

# Predicting the Effects of Market Reform in Zimbabwe: A Stated Preference Approach

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A stated preference approach is used to predict likely responses to market reform in Zimbabwe. A random utility model is estimated using data on consumers' stated preferences for alternative types of maize meal. The model is used to predict demand patterns resulting from market reforms. Predicted demand is then compared with actual demand following market reforms. An analysis of the welfare effects of alternative policy scenarios shows that coupling the removal of consumer maize subsidies with improved access to a broader range of maize meal products ameliorated many of the adverse effects of subsidy removal, especially for lower-income groups.

*Key words:* food subsidies, maize, market reform, random utility model, stated preference, Zimbabwe.

Since the late 1980s, many nations in southern and eastern Africa have undertaken agricultural market reforms designed to boost production and reduce food marketing costs. Yet, throughout the market reform process, concerns have arisen in virtually all of these nations regarding the social costs of reform. While, in the long run, technical changes may reduce the real cost of producing food, and market incentives are anticipated to create broad-based income growth, the experience of some nations in sub-Saharan Africa indicates that the short-run effects of structural adjustment may be severe (Cornia, Jolly, and Stewart; Stewart). Particular concern is often expressed about the impact of

reforms on vulnerable groups such as grain deficit rural households and low-income urban consumers. In many nations, the growing reform impetus has contributed to fears of an increasingly acute "food price dilemma." On the one hand, there are pressures to increase producer prices and spur agricultural supply response; on the other hand, governments have a strong desire to keep retail food prices low (Timmer, Falcon, and Pearson).

In several nations in southern and eastern Africa, including Zimbabwe, a temporary solution to the "food-price dilemma" has been to introduce costly consumer subsidies which reduce the retail price of food while still permitting remunerative producer prices to prevail. Such subsidies are often fiscally unsustainable. The inevitability of subsidy removal has led researchers to investigate other mechanisms that would keep consumer food prices affordable while still providing adequate producer incentives.

Because maize is the primary staple food in much of southern and eastern Africa, this research suggests that policy changes that permit firms to introduce a greater range of relatively inexpensive maize flour products can help mitigate the food-price dilemma by keeping some food prices low, even when consumer subsidies are reduced or eliminated. In much of the re-

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gion, government policy has encouraged the development of a highly centralized maize marketing system, which has restricted consumers' access to alternative types of maize meal.<sup>1</sup> Governments are often reluctant to remove consumer subsidies and relax policies (such as maize movement restrictions) that limit the availability of alternative maize meal products when the potential demand for alternative maize meal products is unknown and the potential benefits of reform are unclear. Because past consumer behavior tells us little about consumer choices when faced with new options, designing "market driven" policy reforms requires knowledge about unarticulated consumer preferences.

In this paper, we present a method for the *ex ante* evaluation of the benefits of maize market reform using stated preference data collected through household surveys. Stated preference techniques, although widely used in transportation and resource economics, have not been used previously to inform food market reform in developing countries. We use the stated preference data to estimate a discrete choice model where choice of maize meal is explained by the various attributes embodied in maize meal products. We use the model to predict future market shares and the resultant welfare effects from the introduction of new maize meal products in Zimbabwe. Our results show that, in the short run, all consumers are worse off as a result of the removal of consumer subsidies on roller meal. However, coupling subsidy removal with improved access to alternative maize meals can ameliorate many, if not all, of the short-term negative effects of consumer food subsidy removal. In our case, since the alternative products have the characteristics of inferior goods, they are self-targeted to low-income groups.

### Hypotheses and Objectives

A complex set of product attributes are considered when consumers make the decision to buy a product. Before 1992, the conventional wisdom in urban areas of southern Africa was that two attributes, degree of "refinedness" and color, were the most important attributes defining consumer choice of maize meal. In Zimbabwe, where maize meal is the staple food

across all income groups, this conventional wisdom translated to the widespread assertion that consumers strongly preferred (i) white rather than yellow maize; and (ii) the more refined maize meals (namely roller meal and super-refined meal) produced by large-scale millers, rather than straight-run maize meal from small-scale hammer mills.

The underlying hypothesis of this study is that the dominance of white, refined maize meal in urban consumption patterns is policy-induced. Our objective is to predict the demand for straight-run meal and yellow maize meal. We surmise that the widespread consumption of refined, white maize meal in urban areas was the result of a set of market restrictions that effectively limited access to alternative maize meal products. Parastatal control of maize purchases and sales, preferential access to maize supplies by large-scale millers, and prohibitions on the transport of maize into urban areas by private traders prevented urban consumers and small-scale millers from obtaining maize for processing into straight-run meal. We hypothesize that a proportion of urban consumers, given a choice, would switch from white, refined maize meal to unavailable products such as straight-run meal or yellow maize meal, if these "new" products possessed certain desirable attributes such as a lower price. Policy changes which permit urban consumers a greater choice in the types of maize meal available for purchase are also thought to have significant welfare benefits.

