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By Cynthia Donovan

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ABSTRACT

EFFECTS OF MONETIZED FOOD AID ON LOCAL MAIZE PRICES IN MOZAMBIQUE

By

Cynthia Donovan

Yellow maize commercial (monetized) food aid has been a major policy instrument for meeting food security needs in Mozambique, particularly among the urban poor. This research studies the effects of this food aid on prices for Mozambique's domestic white maize in different locations, under current and likely future conditions.

Market studies, including a rapid appraisal of the white maize markets, were completed in Maputo and other provinces throughout the country. Then, time series analysis was conducted on weekly price data and weekly food aid deliveries data for the 1990-1995 period. Vector autoregressions were used to investigate the effects of unpredictable fluctuations in prices and quantities. War/drought and post-war/drought periods were determined and analyses conducted based on the separate time periods.

In the war/drought period, maize prices in Maputo were volatile and white maize supplies were highly limited. Heterogeneous preferences for white maize and yellow maize meant that white maize prices rose very high. The importance of yellow maize food aid in this period was as a cheaper consumption alternative, for those consumers willing to switch.

In the second period, however, the analysis showed white maize prices would have been 10 -15 percent higher going into the harvest season of 1995, if food aid had not arrived.

With time, the markets in other parts of Mozambique have begun to recuperate. Market integration analysis based on separate war/drought and post-war/drought periods demonstrated that the effects of Maputo price shocks on Chimoio prices (in a maize production area) were significant. Producer and trader incentives were affected by such shocks.

Finally, the lessons for future food security and food aid policy are presented. As yellow maize food aid supplies diminish, policy analysts must evaluate the market supplies and price relationships, recognizing that domestic production may still be insufficient to meet demand and some imports required. Local purchases of white maize for use in the emergency distribution programs may provide incentives for market development, but must be undertaken with care to avoid generating high consumer prices. Without yellow maize food aid, white maize prices for both rural and urban consumers will be higher.

To my parents with many thanks from CXD

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CXD

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ABBREVIATIONS

ADF	Augmented Dickey Fuller Tests for unit root
AGRICOM	Parastatal food crop marketing agency (replaced by ICM in 1994)
CIM	Companhia Industrial Matola (industrial grain mill)
CNP	National Planning Commission
CPI	Consumer Price Index
DEA	Directorate of Agricultural Economics, Ministry of Agriculture and Fisheries
DNE	National Directorate of Statistics
ERP	Economic Rehabilitation Program
EU	European Union
FRELIMO	Frente de Liberação de Moçambique (political party , currently majority in government)
FSP-M	Food Security Project-Mozambique
GOM	Government do Mozambique
GTZ	German Technical Assistance Agency
IASF	Agricultural Survey of the Family Sector
ICM	Cereals Institute of Mozambique ("Instituto de Cereais do Moçambique")
iid	independently and identically distributed
IMF	International Monetary Fund
kg	Kilogram
KPSS	Kwiatkowski, Phillips, Schmidt, and Shin (tests for unit roots)
LM	Lagrange Multiplier (test statistic)
metical	Monetary unit of Mozambique (plural: meticais)
MAP	Ministry of Agriculture and Fisheries (Mozambique)
MSU	Michigan State University
NGO	Non-Governmental Organizations
RA	Rapid Appraisal
RENAMO	National Resistance of Mozambique (political party/military organization)
S-C-P	Structure-Conduct-Performance (analytical paradigm)
SEMOC	Seed Company of Moçambique
SIMA	Market Information System ("Sistema de Informação de Mercados Agrícolas")
WFP	World Food Programme

Chapter 1

Introduction

1.1. Issues

After years of civil war and a devastating regional drought, Mozambique is highly dependent upon foreign assistance both for government budgetary resources and for food supplies. Foreign aid makes up to 80 percent of GNP and food aid cereals were 30 percent of total cereals' availability in 1994/95. The United States Agency for International Development (USAID) has been the principal donor to bring in yellow maize food aid to be monetized to provide budget resources for the government, while ameliorating food production deficits and import constraints that threaten the food security of many Mozambicans.[1] However, in a market environment undergoing policy reform and recuperation from civil war, commercial food aid has the potential for undermining the market development which has been an objective of government policy.

This research uses time series analysis to evaluate the price effects of food aid arrivals on Mozambican maize markets. There are two time periods for the analysis: 1) a war/drought period, from April 1990 to February 1993, when the destructive consequences of civil war limited movement and economic activity, and a devastating

[1] The European Union has also imported commercial yellow maize food aid, but the in much smaller quantities than USAID.

regional drought decimated maize production; and 2) a postwar recuperation period, from April 1993 through November 1995, when production increased again and private markets were expanding.

Retail market prices provide the basis for the analysis, in combination with detailed information on the structure of markets and the food aid distribution system. The time series analysis allows an evaluation of the effects of food aid arrivals in Maputo on market price changes for white and yellow maize. The analysis also looks at issues of market integration by examining the effects of Maputo price shocks as they spread to Chimoio, an important market in the central maize production region.

1.2 Objectives of this research

The objectives of this research are the following:

1) to determine the key factors in the structure of Mozambican maize markets that mediate how commercial food aid affects those markets;

2) to analyze the relationship between yellow and white maize prices, and quantities of yellow maize commercial food aid arrivals in Maputo during the drought/war period and in the current environment of market development;

3) to evaluate the extent to which the Maputo maize markets are spatially integrated with production region markets by examining how price effects in Maputo are transmitted to producer prices;

4) to identify policy options available to mitigate potential negative effects of food aid while enhancing positive effects.

Four specific research questions arise from these objectives. First, given the market reforms and consequences of war, what are the key aspects of the market structure that influence how food aid deliveries affect prices? Second, how do the arrivals of yellow maize commercial food aid affect prices for white maize in urban and rural markets? Third, how do Maputo white maize price shocks affect the prices for white maize in maize producing areas in Mozambique? Fourth, are there differences in the effects of food aid deliveries and price shocks between the war/drought period in 1992 through early 1994 and the post-war recovery period in 1994 through late 1995? Finally, what lessons can be learned concerning the potential effects of various policy options for ensuring food security?

1.3 Background on food aid in Mozambique

Food aid has arrived in Mozambique since Independence in order to help supplement the nutrition of vulnerable sectors of the population and provide the government with budgetary support through the sales on the market. During the 1991/1992 drought and its aftermath, food aid was responsible for providing the means for survival of thousands, if not millions, of Mozambicans. There are two basic channels for food aid, termed "emergency food aid" and "commercial food aid."[2] Emergency food aid arrives in response to specific expressed needs, distributed for free or for work to targeted groups

[2] The vocabulary used with food aid is not consistent across documents, with terms such as "program aid", "project aid", "monetized food aid" used to denote various types of food aid. Here, emergency food aid is defined as aid received by non-governmental organizations, government ministries, and international agencies in order to be given to people in need. "Commercial food aid" is used here to indicate food aid supplies that arrive specifically to be sold on the local markets, by non-governmental organizations or by the Mozambican government, not to be distributed for free.

(e.g., school children in poor areas, demobilized soldiers, recently returned refugees). In Mozambique, almost all of the free distribution and work projects have been in rural areas.

In contrast, commercial food aid is imported by the donor for delivery to the government of Mozambique. The government can either give or sell the commercial food aid. In the case of USAID, the government of Mozambique must deposit local currency funds equivalent to the free-alongside-ship (FAS) price in a special development account. Most commonly the government sells the maize either through government shops or through private traders in the major urban centers. Government ration shops ceased functioning by 1992, so that the informal sector has been responsible for most of the retail sales since 1991. USAID has used the commercial yellow maize food aid to promote the policy reform efforts towards private market development, requesting that the qualified list of consignees be expanded to ensure greater competition.

Commercial food aid has the dual purposes of providing budgetary supplements to the national government and alleviating food shortages. Food shortages often result in price spikes that threaten food security, particularly of the urban poor who have little or no savings to smooth consumption. However, reducing or eliminating these price spikes may be in conflict with development goals since lower prices diminish incentives to producers and traders, the so-called disincentive effect. The administration and regulations governing commercial food aid in Mozambique will be discussed further in Chapter 4.

In Mozambique, the majority of all food aid cereals have been in the form of yellow maize, as can be seen in Table 1.1. During the war and drought period, maize food aid was a significant portion of cereal availability in the country. By 1992/93, yellow maize food aid reached 60 percent of total cereals availability in the country; commercial yellow maize food aid alone was 25 percent of the total, whereas emergency yellow maize food aid was 35 percent of the total. In 1994 and 1995, domestic production of white maize and other staples began to increase, as did the domestic marketing opportunities for those crops, and food aid cereals became less important in the total. By the 1994/95 marketing year, yellow maize food aid (commercial and emergency) was only 15 percent of total cereals availability. Commercial yellow maize food aid contributed only 6 percent of the total cereals availability in the 1994/95 marketing year.

The 6 percent of total cereals availability arriving in the form of yellow maize food aid represents a large proportion of the cereals available for consumers to buy on the market, and populations in urban areas rely heavily upon the market for basic staples. Estimates of marketed surplus from domestic production of white maize are in the range of 13-20%, or about 70,000 - 100,000 metric tons annually (MAP/UAP 1994; MA/DEA/Estatística 1994; NDAE/DS 1993) . This means that the yellow maize commercial food aid about doubled maize supplies on the market in the country, mostly in the urban areas of Maputo and Beira, where price effects can be expected to be greatest.

