

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APPENDIX: MODEL FORMULATION AND DATA

(a) *Maize supply*

Supply elasticities used in the model are based on econometric estimation of structural equations for annual GMB intake during 1978–91. The supply functions are estimated using regionally disaggregated price, weather and GMB maize intake data (GMB files; National Meterological Service). Smallholder equations were of the form:

$$S_{it} = \alpha_0 + \alpha_1(PP^*_t/CPI_{t-1}) + \alpha_2(PPSUB_{it-1}/CPI_{t-1}) + \alpha_3(RAIN_{it}) + \alpha_4(AFC_{it-1}) + \varepsilon_{it} \quad (1a)$$

while commercial sector equations were of the form:

$$S_{it} = \beta_0 + \beta_1(PP^*_t/CPI_{t-1}) + \beta_2(PPSUB_{it-1}/CPI_{t-1}) + \beta_3(RAIN_{it}) + \beta_4(PF_{t-1}/CPI_{t-1}) + \beta_5(TREND_t) + \nu_{it} \quad (1b)$$

where S_{it} represents sales of GMB by producers in region i in harvest year t; PP^*_t/CPI_{t-1} is the expected GMB producer price to be announced at harvest (not known at planting time), deflated by the consumer price index at time of planting. $PPSUB_{it-1}$ and PF_{t-1} are the producer price of a major substitute cash crop in region i and the price of nitrogen fertilizer at the time of planting. The substitute crops chosen were tobacco in the commercial equation, and cotton or sunflower in the various smallholder equations, depending on which crop was more important in the region. $TREND_t$ is a time trend to capture the effects of excluded time-correlated factors. AFC_{it-1} is the number of smallholders receiving credit from the Agricultural Finance Corporation in region i during the planting year.

Since GMB producer prices for maize are normally announced after planting time, the maize supply equations must be formulated on the basis of price expectations, using information available to the farmer at planting time to predict the likely price announced after harvest. It is well known that the government-determined maize producer price is influenced by the level of GMB maize stocks from the previous harvest and by recent price trends (Wright and Takavarasha, 1989). This suggests a simple maize price expectations model of the form:

$$PP^*_t = \delta_0 + \delta_1(ENDSTOCKS_{t-1}) + \delta_2(PP_{t-1}) \quad (2)$$

where PP^*_t is expected price to be announced by GMB at harvest year t, $ENDSTOCKS_{t-1}$ are GMB maize stock levels at the end of the previous marketing year, and PP_{t-1} is the GMB price announced in the previous year.

The estimated maize price elasticities of supply ranged from 1.62 in the high-potential European commercial farming areas, to 0.27 in the low-potential smallholder areas. Elasticities from 11 of the 18 regional supply equations were significant at the 0.10 level.

(b) *Maize demand*

Information on maize demand by region is not available in Zimbabwe. Reasonable first-order approximations of maize grain and maize meal purchases, however, may be obtained through a combination of household survey data across various regions and years and by miller sales information. This information is used to estimate a point on the demand curve for each region. After this, a price elasticity of demand of −0.4 and −0.8 was assumed for urban areas and rural areas, respectively.

(c) *GMB trading account*

Estimates of the GMB trading account are modeled as a function of price, intake, demand, stock, and trade outcomes from the simulation model. The GMB trading account equation is based on Buccola and Sukume (1988) but adapted to account for regional variations in GMB's maize procurement costs. Region-specific transport and handling costs for the 1990–91 marketing year were provided by GMB personnel. The equation is

$$ER \times [fob \times NX \times D + cif \times NX \times (1-D)] - STK - ADM + P2 \times DD - (P1 + t_i)S_i \quad (3)$$

where

ER = official exchange rate (US/Z);
fob = GMB maize export price (Z$/mt);
NX = net maize exports (mt);
D = dummy variable ($D = 1$ if $NX > 0$, $D = 0$ if $NX < 0$);
STK = GMB stockholding costs [Z$40 × ($endstocks_t - endstocks_{t-1}$)/2];
ADM = administrative costs (a constant, Z$15/mt);
$P1$ = GMB producer price (Z$/mt);
t_i = GMB transport and handling costs from region i to nearest industrial milling firm (Z$/mt);
S_i = GMB maize intake from region i (Z$/mt);
$P2$ = GMB selling price (Z$/mt);
DD = demand for GMB maize (mt), calculated as the aggregation across regions of purchases of industrial maize meal, adjusted by the average grain-to-meal outturn rate, plus demand for maize by stockfeeders and brewers and others (treated as a constant in this analysis).

The model holds the following variables constant: Tobacco, cotton and sunflower prices at their 1990–91 levels, and GNP. Beginning stocks are set at 500,000 metric tons, which is the amount believed by the GMB to be the appropriate minimum level for buffer stock purposes. Sensitivity analysis of rainfall, GMB maize producer prices, selling prices, and commercial roller meal prices allow one to examine the various effects on urban and rural consumption, net exports, the GMB maize trading account, and other factors.

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