We use the term "new" products because when this study was conceived straight-run meal and yellow maize meal were not readily available to urban consumers under normal circumstances. However, both products were familiar to urban consumers, as both were either produced or consumed in nearby rural areas. Straight-run meal was widely consumed in rural areas since rural households grew their own maize and intraregional trade was permitted. Yellow maize was grown domestically by large-scale settler farmers for animal feed, but was only available for purchase as maize meal in urban areas when severe drought forced importation of maize from the Americas (i.e., the years 1967, 1984, and 1992).

In 1993, the Zimbabwean government undertook market reforms, including the removal of consumer maize meal subsidies (on 1 June 1993) and relaxation of movement restrictions (on 5 November 1993), that allowed us to test our hypotheses. We use data from June 1993 to

<sup>1</sup> For example, Kenya, Tanzania, South Africa, Zambia, and Zimbabwe.

predict the potential market share of straight-run meal, and then we compare these predictions with actual postreform market shares from December 1993. We also estimate the market shares for the various maize meal products if yellow maize meal was widely available. For each scenario, we calculate welfare measures for different income groups.

### Research Methods

The model of consumer behavior used follows Lancaster's approach to consumer theory in that utility is derived from the attributes of goods, rather than the goods per se. With this approach, the data can be analyzed using familiar discrete choice methods such as random utility models (McFadden). Random utility models can employ two types of data, either revealed preference data from observations of actual market transactions or stated preference data from hypothetical choices elicited through surveys.

In our case, the objective was to estimate the demand for alternative maize meal products that were not readily available on the market. To overcome the lack of actual market data, stated preferences for alternative maize meal products were elicited through a survey. Stated preference techniques (sometimes referred to as contingent behavior) have been widely applied in market research (Louviere), transportation economics,<sup>2</sup> and are becoming popular in environmental economics (Adamowicz, Louviere, and Williams; Mackenzie; Opaluch et al.; Swallow et al.). With stated preference methods, researchers can design surveys to elicit preferences for goods with attributes that are not available in the market, or for goods that are not traded in markets.

In the initial stage of survey design, two consumer focus group meetings were held with the participants recruited from two community organizations. The focus groups were used to select the five attributes that described the hypothetical maize meal choices and, more generally, helped illuminate household decision making about maize acquisition and consumption. The five attributes selected and their levels were degree of "refinedness" (four levels including straight-run, roller meal, *mudzvurwa*, and super-refined), product price (two levels, Z\$13.10 and Z\$21.80), color of the grain (two

levels, yellow and white), travel time needed to obtain the meal (two levels, five minutes and thirty minutes), and packaging of the product (two levels, packaged and not packaged).<sup>3</sup> The price and time levels were selected based upon focus group responses and spanned the range of prices and travel times in the existing marketing channels. The questionnaire was designed to be administered by enumerators in a face-to-face interview. Pre-testing was used to train enumerators and provide feedback on the structure and wording of the questionnaire. Two rounds of pre-testing were carried out and each of the twelve enumerators conducted at least ten pre-tests. Each round of pre-testing was followed by a lengthy meeting between enumerators and researchers that led to further revisions to the questionnaire.

For the stated preference questions, a set of showcards was used as the vehicle for describing the alternative products to consumers. Each showcard consisted of a drawing plus a written statement in three local languages that identified the attributes associated with each hypothetical maize meal product (two sample showcards are presented in figure 1 at the end of this paper). An orthogonal design was used to overcome the problem of needing sixty-four showcards to investigate the five attributes in the  $4 \times 2^4$  factorial design (Addelman). With the orthogonal design, only eight showcards were required. An enumerator described the showcards to each respondent by reading the statement associated with each showcard. After viewing all of the showcards, respondents were asked to rate the desirability of the showcards on a Likert scale from 1 (most preferred) to 7 (least preferred). After rating each showcard, consumers were presented with each group of showcards which received the same rating and asked to rank the "ties" from most preferred to least preferred. These choices were then coded from 1 to 8 to provide a complete ordinal ranking for each respondent.

The survey sample was drawn from three urban centers representing 75% of the Zimbabwean urban population (and 20% of the total population). In all, 512 urban households were randomly selected from 1992 census data from the Central Statistical Office. Interviews were carried out in June and early July of 1993 with the "primary food purchaser" of each household. Complete data for ranking of the

<sup>2</sup> An entire issue of the *Journal of Transport Economics and Policy* is devoted to the subject (Bates).