Table 1.1. Cereal Supplies and Sources in Mozambique: 1989/90 through 1995/96

Marketing Year (April to March)[1]	Production				Food Aid							Commerc. Cereal Imports[4]	Total Cereals Avail.
	White Maize	Rice	Sorghum/ Millet	Total	Yellow Maize Commercial[2]	Yellow Maize Emer-gency	Yellow Maize Total	White Maize Emer-gency[3]	Rice	Wheat	Total		
1989/90	330,000	95,000	177,000	602,000	83,000	145,000	228,000	0	72,000	109,000	300,000	0	1,011,000
1990/91	452,900	96,400	181,000	730,300	126,000	221,200	347,200	34,000	47,600	116,400	545,200	0	1,274,500
1991/92	327,100	56,300	154,900	538,300	124,900	248,800	373,700	14,900	58,500	123,000	447,100	0	1,108,400
1992/93	133,000	33,000	71,000	237,000	271,700	374,200	645,900	15,900	61,600	47,700	723,400	70,000	1,077,200
1993/94	533,100	49,000	165,000	747,100	77,000	208,100	285,100	0	28,500	57,000	313,600	86,700	1,204,400
1994/95	527,000	97,000	193,000	817,000	70,200	123,900	194,100	70,900	50,000	103,100	315,000	105,000	1,269,200
1995/96[5]	733,800	76,000	278,700	1,088,600	56,000	40,000	96,000	40,000	24,200	73,600	233,800	153,700	1,476,100

1 Marketing year: April - March for DSA and MSU sources (May - April for some sources); Production refers to the relevant production for that marketing year. Based on the 1994 Early Warning Unit/Ministry of Agriculture database, approximately 90% of total maize production is destined for human consumption, with the remaining 10% for seed and losses; for the other cereal crops, 88% for human consumption, and 12% for seed, animal feed, and losses. The Early Warning Unit estimates that 23% of maize produced for human consumption is marketed; the rest is consumed on farm.

2 Includes 10,100 in white maize commercial food aid imports in 1991/92.

Table 1.1 (continued)

[3] This figure is strictly white maize imports for emergency program, and does not include local purchase quantities since those quantities are included in the production estimates.

[4] Prior to 1994/95, commercial imports were rice and wheat. In 1994/95, an estimated 12,000 metric tons of white maize were imported from South Africa. The informal sector may be illegally importing white maize commodities, but these informal imports are unrecorded and so not included here.

[5] 1995/96 data is projected for full marketing year.

Sources: Ministry of Commerce, Department of Food Security, **Boletim de Segurança Alimentar** (issues: Bol 4, 1991/92; Bol. 3, 1992/93; Bol. 3, 1993/94); Ministry of Commerce, Department of Food Security, **Food Aid Pledges and Shipments,** 1990/91 to 1994/95 (November 1994); FAO **Production Yearbook,** 1989/90 - 1991/92 issues; World Food Programme Interfais database; Famine Early Warning Unit, Ministry of Agriculture production database; and MOA/MSU Food aid arrivals database (See MOA/MSU 1993 WP#13 for further information).

There is no domestic yellow maize production, so any production disincentives through prices would be felt by the producers of the main domestically-produced substitute good, white maize. On the consumption side, yellow maize is the less-preferred consumption staple compared to white maize. Yellow maize is prepared for the table in much the same way as the local white maize. Available at prices below the local white maize, yellow maize products give the low-income consumers an alternative consumption good at a lower market price.

1.4 Debate on disincentives

While recognizing the benefits of commercial food aid for consumers, current policy debate in Mozambique centers around the effects of food aid arrivals on both producer and trader incentives. Incentives include not just the level of prices, but also the anticipated fluctuations in prices (opportunity for arbitrage), risks, and the availability of the commodity. All of these in turn depend upon the markets' and traders' behavior.

As argued in Isenman and Singer (1977), producer disincentives stem from the arrival of cheap (or free) food aid commodities which reduce demand for locally produced goods, thus reducing overall prices in the markets. In such a case, farmers would face lower prices for their commodities and have less incentive to produce the basic consumption staples. In addition, the food aid arrivals might increase price risks through counter-cyclical price declines. That is, commodity prices might decline during the hungry season when food aid arrives. A lower mean along with a higher risk would make risk-averse net surplus farmers worse off than before, even when the poor urban consumers would benefit from the reduced costs of obtaining food. This analysis depends upon the price responsiveness of farmers. If a lower price or increased risk reduces their incentives to produce staples, such price effects mean that Mozambique may suffer the long-term consequences of increased food aid or import dependency.

The incentives to trade in locally produced commodities could be decreased by lowered quantities of the local commodity available (thin markets for the domestic good), or from high price risks for the local commodity with an inability to predict food aid arrivals and price declines. Volatility in prices itself need not be a disincentive to traders, if they perceive that the fluctuations present arbitrage opportunities, rather than just an increase in risk. Food aid arrivals may also limit transport availability for local commodity trade. Firms allocate their limited transport resources to the highest profit activity, and this is often food aid. This transport constraint is more apparent with emergency food aid distributions in rural areas with severe transport constraints. The government is withdrawing from direct market activities in buying and selling of grains and flours, thereby increasing the importance of motivating private traders to work with local maize.

All of these potential disincentive effects depend upon various factors, including the price for market sales, the total quantity arriving in relation to quantities available in the market, and consumer preferences. Decisions on the quantity and pricing for commercial food aid are made by both the donors and GOM.

Evaluation of the effects of food aid must rely upon knowledge of market structure and organization. Prices may be determined through government administration, base-point pricing, monopoly or monopsony, collusive action between agents, purely competitive market forces, or some combination of these mechanisms. In the past the government played a key role in the purchase and sales of agricultural commodities, including maize. A minimum producer price is still set, yet there is no effective enforcement mechanism in most parts of the country. It is also necessary to know who is trading with producers, where they purchase and sell maize, and other aspects of the rural marketing system. The price discovery process is dependent upon the market channels available and the competitiveness of these markets. Given all of the changes within the country since the Economic Rehabilitation Program (ERP) and Peace Accord, knowledge about the current structure and performance of maize marketing is critical.

A related problem is the extent of spatial integration of maize markets in Mozambique. If markets are highly spatially integrated, with price shocks from one market quickly and fully transmitted to other markets, the effects of food aid arrivals on Maputo prices will be transmitted to consumers and producers in other regions of the country. On the positive side, if market integration is improving, localized scarcities in Maputo will serve to draw on reserves elsewhere in the country and the producers and traders will respond to the need. Since producer price data is lacking for the relevant historical period, the hypothesis that food aid arrivals affect producer prices cannot be directly tested. However it will be shown that retail prices for markets in the production areas serve as a good proxy for producer prices in order to evaluate those effects.

Spatial market integration is also of interest for policy makers in determining investment priorities and potential for increasing marketed production. Structural transformation of the food system is retarded as long as each region (potentially each household) remains in autarky. Market integration would indicate that price signals are being transmitted from consumption centers to production or import centers, in order to guide investment. The lack of market integration would indicate that either transaction costs are too high to motivate transactions or that other constraints are blocking market development.

1.5 Organization of the dissertation

This dissertation is organized into eight chapters, progressing from a description of market structure and organization into the econometric models, and then the results and policy implications. Chapter 2 will present a brief review of previous research on the effects of food aid in the developing world. Chapter 3 describes the rapid appraisal methodology used to evaluate the structure and performance of the maize markets in Mozambique, as well as the findings of that analysis. Chapter 4 will discuss yellow maize food aid in the context of that market structure, including the administration, delivery, and marketing of food aid.

Chapter 5 presents the data and their characteristics. Chapter 6 details the food aid VAR model and simulations. Chapter 7 presents the market integration model. In conclusion, Chapter 8 brings together the econometric analysis and the rapid appraisal results, exploring the policy implications of these findings.

Chapter 2

Previous Evaluations of Food Aid Effects in Developing Countries

2.1 Reviews of potential effects of food aid

There are two basic objectives of food aid, as noted by von Braun and Huddleston (1988): 1) a transfer to people who are in need and unable to obtain sufficient food supplies; and 2) a source of funds for the government, reducing foreign exchange constraints or other resource constraints, and providing resources for development projects.[1]

The actions to obtain these two objectives may have medium- to long-term effects that undermine the food security of a recipient country. Research on the effects of food aid is extensive, varying both in theme and in analytical methods.[2] Maxwell and Singer (1979) review early attempts to evaluate food aid, with examples mainly from the Indian experience of the late 1950s and 1960s. Later, in 1989, Jones surveyed the literature on food aid disincentive effects in sub-Saharan Africa. Two recent books provide much of

[1] Another basic objective is self-interest, political or economic, on the part of the donor country. The donors may use food aid deliveries to sustain producer incomes in their own countries through government purchases and extraction of commodities from the domestic markets of the donor country, often termed "surplus disposal" in the food aid literature. While it is important in determining the type of food aid available, the self-interest objective will not be discussed further here.

[2] The extensive literature on food aid cannot be covered in this brief chapter. Those interested should refer to the reviews indicated below, as well as the sources listed in them.

the background information and discussion of issues. Edited by V. Ruttan, **Why food aid?** (1993) includes excerpts from much of the literature on the effects of food aid. In **Food aid reconsidered: Assessing the impact on third world countries**, editors Edward Clay and Olav Stokke (1991) concentrate on recent food aid efforts, particularly in sub-Saharan Africa, providing articles that orient the reader on effects, their measurement, and possible policy alternatives.