<sup>3</sup> In 1992, one Zimbabwe dollar (Z\$) was approximately equivalent to 0.20 U.S. dollar.

showcards was provided by 486 households and, of these, 400 provided complete data on their household characteristics. Complete details of the survey are provided in Rubey. The survey was undertaken immediately after the consumer subsidy on roller meal was removed on 1 June 1993, but before formal regulations lifting maize movement restrictions were promulgated. Although enforcement of movement restriction was lax in anticipation of their removal, alternative marketing channels for straight-run meal were still in their early stages of development.

### Model Estimation

We adopt a random utility model (RUM) to model households' preferences for maize meal. RUM models have been widely used in situations where a single product is chosen from a finite set of alternatives. The RUM, as elaborated by McFadden, provides an economic foundation for the use of discrete choice econometric methods. In the usual formulation of a RUM, consumers choose the product that gives them the highest utility among some set of alternative products. All of the relevant product attributes are known to the consumer when the choice is made. Randomness enters the model because not all of the relevant attributes are measured by the researcher.

In our case, the  $i$ th consumer is faced with  $J$  alternative maize meal products. Each of the products is described by a vector of attributes that can be measured by the researcher. We denote this vector of attributes by  $\mathbf{x}_{ij}$  where one of the elements is the product price. From the researcher's perspective, the conditional indirect utility of alternative  $j$ ,  $U_{ij}$ , can be represented by a deterministic component,  $\beta\mathbf{x}_{ij}$ , and a random term,  $\varepsilon_{ij}$ , as follows:<sup>4</sup>

$$(1) \quad U_{ij} = \beta\mathbf{x}_{ij} + \varepsilon_{ij}.$$

In the literature,  $U_{ij}$  is referred to as the conditional indirect utility of alternative  $j$ . Conditional on choosing  $j$ ,  $U_{ij}$  represents the maximum utility that consumer  $i$  can attain given attributes  $\mathbf{x}_{ij}$ . The vector  $\beta$  parameterizes the utility index, and the elements of  $\beta$  reflect the rela-

tive utility of each of the attributes.

Faced with  $J$  alternatives, if the consumer ranks a particular alternative,  $k$ , as best, then  $U_{ik}$  is assumed to be the maximum among the  $J$  utilities. Let  $Y_i$  be a variable indicating the best alternative for individual  $i$ . The probability that alternative  $k$  is best is given by

$$(2) \quad \text{prob}(Y_i = k) = \text{prob}(U_{ik} > U_{ij}) \text{ for all } j \neq k.$$

The probability functions in equation (2) serve as our expected demand functions for each of the discrete products.

The choice of a distribution for the  $\varepsilon_{ij}$  is needed for the econometric model. If the  $\varepsilon_{ij}$  are within the class of generalized extreme value distributions, then the expressions in equation (2) have a closed form which facilitates maximum likelihood estimation of the parameter vector (McFadden). Alternatively, if the  $\varepsilon_{ij}$  are multivariate normals, then the probabilities in equation (2) will not yield closed-form solutions for the choice probabilities, making maximum likelihood estimation computationally impractical if there are more than a few choices. We follow previous applications of RUM models by assuming that the error terms in equation (1) are independently and identically distributed across the  $J$  products and the  $N$  individuals with a type I extreme value distribution (Adamowicz, Louviere, Williams; Louviere; Opaluch et al.; Swallow et al.). In this case, the probability that  $k$  is best is

$$(3) \quad \text{prob}(Y_i = k) = \exp(\beta\mathbf{x}_{ik}) / \left[ \sum_j \exp(\beta\mathbf{x}_{ij}) \right]$$

where  $\beta$  is the parameter vector to be estimated. This formulation yields the conditional logit model (Greene, McFadden). The assumption that the errors are independently distributed across the  $J$  products and the  $N$  individuals requires that care be taken when collecting the data and specifying the model. Substantial effort went into the survey design, interviewer training, and survey implementation in an attempt to minimize any systematic correlations between the error terms and the measured attributes. For example, when designing the survey and collecting the data, efforts were made to ensure that respondents' stated preferences for the products were based only on the attributes listed on the cards. Moreover, to reduce the possibility that the errors are not independently distributed across the  $J$  products for any given individual, interaction terms based on in-

<sup>4</sup> Small and Rosen assume that  $U_{ij} = V(y_j) + W(p_j, z_j, y_j) + \varepsilon_{ij}$ , where  $p_j$  is the price of  $j$ ,  $z_j$  are the attributes of product  $j$ , and  $y_j$  is income. This is consistent with our model formulation, and, as Small and Rosen note, one cannot recover parameters of  $V(y_j)$  because it does not vary across alternatives.

dividual characteristics were introduced. Because including the interaction terms allows the estimated preference parameters to vary across individuals, Swallow et al. suggest that the model can be viewed as a type of varying parameter model. The interaction terms were highly significant, suggesting that a model without the interactions would not have satisfied the i.i.d. assumption.