Maxwell (1991) categorizes food aid disincentive scenarios into macro versus micro scenarios with possible effects through prices, policies, food habits, and labor. In the guidelines developed by Shaw et al. (1991) for the World Bank and the World Food Programme (WFP), price disincentives are related to the absorptive capacity of the economy, i.e., "the level of food aid that can be absorbed without causing prices to fall below the border price" (1991, p.2). This is not the only issue with regard to prices, since increasing the volatility in prices or adding an additional source of price variability, may create price risks unacceptable to traders or farmers.

The policy disincentives of commercial food aid stem from the budget subsidies to the government which may allow the government to ignore agricultural policy needs or food security policy needs. The budget subsidies are often given, however, to provide additional resources necessary to support policy reform, so there may be both positive and negative effects on policy reform. Negative effects of food aid on food aid are attributed to the availability of imported food aid commodities that create new demand for imports, increasing the dependence upon imported staples, rather than the domestically produced staples. Regarding the labor disincentives, the issue is usually raised concerning either food for work programs and labor market distortions, or free distribution of food reducing the need to sell labor, neither of which is at issue here. Thus, the remainder of this chapter will focus on the potential price disincentives from additional supplies brought onto the market at subsidized prices.

2.2 Analysis of price disincentives

When concerned about the effects of food aid on local markets, the primary focus of researchers has been on producer price disincentives. The argument is the following: food aid commodities arrive at subsidized (or zero) prices, adding quantities to the markets, displacing the consumption of locally produced food commodities, depressing their prices, and thereby reducing production incentives, eventually leading to lowered production of food grains (Isenman and Singer 1977). Researchers have thus attempted to determine trends in food prices and production, and determine how food aid quantities may influence those trends.

Isenman and Singer (1977) present one of the most well-known analyses of the effects of food aid on local prices in their work on India in the 1950s and 1960s. As the authors noted, the lack of data precluded a multi-equation econometric model to evaluate effects and instead they used a "common sense" approach and some basic price analysis. The food aid effects depend on several factors: 1) the extent to which food prices are depressed with the arrivals of food aid; 2) the aggregate supply response of farmers to price changes; and 3) other nonprice constraints on production and incentives to produce, such as the lack of inputs.

Using annual data from 1955-1971 for India, Isenman and Singer (1977) found evidence of possible short-run negative price effects, but positive long-run effects on prices and consumption. There were declines in producer prices for rice in the short run. However, in the long run, there were income-induced demand increases that were supported by the increased nonagricultural investments. Food aid, by keeping the price of food low, ameliorated difficulties of a food bottleneck, thus bolstering investments and economic growth (Isenman and Singer 1977). In addition, they cite further research (Mann 1969; Rogers, Srivastava, and Heady, cited in Isenman and Singer 1977) that looked directly at production and prices through the 1950s and 1960s, with findings that bolster Isenman and Singer's arguments that the price effects were short-term. An additional concern was that food aid was used to support the government in pursuing policies that did not favor the agricultural sector. The authors stress that food aid can be used to support policies both favorable and unfavorable to agriculture, just as with monetary aid.

Farzin's (1991) work in Somalia sought to evaluate various effects of food aid, including whether or not the food aid displaced commercial imports. This is important for US food policy since the legislation specifically states that food aid must be additional to, rather than displacing, commercial imports. In Somalia's case, Farzin found that donors did not decrease the amount of food aid arriving after the crisis, resulting in continued dependence of the government upon counterpart funds as well as continued disincentives for the domestic crop production. The research does show evidence of disincentive effects of food aid through lower prices for consumption goods, but the analysis is based on annual prices and production, thus not lending itself to a more dynamic analysis of the effects.

The role of food aid in price stability has been evaluated by several researchers.[3] Farzin found that food aid programs of the donors in Somalia were uncoordinated, resulting in unpredictability of food aid flows which "added to local price instability and increased the risks and uncertainties facing local producers" (p.269). He did not extend the analysis to evaluate how such variability might have affected traders. With research conducted in Ethiopia, Buchanan-Smith (1988, as cited by Maxwell 1991) argues that trader incentives may be undermined by food aid, with unexpected price volatility increasing the risks and reducing inter-seasonal storage. In general, the effect of food aid on market development and traders' activities has not been a focus of researchers in the past. A recent study on the informal markets in Maputo addressed the relationship between food aid arrivals and the development of the informal markets (Tschirley et al 1996). The research in this dissertation continues from that knowledge base.

In a 1989 survey of literature on the impacts of food aid specifically in an African context, Jones found that the lack of reliable statistical information hampered efforts to evaluate the direct market disincentive effects of food aid. Jones concluded that existing research

[3] Some food aid commodities enter directly into commodity price stabilization programs as reserves. In the current research, the focus is on commodities which enter into the market directly, not through a commodity reserve program. Discussion of price stabilization programs can be found in documents such as Pinckney 1989 and Mellor and Ahmed (1988).

shows that the more important effects of food aid may stem from the policy disincentives from food aid rather than the direct market disincentives observed in prices. Nevertheless, Jones writes that "given the lack of reliable statistical information the true extent of [direct market disincentives] has been unclear" (p.16).

2.3 Methodologies

Researchers have used a variety of tools to reach their conclusions. In the early literature, basic price and quantity analysis was used, including some correlation coefficients and ordinary least squares regression analysis. Examples are Isenman and Singer's (1977) work in India, Khadka (1989) in Nepal, and Stevens (1979) in four African case studies. Isenman and Singer did cite two other multi equation studies of food aid in India. However, in their analysis, based on a "common sense view," an expected yield was estimated and then expected prices given that yield. Those prices were compared to the realized prices and the food aid to see if lower than expected prices could be associated with years in which food aid was high, and it was found to be true. Then, the authors looked to see if years of low prices for food grains were followed by declines in production that could not be explained by rainfall, and the evidence was less clear.

As Stevens did in 1979, Farzin's (1991) analysis uses aggregate price, import, and production data, showing trends over time, with narrative on economic relationships connecting the pieces together. Farzin's study focused on the issue of import dependence and changes in consumption habits. He supported his conclusions by comparing consumption data and relative consumer prices over different time periods during which there were food aid arrivals. This follows Maxwell's (1991) recommended use of both quantitative and qualitative methods for evaluation, as reflected in Maxwell's (1986) study in Senegal, where lack of data frustrated detailed evaluation.

As data and computers have increased technical potential, researchers have developed general equilibrium models. An example of this type of analysis is Cathie's (1991) research on Botswana using a social accounting matrix for the period 1965-1984 and aggregate data on production, income, imports, exports, prices, labor remittances, and net resource inflows. The data demands of this analysis make it inappropriate for the current case. In addition, the annual analysis ignores the intra-annual dynamics of the supply and price relationships.

Micro-level studies have been used to evaluate food aid, as with Bezuneh, Deaton, and Norton (1988), but the focus was on food for work programs and the direct effects upon household resource allocation of the recipients of the food aid.

In the current literature on the effects of liberalization and structural adjustment, time series techniques are commonly used in price analysis, to determine if real prices have increased or decreased, and to estimate the variation and possible structural shifts. The development of market information systems in many countries during the 1980s has enabled researchers to incorporate time series analysis, previously limited by the data constraints.

The literature, while addressing the issue of producer prices and food aid, has not had the detailed price and arrival data necessary to look at the short-run dynamics and the uncertainty that may be added to production and trading within a given year. While the average annual price may remain the same or even be higher, it may be the distribution of those prices through the year that is of interest to traders and producers.

Lavy's (1991) analysis is the only article specifically on food aid found that uses VARs, the econometric approach that will be used in this research. Farzin used annual data on aggregate cereal production, imports, and food aid for 33 countries in sub-Saharan Africa for the period 1970-1987 to evaluate whether food aid had positive or negative effects on the economies. The results point to food aid having a significant positive effect on food production over time. However, given the heterogeneity in the countries, the difference in relative importance of food aid between the countries, and the different policy and market environments involved, as well as structural changes during the period (independence, economic reforms), there are doubts as to the validity of the results. Lavy does attempt in various ways to deal with the heterogeneity, however data constraints are present.

2.4 Market integration in the food aid literature

The market integration literature contains many examples of time series econometrics from the early use of price correlation coefficients over time and space, to notions of Granger-causality, to more recent work with Error Correction Models (ECM) and cointegration analysis. All of these analyses are based upon the Law of One Price, with variations due to assumptions about competitiveness and efficiency.

As was found with studies attempting to assess direct food aid effects on markets, analysis of the price discovery process involves so many factors that structural models are not possible in a developing country environment. Few countries collect the entire set of data necessary to correctly specify a structural model. In addition to the data problems, structural models are identified on the basis of strong restrictions on the parameters and their interactions.

Time series modeling has added to the recent work with market integration, enabling analysts to use these techniques to model relationships over time. Sims promoted vector autoregressions (VARs) for macroeconomic policy analysis. He stressed that the VARs are able to evaluate the long-term trends between variables, and the responses of different variables from shocks from other sources.

One of the most difficult aspects of this type of econometric analysis is linking the statistical relationships to sound economic theory. In the early work with VARs, found in articles by Sims, for example, researchers identified systems assuming that the simultaneous relationships between the variables followed a strictly recursive structure. This is a strong assumption, often violated in reality. Recent developments in computer technology and econometrics have enabled analysts to develop other nonrecursive systems for identification based on economic reasoning.

It is still important to bear in mind the cautions of Harriss and Faminow and Benson regarding what prices can tell, based upon the economic structure and physical reality.

That two prices move together may indicate competitive markets effectively operating. However the same comovement can be found where an oligopolist operates or where the government administers prices. Prices in two spatially separate markets may move together not because the markets are directly connected, but because both markets are affected by some common phenomenon.

Sexton, Kling, and Carman (1991) used weekly data to model market integration in the point-space tradition, with each market having its own supply and demand factors. In equilibrium, there are three possible arbitrage regimes: efficient arbitrage, relative storage, and relative glut. The existing regime depends upon the transaction costs, the price in the markets of the supply region, and the autarky price of that region. There was trade when the difference between the market price and the autarky price was greater than the transactions costs.

In an analysis of market integration and the transition from war to peace in Ethiopia, Dercon (1994) provides an example of the econometric analysis using error correction methods, an adaptation of VARs in which long-run relationships between markets are key. This will be discussed further in Chapter 6. The author's comparison of different time periods is based in part on separate analyses for each period. For some aspects, regressions are estimated using dummy variables for the war to peace transitions. The latter method may be questionable when underlying structural changes are ignored in the dummy variable simplification.

In addition to the classic spatial market integration, with the same commodity in two spatially distinct markets, researchers have applied market integration analyses across commodities. When two commodities are substitutes or complements, as is the case with white and yellow maize products, the prices for each are expected to move in concert. Regarding substitutability, Sexton, Kling, and Carman state that if goods are not perfect substitutes (i.e., there is no stable premium between them), "then their price difference may systematically range above or below α_i (the premium) in response to variations in each product's individual supply-demand factors" (p.574). This relationship between products' prices over time is part of the analysis needed in cases where the food aid commodity is distinct from the locally produced commodity.

2.5 Analytical concerns in the present study

Back in 1977, Isenman and Singer point out the three major factors in determining whether or not food aid has a price disincentive effect on farm production: 1) the extent to which food prices are depressed with the arrivals of food aid; 2) the aggregate supply response of farmers to price changes; and 3) other nonprice constraints on production and incentives to produce, such as the lack of inputs. The present research first looks at prices and whether they are affected by food aid, using as analytical support recent developments in econometrics in addition to the common sense qualitative analyses suggested by Maxwell(1991). In addition to the direct price effect, this research addresses the potential disincentive effects upon traders that stems from unpredictable variations in prices. Points 2 and 3 of Isenman and Singer's list cannot be answered with the current research, although qualitative analysis provides orientation on possible answers for Mozambique.

Thus, both the food aid disincentives research and the market integration research offer tools that will be helpful for the present study on food aid in Mozambique. In the next chapter, the structure and conduct of the maize markets will be described in order to set the stage for the econometric work that will evaluate the market outcome in the changing economic environment.

Chapter 3

Maize Markets

3.1 Introduction

Walking into any market in Mozambique, the observer will see many people selling white and yellow maize grain or flour. Prices observed in these markets are the end result of the interaction of many agents, thus information on how supplies arrive in the markets, who is involved in the process, and the information available to the agents enables the information in prices to be analyzed. To interpret changes in prices, a thorough knowledge of the organization of markets is necessary, including the competitiveness, the integration between markets, and the role of the private and public sector.

Mozambique's fight for independence and the subsequent years of civil war left much of the production and market infrastructure destroyed or useless. The socialist policies in the post-Independence era introduced changes and then market reforms initiated in 1987 began a new process of change. However, it was difficult for researchers to follow the whole process. The landmines and frequent assaults on the roads made research in rural areas difficult and government funds for research were limited. This has meant a paucity of research on the currently evolving markets, with a few exceptions (MAARP 1990, Quezada et al 1990, Billing 1990, MOA/MSU WP#10 1993).

Thus, in 1994, the Ministry of Agriculture and Fisheries project in connection with Michigan State University (referred to as MAP/MSU) assisted the Agricultural Economics Directorate (DEA) in the development and implementation of a rapid appraisal (RA) of the domestic maize markets, focusing on white maize and the constraints on market development. Earlier research in Maputo (conducted by MAP/MSU in 1992 and 1993) provided much of the basis for the yellow maize markets and food aid analysis, which will be detailed in Chapter 4. Figure 3.1 shows the location Maputo (the capital city), Chimoio (a research site), as well as the provincial boundaries.

This chapter will present a brief description of white maize production and total maize consumption in Mozambique, followed by a brief review of the organization and performance of the white maize markets, focusing on the aspects relevant for the current analysis of food aid and the maize markets. The fragility of the nascent markets, the lack of market infrastructure, the prevalence of the informal sector traders in spite of the bias against them, the high risks in production and trade are all factors that contribute to the effects of food aid on these markets.

3.2 Maize production in Mozambique

Maize production in Mozambique is almost entirely white flint, open-pollinated varieties, with no yellow maize production. Based upon rain-fed production systems, total white maize production in Mozambique in any given year depends upon the timing and quantity of the rains. As can be seen in the rainfall data for Chimoio station in the center of the

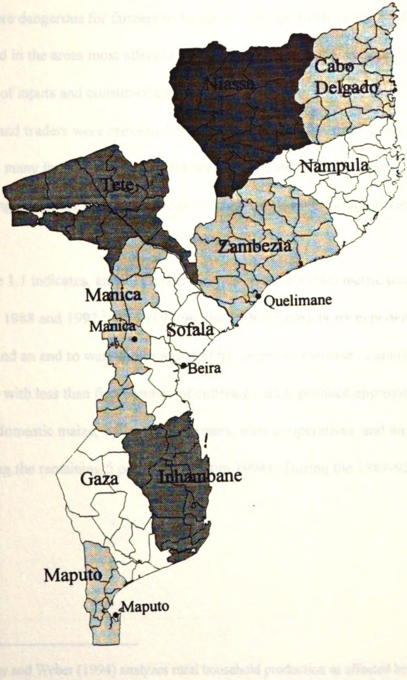


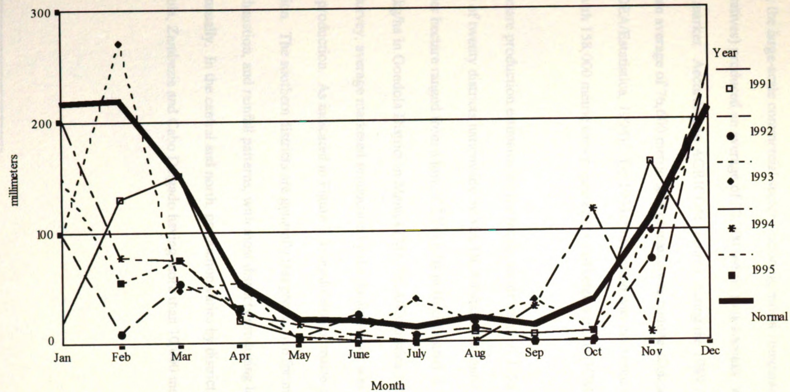
Figure 3.1 Map of Mozambique with Maputo, Chimoio, and provincial borders

country (Figure 3.2), there is a single rainy season (unimodal distribution), thus there is only one cropping season per year in most parts of Mozambique. In the late 1980s and early 1990s, war limited the production of maize. Roads and even footpaths to distant fields were dangerous for farmers to travel, so only the fields close to villages could be cultivated in the areas most affected by the war.[1] Transportation problems also limited the delivery of inputs and consumer goods. Finally, many rural stores were destroyed during the war and traders were prevented from purchasing surplus production. After the drought, many farmers relied upon the seeds distributed by relief agencies and are continuing to use the later generations of those seeds, even though some were hybrids.

As Table 1.1 indicates, annual production was below 500,000 metric tons per annum between 1988 and 1992.[2] The 1993/94 and 1994/95 crop years experienced both better rainfall and an end to war, and production has begun to increase. Family sector farmers (farmers with less than five hectares of cultivated land) produce approximately 95 percent of total domestic maize, with private farmers, state cooperatives, and mixed farms producing the remaining 5 percent (Agricom 1994). During the 1989-92

[1] Tschirley and Weber (1994) analyzes rural household production as affected by war and other factors in northern Mozambique in the recent period before the Peace Accords.

[2] All production and consumption figures in Mozambique must be taken as indicators rather than exact numbers, until new censuses of the population and of rural production can be conducted.



Source: Republic of Mozambique, Instituto Nacional de Meteorologia database, 1995.

Figure 3.2 Total monthly rainfall at Chimoio station, 1991 - 1995 period, the large-scale commercial sector (including mixed companies and state cooperatives) produced an average of 22,000 metric tons annually, with 95 percent sold on the market. According to AGRICOM records, during the 1989 - 1992 marketing years, an average of 76,600 metric tons of maize was commercialized per annum (MA/DEA/Estatística, 1994).[3] By 1994, production was estimated at 527,000 metric tons, with 158,000 metric tons projected for marketed surplus (ICM 1995).

Per hectare production estimates for the family sector vary. A 1993 farm household survey of twenty districts nationwide by MA/DEA/Estatística found that district average yield per hectare ranged from a low of 259 kg/ha in Buzi District in Sofala to a high of 1,330 kg/ha in Gondola District in Manica (MA/DEA/Estatística 1995). From the same 1993 survey, average marketed production by the family sector was 14 percent of total maize production. As indicated in Figure 3.3, production of maize in Mozambique varies by region. The southern districts are generally less productive for maize due to soil type, soil exhaustion, and rainfall patterns, with most districts producing less than 5,000 metric tons annually. In the central and north, production varies by district, with districts in Nampula, Zambezia and Cabo Delgado having more than 10,000 metric tons each.

[3] The marketed tonnage estimated by AGRICOM and by ICM is based mainly upon the formal sector trade, thus reflecting the minimum marketed maize quantities. Actual quantities marketed in the country may be much larger due to the strong participation of the informal sector.