The showcard ranked best out of the eight cards is used to specify the model. Price and time are treated as continuous variables. Dummy variables represent attributes of color, packaging, and the degree of "refinedness." The product *mudzvurwa* serves as the baseline for the refinedness variables. In addition, each of the showcard attributes was interacted with three household characteristics. The household characteristics were monthly household income, number of household members, and length of time lived in a major urban area. The interaction terms permit heterogeneity among the estimated preference parameters which has been found to be important in other applications using stated preference data (Swallow et al.). The three household variables interacted with the seven showcard attributes yields a total of twenty-eight independent variables. Likelihood ratio tests and adjusted likelihood ratio indices (Horowitz) were used to select the final model. We adopt the practice of maintaining all the main variables which have significant interaction effects (Scheffe, Opaluch et al.). The final model includes the seven showcard attributes and six interaction effects. The estimation results are presented in table 1.<sup>5</sup>

The estimated coefficient on *PRICE* is negative as expected. The influence of *TIME* (the minutes spent traveling to purchase maize meal) is negative as expected but is not significant. However, the interaction between income and time is significant and negative. By dividing the coefficients on the time terms by the coefficient on price we derive an estimate of the marginal implicit price of time. Since the time variable is measured in minutes of travel time required to obtain maize meal, the time value reflects the value of time spent traveling to procure maize meal. These time values differ among individuals because of the significant

interaction effect with income. Average time values per hour for each income quintile are presented in table 2 along with values for other relevant household characteristics.<sup>6</sup>

### Potential Shares Following Introduction of Straight-Run and Yellow Meal

In this section, we illustrate how the model can be used to predict market shares arising from policy changes which influence the prices and availability of alternative maize meal products. Given the parameters estimated from the consumer rankings, it is possible to predict the eventual market share of alternative maize meal products in the aftermath of market reform. Because market reforms were actually undertaken, we compare our model predictions with actual market results following the removal of maize meal subsidies and maize movement decontrol.

In the prereform situation, only two maize meal products exist: white roller meal and white super-refined meal, selling at government-set retail prices of Z\$11.40 and Z\$24.27 respectively. The "after" situation assumes that a new product, white straight-run meal, is available with specified attributes. The percentage of households choosing each of the meal varieties is predicted and compared with the percentages from a separate, postreform market survey of over 4,000 households conducted in December 1993 (GRZ).<sup>7</sup> Because all households do not consume the same quantity of maize meal, the percentage of households consuming the various maize meal products is not strictly equivalent to market share. Because the postreform survey only provides information on the distribution of households consuming the various maize meal products, we compare the share of households consuming the products rather than the market shares of the products.

In order to predict the demand for actual products, we must define the attributes for each of the products in the postreform period. For roller meal and super-refined meal, the only attribute that changed in the postreform period was the price. The prices for the roller and super-refined meals are based on the market prices as of December 1993, which were

<sup>5</sup> In a model without the interaction terms, the coefficients on all seven attributes are significant at 5% except for the dummy for super-refined meal. The coefficients from this simple restricted model are as follows: price, -0.155; time, -0.014; color, 1.241; pack, 0.723; super, 0.246; roller, 0.624; and straight, 0.422. A likelihood ratio test favors the model with interaction terms.

<sup>6</sup> The average urban hourly wage in 1993 was Z\$3.20.

<sup>7</sup> Although this "Report of the Fourth Round of the Sentinel Surveillance for SDA Monitoring" does not present an appropriate break-down of urban consumption with which to make a comparison with our survey, Nicholas Minot kindly extracted the necessary urban figures from the December 1993 survey data.