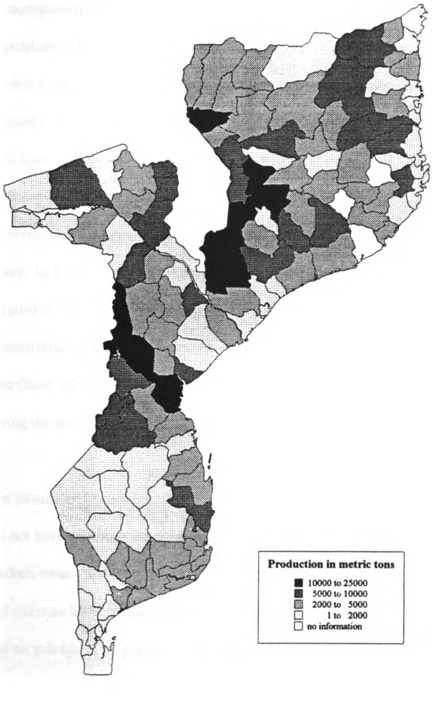


Figure 3.3 District level maize production in Mozambique, 1993/94

3.3 Maize consumption in Mozambique

Maize consumption figures are difficult to estimate due to the lack of recent household consumption surveys, population changes during the war, and no recent census of population. Maize is a major staple, although some regions of the country consume manioc or rice as an alternative staple. Across the 10 regional capitals (excluding Maputo), in a 1992/3 survey of income and expenditures, 30 percent of average monthly total household expenditures went toward bread and cereals, about half of which (49%) were expenditures on maize products (Republic of Mozambique, CNP/DNE 1994). Thus, 15 percent of average monthly household expenditures in these urban zones were on maize. In Maputo, a household expenditure and consumption survey conducted in Maputo in 1991/92 estimated that for the poorest 20 percent of households, household expenditures on maize products were 18 percent of total household expenditures at that time (Sahn and Desai 1993), however the drought was affecting consumption patterns during the survey period and a new survey is needed.

The income and expenditures surveys from the provincial capitals that were cited above did not have consumption components. Rural traditions and the past unreliability of the markets means that many urban households have land plots in the surrounding rural areas and cultivate basic consumption goods. The DNE 1992 urban household survey indicated that an average of 73 percent of the households in the provincial capitals own agricultural land, reaching almost 90% of the households in Tete, and many produced maize for own household consumption (Republic of Mozambique, CNP/DNE 1994). In the 1994 preference survey in poorer neighborhoods of Maputo, 47 percent of the households indicated obtaining at least some maize from nonmarket sources, including maize from own fields and from friends and relatives elsewhere, although 90 percent said that market purchases were the main source of maize for the household (MAP/MSU WP # 18, 1994).

The Cornell consumption survey in Maputo in 1991/92 was undertaken when regional drought and war limited consumption alternatives and affected relative prices, so it is difficult to estimate actual consumption, yet this study provides the best estimate available. In terms of total consumption, Dorosh et al. (1993) used the 1991/92 household consumption survey to calculate Maputo urban area maize consumption of 110,000 metric tons annually, about 9,000 metric tons monthly. When comparing this to a total nationwide marketed amount of 76,000 metric tons annually, the need for imports is clear, at least until production of maize for the markets can increase, and transport can get the supplies down to the Maputo consumers.

In consumption studies, there has been extensive discussion on the substitutability of white and yellow maize. Tschirley et al. (1996) present the strong evidence that white and yellow maize products are imperfect, but close, substitutes[4], with yellow maize an inferior good compared to white maize, but cross-price elasticities would appear to be high.[5]

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[4] Perfect substitutes require that consumers would be indifferent to the two commodities at some fixed margin between their prices; however, in white/yellow maize consumption, approximately one-quarter of consumers indicated in a 1994 Maputo household survey that they would not consume yellow maize regardless of the price differential between white and yellow. Thus the goods are imperfect substitutes.

[5] The cross-price elasticity of demand for white and yellow maize products remains unknown. Dorosh et al. (1995) estimated a very low value of 0.013 for the elasticity of demand for yellow maize with respect to white maize price; however the data were collected at a time of increasing white

Women in Mozambican households use either white or yellow maize to make the local "chima", a maize porridge eaten daily. There are regional differences on preferences and substitution of commodities in consumption. In some regions, manioc becomes a hungry season substitute for maize products, as in the north. Rice is considered the preferred good (to maize products) for many urban households. In terms of complements for the consumption of maize products, there are no clear choices, since the types of sauces used with the "chima" vary greatly, with peanuts and dark green leafy vegetables predominating.

Consumption of maize products depends upon the household income level, composition, and preferences, as well as prices. The preparation methods for white and yellow maize are similar enough, such that preparation costs do not vary greatly. However, for hand-pounding, the flint maize varieties (including the white maize varieties grown in Mozambique) are harder and lose less of the endosperm, resulting in a preferred "chima", while the dent varieties (including all of the yellow maize that arrives in Mozambique) tend to become powder with the pounding, resulting in a pastier "chima".[6] Regardless of how the maize is prepared or the color of the maize, consumers in Maputo and other urban areas depend upon the markets to supply the basic grain, so logically the structure of those markets influences the consumers' options.

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maize scarcity and rising real and nominal prices. The 1994 Maputo preference study (MOA/MSU WP#20) suggests that there should be a much higher value for the cross price elasticity of demand for yellow. The issue will remain unresolved until new consumption analyses can be undertaken in current market conditions or longitudinal studies conducted.

[6] For an in-depth discussion on the characteristics of flint and dent maize in consumption in Mozambique, see Weber et al. 1992.

3.4 Rapid Appraisal (RA) Methodology[7]

A rapid appraisal (RA) methodology was selected for the market research, using the basic framework of Structure-Conduct-Performance (S-C-P), focusing on the structure and conduct aspects. As Holtzman (1986) defined it, a RA is "a broad preliminary overview of the organization, operation, and performance of a food system or components thereof, designed to identify system constraints and opportunities". A combination of informal interviews, formal surveys, and secondary data are used. The choice of activities depends upon the objectives and prior knowledge of the system. This methodology is a flexible and rapid way to identify agents and structures (Holtzman 1986), a basic objective of this research in Mozambique.

The RA consisted of the following aspects: 1) informal interviews with key informants, from the public and private sectors; 2) formal interviews, based on survey instruments, with traders in both the formal and informal sectors; 3) direct market observations; and 4) various types of secondary data, including prices, family sector survey data, and infrastructure status.

In each research site, the research team went to at least one retail market site, searching for various types of traders, usually accompanied by enumerators from the market information system, the SIMA. The SIMA enumerators are generally well known in the

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[7] For an in-depth presentation of research methods and results, see MOA/MSU Working Paper #20. Working Paper #20 is available only in Portuguese as of February 1996. The report by Coulter (1995) contains some of the results of that work in English.

markets, helping the research team to overcome problems that might arise due to lack of confidence of the traders in strangers. Survey instruments were designed specifically for each basic type of trader thought to be operating in the markets, including itinerant wholesale traders, itinerant retail traders, informal retail traders in markets, and formal wholesalers. The interviews obtained information on type of products, costs of transport and of products, sales prices, taxes and fees, units of transactions, suppliers, and clients. With respect to market observations, the research team noted the number of traders, the available transport, the products offered for trade, common units, and other aspects of the basic operations. The language of the interview depended upon the languages of the participants, preferably the local language, but at times in Portuguese.

Various criteria entered into the selection of sites for the RA, including overall agricultural production, production of maize, commercial and parastatal activity in maize markets, access, and population. Variability in the criteria was sought. For example, sites were selected that had good transport access while other sites were chosen for difficult access. Based upon the criteria identified by the research team, seven research sites were selected. Table 3.1 presents basic information on location and characteristics of the sites chosen for the RA, while Figure 3.4 indicates the location of each district on the map. For the 1993/94 production year, Manica Province had the highest estimated maize production in the country, although by 1994/95, it was only fourth in total estimated production. The Beira Corridor highway and railway have been maintained throughout the war and assure accessibility at least near the Corridor itself. The area has been commercially active in

Table 3.1 Characteristics of the research sites for the rapid appraisal

Site	Zone	Province	Number of market-places visited	Provincial population in 1993	Provincial maize production in 1993/94 production year (metric tons)	Qualitative assessments	
						Level of commercial activity	Access
Caia/Sena	Center	Sofala	2	1,336,000	52,000	Low	Difficult
Chimoio/ Sussundenga	Center	Manica	2 in Chimoio, 1 in Sussundenga	659,000	102,000	High	Good, but in rural areas moderate
Homoine/ Maxixe	South	Inhambane	1 in each	1,297,000	38,000	Moderate	Good
Malema/ Mutuali	North	Nampula	none	2,957,000	41,000	Low	Difficult
Mocuba	Center	Quelimane	1	2,985,000	92,000	High	Moderate
Montepuez/ Balama	North	Cabo Delgado	1	1,261,000	45,000	Moderate	Moderate
Nampula/ Ribaue/ Namialo	North	Nampula	1 in Nampula, 1 in Namialo	2,957,000	41,000	Moderate	Moderate

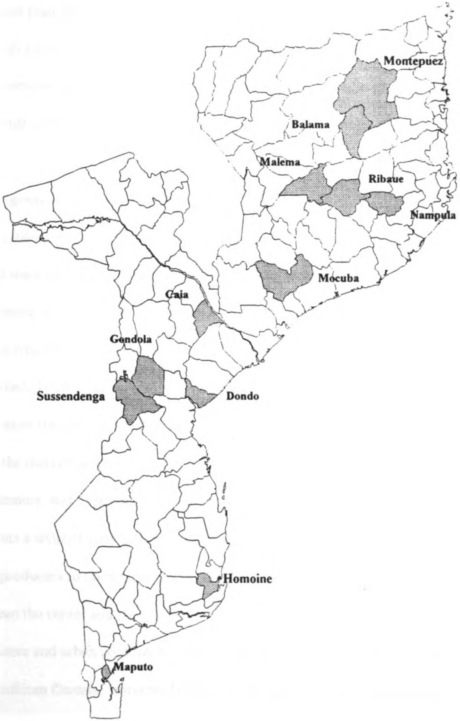


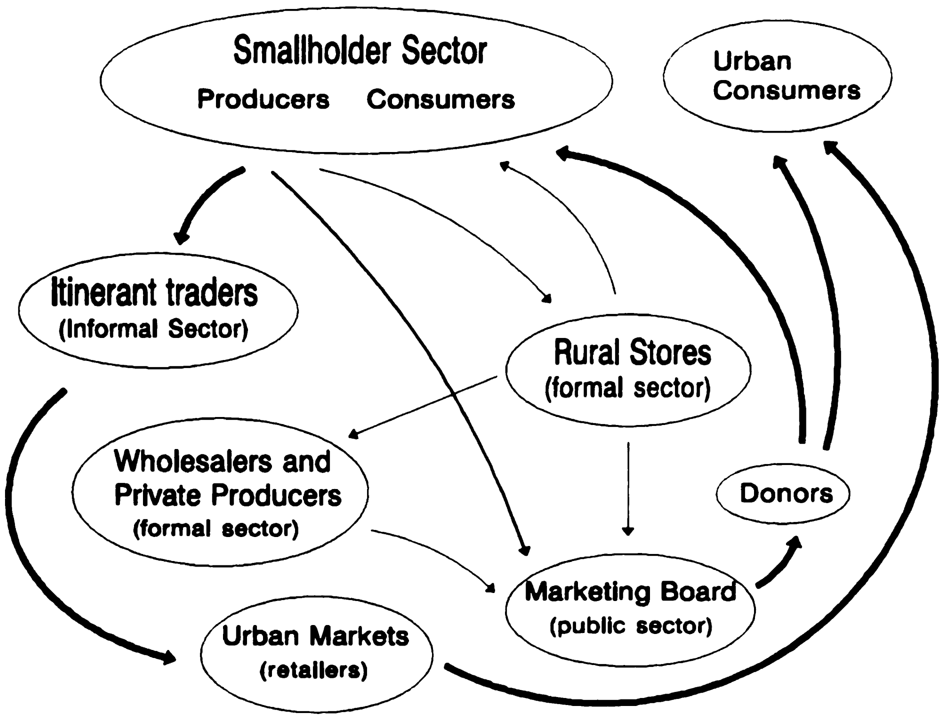
Figure 3.4 Map of Mozambique with rapid appraisal sites, July - September 1994

maize markets for years and was the site of market research in 1990. Other sites chosen, such as Caia and Sena in Sofala province, had very poor access to large urban markets and also had poor production in the 1993/94 production year. In the north, Malema and Mutuali had good production but poor access; Mocuba had fairly good production and has limited access to the Quelimane market, while Ribaue was in a similar position for the Nampula market.

3.5. Agents in the markets

3.5.1. *Intervenientes*

In the marketing of agricultural commodities, the term "interveniente" (loosely translated as "people who act within the markets") is used in Mozambique to designate all economic agents who buy and sell in the market. The following types of *intervenientes* were identified: 1) farm producers, both family and private sectors; 2) rural traders, both formal rural store traders ("lojistas" in Portuguese) and informal; 3) retailers, formal and informal, all in the marketplaces; 4) itinerant traders, retailers and wholesalers; 5) formal wholesalers; and 6) public sector agents including parastatals and donors. Figure 3.5 presents a stylized view of the major agents involved in the supply of white maize from farm producers to consumers during the RA period. The informal sector was very active between the center and the south, serving as the middlemen and middle women between producers and urban consumers. The formal sector traders supplied the parastatal Mozambican Cereals' Institute (ICM), and the donors. That role definition becomes important in discussing the fragility of the maize markets, as well as the sources of



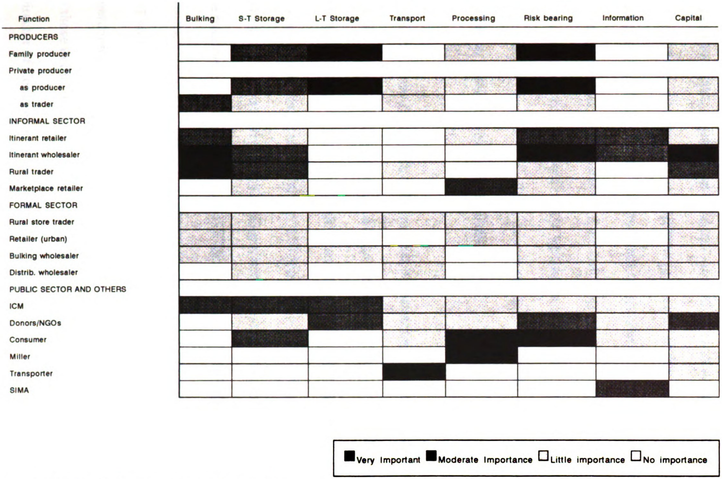
Note: Thicker lines indicate greater volume.

Figure 3.5 Principal marketing channels for domestic white maize observed during Rapid Appraisal in 1994/95 marketing year dynamism in those markets. Figure 3.6 indicates the strong participation of the informal sector in accumulation, short-term storage, and assumption of risks, whereas the formal sector participated only minimally in any of these functions during the 1994/95 marketing season, according to the assessment of the RA team.

"Formal" and "informal" are used here to indicate the relationship that the trader has with legal authorities. Formal sector agents are registered as retailers or wholesalers with the Ministry of Commerce and have legal status. Informal agents do not have legal recognition for their commercial activities. At the retail level in the marketplaces, there is little difference between the formal and informal. At the wholesale level, however, the formal sector wholesalers have more resources and permanent assets than the itinerant wholesale traders.

3.5.2 Marketing channels prior to ERP

In the 1980s, maize was marketed using a combination of private and public sector agents. The first buyer was the "lojista", the formal sector rural trader who engaged in a variety of activities, including buying and selling of smallholder production, provision of production inputs and consumer products, and provision of credit. Lojistas sold the agricultural commodities to the state sector or to large-scale formal wholesalers, and then through the government shops or private retailers, the maize was bought by consumers. A few lojistas said that they bought limited quantities of white maize to store and then sell back to consumers in the hungry season, but this did not appear to be common.



Note: Table shows the assessment of importance of different agents in fulfilling market functions. Transport is the provision of transport and does not include arranging for transport. S-T Storage is short-term storage of less than 1 month; L-T Storage is long-term storage of more than 1 month.

Figure 3.6 Agents and functions observed in the white maize markets, July - September 1994

During this period, there were official price schedules for maize from the producer level all the way to the consumer level. With the government as an active buyer and seller on the markets through its agricultural products' marketing board AGRICOM, the official prices were relatively effective. The government granted monopoly trading rights to lojistas for their zones of influence. The resulting marketing system had the lojistas purchase maize and other agricultural products from the farm producers; the lojistas then sold directly to the parastatal marketing board or to a wholesaler who traded with the marketing board or sold maize at the retail level. Thus, private sector traders were active in the white maize markets at both wholesale and retail levels.

The lojistas were most often of Portuguese or Asian descent and, at the time of Independence, many of the lojistas left the rural areas, either for the cities or for foreign destinations. During the ensuing war years, many stores were damaged or destroyed, and so in some regions, operating stores are rarities. By 1992, the official statistics registered more than 10,000 stores, of which 33 percent were either destroyed or non-operational, the majority in rural areas (Republic of Mozambique, CNP 1993). According to the Provincial Directorate of Commerce in Manica, a major maize production zone, out of 461 authorized retail outlets in the province, 209 stores were destroyed, 74 were non-operational for other reasons, and 178 retail stores (39 percent) remain in operation, many of those in the urban areas of Chimoio and Manica City (personal communication, Director of Commerce, Manica Province, 1994).

The effects of the war were less severe in the north such that lojistas still buy maize from the producers for sales to private wholesalers or the parastatal ICM. The informal sector development has lagged behind in this zone, as well. Throughout the country discussions on the "commercial network" and market development involve rehabilitating these multipurpose rural stores. In the meantime, other marketing channels are developing to fill the void left at the producer level, particularly in the hard hit central zones of the country.

3.5.3 Marketing channels in the informal sector

The informal sector has grown tremendously in the period since the PRE began and especially since the Peace Accord took effect. This sector has no legal status and is occasionally the target of police crackdowns, although the government for the most part looks the other way. Initially, the informal sector was focused in the urban areas, selling small quantities of goods obtained through illegal imports, through leaked food aid or ration shop supplies, or through other means. The informal urban maize traders traveled wherever transport was available in order to obtain supplies, including the southern production areas of Gaza and Inhambane as well as Swaziland.[8] There was also active trading in food aid yellow maize supplying towns such as Xai Xai and Inhambane. After the Peace Accords, the geographical range expanded to include the central production areas in Manica Province, whose location is shown in Figure 3.1.

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[8] MOA/MSU Working Paper #10 (1993) presents a more detailed presentation of the growth and operation of Maputo informal markets for white and yellow maize products.