**Table 1. Estimates for the Conditional Logit Model for Alternative Maize Meal Choices**

Variable	Variable Definition	Coefficient Estimates <sup>a</sup>
<i>PRICE</i>	Price of 10 kg. of maize meal (Z\$)	-0.1522 (-8.06*)
<i>TIME</i>	Travel time (in minutes)	-0.0034 (-0.44)
<i>COLOR</i>	Color of the meal (0=yellow, 1=white)	1.3513 (5.17*)
<i>PACK</i>	Dummy variable for whether product is packaged (0=no, 1=yes)	0.4591 (2.31*)
<i>SUPER</i>	Dummy variable for super-refined meal (0 = no, 1 = yes)	0.2422 (3.14*)
<i>ROLLER</i>	Dummy variable for roller meal (0=no, 1=yes)	0.4500 (0.73)
<i>STRAIGHT</i>	Dummy variable for straight-run (0=no, 1=yes)	0.7262 (1.51)
<i>ITIME</i>	Interaction between monthly household income and <i>TIME</i>	-0.00002 (-2.89*)
<i>ICOLOR</i>	Interaction between monthly household income and <i>COLOR</i>	0.00026 (2.93*)
<i>IPACK</i>	Interaction between monthly household income and <i>PACK</i>	0.00046 (1.84*)
<i>UCOLOR</i>	Interaction between months lived in urban area and <i>COLOR</i>	-0.00183 (-2.14*)
<i>UROLLER</i>	Interaction between months lived in urban area and <i>ROLLER</i>	0.00251 (3.27*)
<i>HSUPER</i>	Interaction between number of household members and <i>SUPER</i>	0.08592 (1.67*)

Note: \* denotes significant coefficient at 0.10 level. Log likelihood = -623.86. Number of observations = 400. The  $H_0: \beta = 0$  is rejected based on  $\chi^2(13) = 415.83$ .

<sup>a</sup> *t*-statistics in parentheses.

Z\$24.35 per 10 kg for super-refined meal and Z\$17.45 per 10 kg for roller meal. These are the prices after the removal of the consumer roller meal subsidy. Because of the high inflation in Zimbabwe, we deflate the December prices by the six-month CPI (0.9) to express prices in real terms as of June 1993.

Because straight-run meal is a new product in the postreform period, we must define all of the attributes. Several assumptions were made about the attributes of the "new" straight-run meal product. First, based upon data from a separate October 1993 survey (Rubey), the average time required to acquire straight-run meal is 74.4 minutes, which includes the time spent making the trip to and from a hammer mill and the time spent waiting in line at the mill. The time spent to obtain roller and super-refined varieties is 30.5 minutes, which is the average time traveling to, waiting at, and returning from a retail shop to purchase packaged maize meal. These travel times are then divided by two to

yield one-way travel times that are comparable to the one-way time attribute in the model. Second, the average price of straight-run meal was calculated as the sum of the acquisition price of grain plus the hammer milling costs. The acquisition price of grain reflects a weighted sum of the average price paid for grain in urban markets and the opportunity cost of home-grown grain (the Grain Marketing Board buying price of Z\$900 per ton). The weights are the sample shares of the quantity of grain obtained in that manner. The resulting price for white straight-run meal was Z\$10.30.

In addition, for the market predictions it was necessary to select a value for the packaging dummy variable for all of the products. The package options that were presented to respondents in the survey were meal prepackaged in plastic bags versus already processed, unpackaged meal available in bulk. Neither of these packaging options precisely correspond to the type of straight-run meal packaging prevailing

**Table 2. Mean Values of Household Characteristics by Income Quintiles**

	Monthly Household Income (Z\$)	Household Members	Months Lived in Urban Area	Kgs. Maize per Typical Month	Value of Time Spent to Get Maize (Z\$)
Overall average	869	4	188	29	6.47
Highest income quintile	2,373	5.4	209	33	15.37
2nd highest income quintile	871	4.5	168	32	6.48
Middle income quintile	543	4	185	27	4.54
2nd lowest income quintile	352	3.7	162	30	3.41
Lowest income quintile	186	2.6	227	21	2.43

**Table 3. Percentage of Households Consuming Alternative Maize Products**

	White Super-Refined Meal	White Roller Meal	White Straight-Run Meal
Market survey results (December 1993)	5	41	54
Predicted results, straight-run <i>PACK</i> = 0 (June 1993)	15	52	33
Predicted results, straight-run <i>PACK</i> = 1 (June 1993)	11	39	50

after market reform. While all the refined meals are available in the market in presealed packages, straight-run meal is not. Furthermore, straight-run meal is generally not available as previously milled-maize meal sold in bulk. Consumers usually obtain straight-run meal by having the maize "custom milled" while they wait. Consumers bring their own plastic bags and the processed maize flows directly into the consumer's own container. By milling maize in the presence of the consumer, as was the case during all of 1993, the cleanliness and quality of the grain and milling procedures can be monitored by the consumer. Evidence from focus groups suggests that consumers view custom milled maize as having a higher degree of cleanliness than bulk maize. Since it is not clear which value of the packaging characteristic (packaged versus unpackaged) should be used to predict actual demand for straight-run meal, we present results for both values of the packaging variable.

Table 3 presents the predicted percentage of households that would choose each of the three meal types. The percentages are calculated by predicting each household's probability of choosing the three meal types, and averaging these probabilities over the sample. Table 3 also presents the percentage of households choosing each of the meal varieties based on a separate, postreform market survey conducted in December 1993 (GRZ). Our model, based on the ex-

pressed consumer preferences for the eight different showcards, predicts that 33% of households would choose straight-run meal, and the postreform survey yields a value of 54%. When the effect of packaging is removed, the model predicts that 50% of the households choose straight-run meal. For both values of packaging, our model overpredicts the percentage of households consuming the super-refined meal variety relative to the results of the postreform survey.

For both values of the packaging dummy variable, the model predicts a major shift toward straight-run meal. The model underpredicts the share of households consuming straight-run meal relative to the postreform survey when the straight-run packaging variable equals zero (*PACK* = 0). However, the results with the dummy on straight-run packaging equal to one (*PACK* = 1) are quite close to actual market shares prevailing in December 1993. The magnitude of either of the predicted shifts to straight-run meal can be contrasted against the prereform conventional wisdom. For example, in early 1992, a Miller's Association press statement asserted that "straight-run meal is an unsophisticated, unrefined product" liked by "very few customers" and "as this product has never been popular its demise is no great loss" (*The Herald*). Because such views were shared by several influential government officials, model estimates that 33% to 50% of

urban households would shift to straight-run meal in a postreform scenario would likely have been viewed as extreme, if not faulty.

Given the strong influence of travel time in shaping consumer choice of maize meal, a decrease in the average distance to small-scale hammer mills would mean an increase in the demand for straight-run meal. A survey of milling operations conducted in October 1993 suggests continued growth in the number of new urban hammer mills, thereby reducing consumers' average travel time (Rubey). In this case, with the time required to obtain straight-run meal overstated, the demand for straight-run meal (and associated welfare benefits) are understated.

We are also interested in what might happen if further removal of market restrictions were to improve access to yellow maize meal varieties. To predict the share of households consuming yellow straight-run and yellow roller meals, we assume the yellow varieties have the same characteristics as their white counterparts, with the exception of price and color. For prices, we assume that yellow maize meal products sell at a 10% price discount. Other assumptions about prices could easily be examined. Table 4 presents the predicted shares of households consuming the five products. The distribution of households choosing the various meal types clearly depends on the packaging characteristic. However, the influence of packaging is largely between straight-run varieties and more refined varieties. In both scenarios, a quarter of the households are predicted to choose a yellow meal. Thus, our estimates reveal a substantial market for yellow products if they can be sold at a modest price discount relative to white maize meals.

### Welfare Effects of Subsidy Removal and the Introduction of New Products

In this section, we use the estimated parameters of the RUM to predict the welfare effects of subsidy removal and increased availability of alternative maize meal products. Because of the uncertainty inherent in equation (1), we cannot say with certainty which products will be chosen. However, we can use the probability functions in equation (3) as expected demand functions for the alternative products. We can then derive expected welfare measures from these expected demand functions (Small and Rosen). For models which are based on the conditional logit model, benefits (losses) can be measured by

$$(4) \quad W = \left[ \ln \left( \sum_{m=1}^{M^1} \exp^{\beta x_m^1} \right) - \ln \left( \sum_{m=1}^{M^0} \exp^{\beta x_m^0} \right) \right] / \mu$$

where 0 and 1 denote the values of the product characteristics before and after policy changes [Small and Rosen, equation (5.8)]. The number of alternative products also can vary under the policies. The parameter  $\mu$  represents the marginal utility of income. Following the suggestion of Small and Rosen, we approximate  $\mu$  by the negative of the coefficient on the price characteristic divided by the annual quantity of meal consumed by the household. This expected welfare measure is like the Marshallian surplus measure because it is derived under the assumption that  $\mu$  is constant and income effects are negligible (Small and Rosen).<sup>8</sup>

The expected welfare measure in equation (4) was calculated for three policy scenarios. In scenario 1, consumer subsidies on roller meal are removed but yellow roller meal and straight-run meal remain unavailable. In scenario 2, subsidies are removed and prohibitions on transporting maize into urban areas are lifted making straight-run meal widely available, but yellow maize meal remains unavailable. This second scenario reflects the actual situation that transpired in Zimbabwe in the months following the stated preference survey. In scenario 3, we assume consumers have access to white straight-run meal as well as yellow maize products such as yellow roller meal and yellow straight-run meal. The assumptions underlying the characteristics of the maize products are the same as outlined above for the predictions of the share of households consuming these products. Table 5 presents the annual expected welfare effects of each of the three scenarios by income quintiles.