The informal traders from Maputo and Beira travel to the production areas with cash to purchase grain. They go into the rural areas, following the recommendations of other traders, friends, and family. Traveling with cash for grain purchases, empty sacks, and a tarp to cover the maize, they live for a week or so at a crossroads or truck stop, buying white maize that the farmers carry on their heads from the farm to the crossroads. Sales are based on volumes, so no scales are needed. There may be several different traders at a given spot, either friends from Maputo or competitors from another city. At one crossroads in Manica provinces, there was observable competition between two women traders from Maputo sitting together on their sacks at one side, and three male traders from Beira, with their sacks on the other side. Farmers approached on foot with 30- to 50-kilogram sacks of maize carried on their heads, seeking the best price.

After purchasing up to the limit of their funds, the itinerant traders hire transport to the nearest paved road and then transport to the city from which they came. They sell the maize in bulk on the fringes of the markets to retailers from the market, who in turn sell in small, nonstandard units to the consumers. There is a notable shift in gender of the traders between regions, with women traders from the south and men traders from the center and north. Cultural and ethnic differences may explain the shift.

The informal sector dominates retail sales of domestic white maize in Maputo and elsewhere. After the PRE in 1987, informal marketplaces began to appear and grow in Maputo, often near the official marketplaces. Called "dumbanengues" in the south and 'tchungamoios" in the north, the informal marketplaces abound with individuals selling basic food stuffs, fuel, and other consumption goods, in small units. Edible oil is sold in sizes as small as a bottlecap, while maize grain and flours are sold by the bowl, cup, or can. In Maputo, the most common unit is a used infant formula can which holds about 800 milligrams. Traders group themselves by commodity and competition appears to be strong, with little price variability or price bargaining for the most common foodstuffs. As indicated in surveys done in Maputo markets, many white maize retailers obtain white maize from itinerant traders within the same market or from a nearby larger market. Thus, the informal traders fulfill most of the marketing functions from rural producer to urban consumer.

3.5.4 Marketing channels in the formal commercial sector

As will be seen, the formal sector and the informal sector in the white maize markets do not have joint transactions. The formal wholesalers obtain white maize in two basic ways.[9] As noted earlier, the formal rural retailers, "lojistas", provided maize purchased from producers and sold to the wholesalers, a system still in place in the north. Alternatively, in areas in which the rural lojas were largely eliminated, the formal sector wholesalers send out their representatives to purchase white maize from private and family sector producers. The final purchaser in both cases is either a donor or ICM.

The weak participation of formal wholesale agents in white maize marketing, as shown in Figure 3.6, stems less from supply difficulties than from the perceived lack of a stable

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[9] Formal and informal sector trading of **yellow** maize commercial food aid will be discussed in Chapter 4. Formal and informal do have continued direct trading relations, with yellow maize.

market for the white maize. During the RA, wholesalers complained in every part of the country about the "lack of a market" for white maize. Accustomed to dealing with parastatals that were authorized to buy maize at the official price, wholesalers had not developed private markets for white maize and were not interested in storing what is perceived to be a risky commodity. In 1994, wholesalers became active in the white maize markets only when the donors and ICM began buying white maize, providing the traders with a guaranteed market for immediate sales of maize. Wholesalers bought white maize with prior knowledge of the buyer and the price, thus minimizing the price risks.

3.5.5 Marketing channels and the public sector

Over time the public sector role in the maize markets has shifted. As noted earlier, before the PRE, the government maintained a minimum price system by being an active buyer and seller on the market. Since 1987, that role has greatly diminished. Urban ration shops have been eliminated, and the new marketing parastatal ICM was established in 1994 without the substantial subsidies of previous agencies. AGRICOM, ICM's predecessor, was declared bankrupt and dissolved in 1994, with its assets turned over to ICM, after years of government and donor subsidies.[10]

ICM uses commercial bank loans in order to operate in the marketing of maize and the general manager speaks of the need to be a financially sound, independent profit-making

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[10] During the RA, most traders still referred to the parastatal agency as "AGRICOM" rather than "ICM", suggesting that there was no perceived difference between the two agencies other than the name.

business in order to survive. In the future, it is believed that ICM will have to respond to market forces, paying no more than what they can profitably pay.

Occupying the same buildings, sometimes without even a new nameplate, ICM has lost markets due to the problems that traders and farmers had with the previous parastatal, AGRICOM. In a liquidity crisis during the 1993/94 marketing season, AGRICOM issued checks in 1993 that could not be cashed for at least several weeks after maize was received, discouraging future trades. In a glaring example in Manica Province in August 1994, one family sector producer with 10 50-kg sacks of white maize to sell preferred to deal in cash with a rural trader at 450 meticais/kg rather than travel 2 kilometers further to the ICM warehouse and possibly receive 550 meticais/kg but in a check. The rural trader said that AGRICOM's August 1993 check to that farmer was not honored until January 1994.

Nevertheless, in 1994, ICM purchased 34,000 metric tons from traders and producers throughout the center and north of the country. Of that, about 16,000 metric tons of white maize were sold by ICM to private traders. Otherwise, the maize that enters this marketing channel of formal wholesalers to donors or to ICM is not destined for the retail markets. ICM purchased 22,000 metric tons for the WFP, while donors and non-governmental organizations directly purchased up to another 20,000 to 30,000 metric tons. Thus, around 50,000 (somewhere between 42,000 and 52,000) metric tons was distributed by non-governmental organizations to people without effective demand, including returned refugees, internally displaced persons, and ex-soldiers.[11] As a result, the local purchasing channel removed 50,000 metric tons of marketed surplus from the retail trade available to consumers. Considering that total marketed surplus was estimated to be about 123,000 metric tons, this represents 40 percent of white maize marketed. This was the maize marketing channel of the formal sector. The donors have made no long term commitment to continued local purchases, and so this channel may no longer be significant in a few years time, leaving the formal wholesale sector without a guaranteed market, likely reducing formal sector participation in white maize markets, unless private market channels develop.

The government still maintains a minimum producer price policy, with the panterritorial, panseasonal prices set at the beginning of the marketing season each year (March or April). Figure 3.7 shows the nominal official producer prices, along with the actual **retail** level prices in three markets: Maputo, Chimoio, and Nampula. When the actual retail price and the announced producer price are close, there is no potential retail margin left. Farmers can get the retail price by traveling to the markets to sell. Alternatively, if the parastatal ICM were purchasing from farmers, farmers could get the official price. If farmers can only sell to local traders due to transport or other constraints and there is no profit margin for the traders, there will be no maize traded at the official price. Thus

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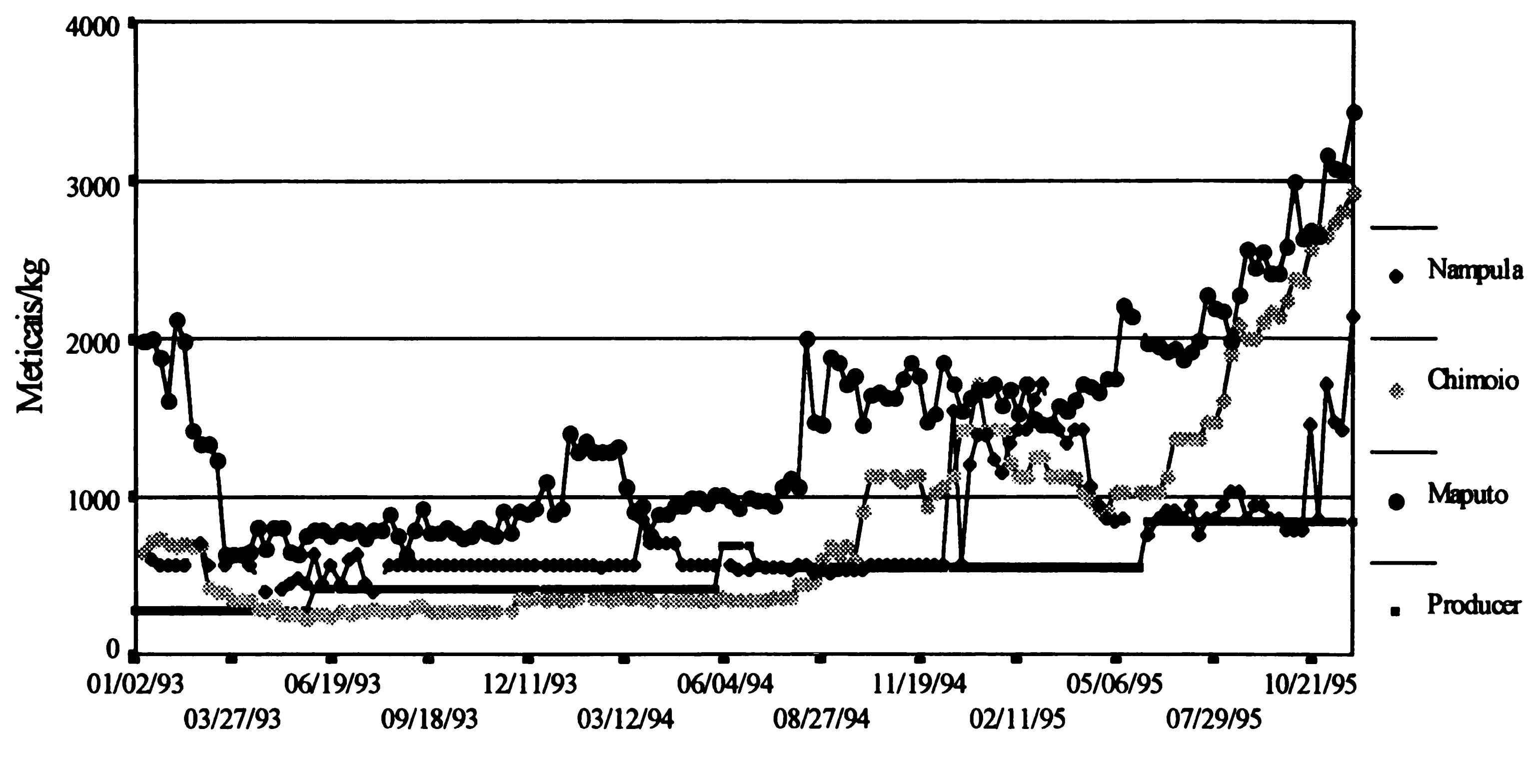
[11] It is possible that some of the maize supplies distributed in the emergency programs were then resold by the participants into the market. The extreme scarcity of alternative consumption staples and the high market prices for them makes it likely that leakages would be small and would not enter Maputo markets since distributions are conducted elsewhere. During the RA, leakages from the distributions to demobilized soldiers were found, but this was highly localized.