The welfare effects of the three policies are quite revealing. As one would expect, the removal of consumer roller meal subsidies (scenario 1) leaves all consumers worse off in the short run. In absolute terms, consumers in higher-income groups incur larger losses than the lowest income group. Recall from table 2 that these groups have larger households and purchase more maize meal than the households in the lowest income quintile.

<sup>8</sup> Because our model does include some income interaction terms,  $\mu$  is not constant, and the measure in (4) is an approximation. We note that the marginal effects of income on the estimated utility index are small. Following the notation of Small and Rosen, the empirical magnitude of each of the  $\partial W / \partial y$  terms is less than 0.00005 for all of our policies.



**Table 4. Predicted Percentage of Households Consuming the Various Maize Products Following the Introduction of Yellow Maize Meals**

	White Super Refined Meal	White Roller Meal	White Straight- Run Meal	Yellow Roller Meal	Yellow Straight- Run Meal
Predicted results (straight-run <i>PACK</i> = 0)	12	39	25	16	9
Predicted results, (straight run <i>PACK</i> = 1)	8	29	38	12	13

**Table 5. Welfare Effects of Consumer Subsidy Removal and Market Reform, Comparison of Three Scenarios by Income Quintiles**

	Scenario 1: Consumer Subsidy Removal	Scenario 2: Consumer Subsidy Removal with Market Reforms that Make Straight-Run Meal Available	Scenario 3: Consumer Subsidy Removal with Market Reforms that Make Straight-Run and Yellow Maize Meal Available
Overall average	-168.15	-23.69	40.38
Highest income quintile	-288.60	-88.49	-26.93
2nd highest quintile	-170.75	-30.35	32.02
Middle income quintile	-140.34	-10.81	51.76
2nd lowest quintile	-160.65	5.56	84.16
Lowest income quintile	-91.84	-0.09	55.16

Note: Results are presented for the case where *PACK* = 0.

While consumer subsidy removal makes consumers worse off in the short run, subsidy removal does entail considerable fiscal savings for the government and these savings exceed consumers' welfare losses. We estimate that the yearly savings to government from ending consumer subsidies are Z\$203.63 per survey household (Rubey), while table 5 shows the average annual welfare loss per household is Z\$168.15. Furthermore, to the extent that subsidy removal does, over time, reduce the tax burden on consumers and reduce government deficits that curtail economic growth, these losses accruing to consumers from subsidy removal are overestimated.

Next, consider the policy of subsidy removal coupled with the removal of maize movement restrictions that limit access to straight-run meal (scenario 2). On average consumers are still worse-off with scenario 2, but the average welfare loss is sharply reduced by the introduction of the straight-run meal product. For the lowest income quintile, the introduction of the "inferior" straight-run meal product almost completely ameliorates the adverse effects of consumer subsidy removal, with the average

annual welfare loss falling to Z\$0.09 per household from Z\$91.84 in scenario 1. The second-lowest income quintile actually realizes a net welfare gain (Z\$5.56) from accompanying subsidy removal with the introduction of the straight-run meal product.

Scenario 3, consumer subsidy removal coupled with widespread urban availability of straight-run and yellow maize meal products, makes all income quintiles except the highest better off. For all but the richest 20% of the urban population, the negative effects of subsidy removal are more than offset by the benefits arising from availability of a more diverse set of maize meal products. On average, welfare gains are Z\$40.38 per household, with the lowest two income quintiles realizing gains of Z\$55.16 and Z\$84.16 per household.<sup>9</sup> The introduction of yellow maize meal has a disproportionately positive effect on lower-income households since yellow maize meal has characteristics of an inferior good. Scenario 3 is also dependent on yellow maize meal products selling at a 10% price discount relative to white maize meal products, a logical assumption given historically higher farm yields of yellow

maize vis-à-vis white maize in Zimbabwe.

In each of the scenarios presented above, the assumption is made that straight-run meal is unavailable as a packaged product ( $PACK = 0$ ). Although the results are not presented here, when this assumption is relaxed and welfare benefits are calculated for the case where straight-run  $PACK=1$ , none of the income quintiles experience welfare losses in scenarios 2 and 3.

### Implications

Many nations face a dilemma similar to that in Zimbabwe: in order to maintain remunerative maize producer prices and reduce government deficits, there are great pressures to remove consumer subsidies on food staples. Under any of the scenarios examined here, welfare losses to urban Zimbabwean consumers associated with consumer subsidy removal were mitigated by complementary market reforms that essentially eliminated well-established restrictions on the private transport of maize grain into urban areas. The major implication of this analysis is that coupling consumer subsidy removal with improved access to a broader range of food staples ameliorated many (if not all) of the adverse effects of subsidy removal, especially for lower-income groups.

The estimated annual consumer surplus losses of consumer subsidy removal alone were Z\$168.15 per household. These losses were lower than the estimated fiscal savings due to subsidy removal. When consumer subsidy removal was coupled with measures that ensured access to straight-run meal, average welfare losses per household were sharply reduced. Coupling consumer subsidy removal with decontrol of maize movements resulted in a slight positive welfare gain (Z\$5.56) per household for the second-lowest income quintile and virtually offset the negative effects of subsidy removal for the lowest income quintile. While the introduction of straight-run meal benefited all

consumers, the poorest consumers realized the largest gains since straight-run meal is an "inferior" good.

The results also suggest that further reforms that make yellow maize meal products widely available in urban areas of Zimbabwe will lead to further welfare gains for consumers, completely offsetting the negative effects of consumer subsidy removal for all except the wealthiest income group. Consumer acceptance of yellow maize also has implications for the design of agricultural research. Since scientists' perceptions about consumer preferences for maize color influence the direction and scope of research on improved maize varieties, the design of agronomic research would benefit from consumer studies similar to the one presented here.

Although stated preference data have been used in market research and other areas of economics, our research suggests wider potential for applications aimed at informing food policy during market reform. As in this paper, survey data of stated preferences can be used as an *ex ante* analytical tool to help provide an estimate of the potential demand for alternative staple foods that are unavailable on the market due to policy and regulatory constraints. In our case, with goods that were familiar to consumers, predictions of potential market share were reasonably close to actual market outcomes, although quite different than the prevailing conventional wisdom. By validating or countering the prevailing conventional wisdom, this type of empirical evidence regarding consumer preferences can help ensure that policy reform is "market driven" and reflects consumer demand.

One advantage of stated preference models in developing countries is the low cost of data collection. Important policy-relevant information can be obtained with modest survey effort centered on recording respondents' relative preferences for various products. The estimated results can provide a good general indication of preferences for a group of products. Moreover, orthogonal designs can be used to uncover effects which might otherwise be highly collinear in revealed preference data. For example, in our case it would not be possible to use postreform market data to separately identify the effects of procurement time, packaging, and level of refinedness for the straight-run product. Our results indicated that the higher procurement time is a significant, negative attribute of straight-run meal. Finally, knowledge of the demand for specific product attributes such as time and packaging

<sup>9</sup> There are also nutritional gains from the switch to straight-run meal and/or yellow maize meal. To the extent the respondents are informed about the nutritional characteristics of alternative types of maize meal, such characteristics would be incorporated in their response in this model. However, the survey revealed that exactly half of all consumers did not know that straight-run meal has more nutrition than roller meal or super-refined meal (Rubey). Thus, to the extent that the wider consumption straight-run meal and yellow maize meal yield brings nutritional gains that are positively valued by respondents, we have understated the welfare gains accruing to consumers.

can help emergent small-scale milling firms develop appropriate marketing strategies and bolster government efforts to provide technical assistance to emerging food processing firms.

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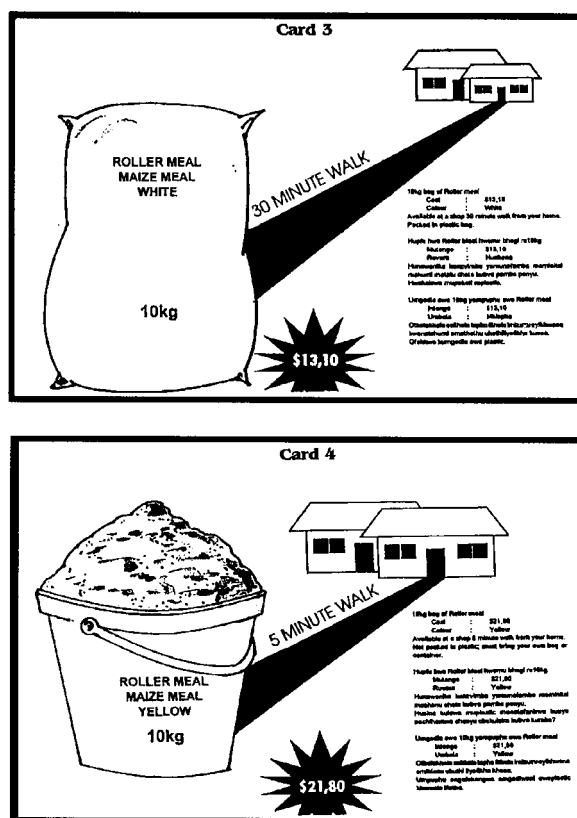
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**Figure 1. Sample survey showcards for eliciting stated preference data**

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