Source: MAP/MSU SIMA database.

Figure 3.7 White maize grain retail prices in Maputo, Chimoio, and Nampula, and official producer prices, Jan.2, 1993 - Nov.25, 1995 (nominal meticais/kg) farmers are likely to face lower than official prices when the retail and official producer prices are close.

In 1994, there were continued difficulties with the producer price policy. The government declared a minimum of 700 meticais/kg and then reduced that to 550 meticais/kg, in part because the donors indicated reluctance to initiate local purchases of white maize at the 700 meticais/kg price.[12] Without the donors participation, ICM has limited access to bank credit and would likely have not participated in the marketing season in any significant way. This would leave the government with no real way to enforce a minimum price policy. Another problem in 1994 stemmed from the official announcement of the minimum price when the marketing season had already begun. This late date prevented producers from adjusting their planting or cultivation investments in accordance with the price. By changing the price after an official declaration, the government further weakened the incentives that an official minimum price might give, leaving uncertainty about the policy's efficacy in future years.

If the government is no longer a buyer, the minimum prices become irrelevant or a hindrance to many producers and traders. The Ministry of Industry, Commerce, and Tourism (MITC) is responsible for enforcement of the minimum price policy, with very limited success. One district administrator lamented that the policy may take markets

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[12] A similar scenario is being played out in January 1996, as the World Food Programme indicated that it would not purchase local maize at the official white maize producer price of 1450 meticais/kg for 1996, about US $132 per metric ton at January exchange rates.

away from the farmers, for if he were to enforce the official prices, no traders would buy maize from the farmers at all, and the farmers would be left with maize rotting in storage. For example, a rural store in Nampula Province was closed by an official of the MITC in August of 1994 for purchasing at prices below the official producer price. Yet **retail** prices in Nampula City at that time, about two hours away by unpaved road, were at or slightly below the official 550 meticais/kg (Figure 3.7), leaving traders no potential margin for covering transport costs if the maize were sold in the market. Traders also cited such closings as harassment, adding another risk factor for private traders due to discretionary enforcement.

3.5.6 Role of processing industries

In industrialized countries, one of the main intermediate sources of demand for raw materials is the processing industry, which needs a reliable supply. The industrial maize milling sector is now beginning to recuperate in Mozambique. In 1995, after several years of reliance upon yellow maize food aid imports, the industrial mills began purchasing more domestic white maize for processing and sales. The Companhia Industrial Matola (CIM) is a recently privatized industrial mill. It purchased 2,000 metric tons of white maize in the north for maritime shipment to the south for milling and distribution near Maputo. This sector could provide a source of demand for the formal wholesalers, but as yet little white maize is involved in these trades.

In Maputo, small-scale maize processing mills can be found near every market, as retailers and consumers buy grain in bulk to take to the mills for custom processing. A recent nationwide survey of small-scale mills found that almost 100 percent of mills work solely on commission basis, processing maize owned by third parties (MAP/MSU Working Paper #21, 1995). Thus, this sector does not provide a direct source of demand for the white maize.

3.5.7 Imports and exports

A variety of factors influence imports of white maize. In the past, the country has imported white maize food aid from Mexico or from countries in the region, particularly Zimbabwe. These latter are known as triangular transactions, in which a donor purchases maize from a surplus country in the same region as Mozambique. Generally, the world markets for white maize are thin, and regional supplies of white maize are covariant with production variability in Mozambique, making these markets unreliable, particularly in the times of drought, when the need is greatest. However, the southern region of Mozambique suffers from a structural maize deficit and will need supplies even in the best of production years. Whether traders purchase maize from South Africa or from central and northern Mozambique depends upon the relative prices and costs of delivery. One formal trader did import maize from South Africa in 1995. Since September 1995 and in previous periods, small scale informal traders have continuously brought in the finely processed white maize flour from South Africa. The South African price for white maize products thus puts a ceiling on the prices for domestic maize in Mozambique.

White maize exports are illegal according to the food aid agreements, as long as Mozambique is receiving maize food aid from USAID, and thus such trade is unregistered.

Trade between Malawi and Mozambique has developed in the postwar period, but the direction of white and yellow maize trade depends upon the relative prices in each. At times, maize may flow from Malawi to Mozambique; at other times, the flow is reversed.

3.6 Additional considerations

3.6.1 Nonmarketed production

The above details on market channels must be taken in the context of a semi-subsistence agricultural sector. By all estimates, less than 25 percent of the maize produced in Mozambique enter these market channels. Home consumption is still the most important destination of white maize, and many households obtain grain through nonmarket exchanges, though the volume of these transactions is not known. Development of the maize markets is needed to provide higher cash income potential for rural households, as well as reduce the vulnerability of land-poor households (Tschirley and Weber 1994). Overall market development ensures the availability of consumer goods and services, providing additional incentives for households to invest in crop production for the market. As various authors (e.g., Kyle 1991, Barker 1985, Billing 1990) have noted, the serious lack of consumer goods in rural Mozambique, especially in the past 10-15 years, has lessened the incentive for farmers to produce for the market.

3.6.2 Marketing margins and price risks

Table 3.2 presents indicative marketing margins from the RA in 1994 for various types of traders in the white maize markets.[13] While these margins are based on a small, purposive sample, they can help to evaluate the potential effects of price variability on different traders in the system. Consider the case of the formal wholesale traders in Nampula. If they pay the legal minimum producer price, pay all of the taxes, and then sell to ICM in Nampula, they obtain negative returns. This is not to say that the formal traders are participating in a losing activity; rather, if they do buy white maize, they cannot pay the legal price and cover costs, let alone make a normal profit.

In connection with this, comments from the formal traders throughout the country during the RA can be expressed in the often heard phrase "No ha mercado" ("there is no market"). By this, traders meant that there was no satisfactory market, for they would not buy maize unless they knew the prices and the buyer beforehand. The example represented by results of the Nampula formal wholesalers assumes that traders do not store the commodity for any length of time because there was little observed storage by formal traders in the production regions. "Having a market" means quick turnover, guaranteed profit, no price risk. During the RA, only two formal traders were interviewed who stored maize for later sales in the hungry season, and both would sell at the retail level, in small units at rural lojas, not wholesale.

[13] The table only looks at white maize trade, not at the formal traders in the yellow maize markets. As will be seen in Chapter 4, the low official consignee price leaves a wide margin for rents when market prices are high, rents which are captured by the formal traders.

Table 3.2 **Indicative marketing margins for white maize traders observed during rapid appraisal, July - September 1995**

Costs, prices, and estimated margins for one 50-kg sack of maize (in meticais)	Type of trader and location					
	Itinerant wholesaler in Chimoio	Itinerant wholesaler in Ilé/Mocuba	Itinerant wholesaler in Malema	Formal wholesaler in Nampula	Informal retailer in Maxixe market	Informal retailer in Chimoio market
Destination	Maputo market	Quelimane market	Nampula market	ICM in Nampula	Maxixe market	Chimoio market
Purchase price	28571	18000	20000	27500[3]	47222	22222
Taxes and fees	0	0	0	3250[5]	500	500
Transport costs	10714	7000	8000[4]	825[6]	0	3400
Packaging cost (sacks)	2500	2500	2500	2500	500	500
Other costs (milling, credit)	0	0	0	250[7]	3000	0
Own labor: time	0.1 days	0.1 days	1.5 days[8]	<0.01 days	1 day	0.5 days
Hired labor: cost	0	0	0	500	0	0
Sales price[2]	55000	38250	43333	32500	62500	33333
Transport costs as a % of sales price	19.5%	18.3%	18.5%	2.5%	0%	10.2%
Gross margin	48%	53%	54%	15%	24%	33%
Net margin	24%	28%	30%	-7%	18%	20%

Table 3.2 (continued)

[1] Transactions were converted to a standard 50-kg sack unit for comparison purposes.

[2] Sales prices for wholesalers are observed wholesale prices at the destination market during interview week (Maputo, 27/8/94; Quelimane 10/9/94; Nampula 3/9/94).

[3] The purchase price is the 550 meticais/kg stipulated by the government as the minimum producer price. ICM paid formal traders 600 meticais/kg when ICM sacks were used and 650 meticais/kg otherwise. The negative net returns suggest that they did not pay 550 meticais/kg to purchase.

[4] Itinerant wholesale traders were found to pay personal transport only when travelling to production zones.

[5] The "Circulation Tax" is 10 percent of the sales price received from ICM. Income taxes not included.

[6] Transport costs based on 30 km trip for 200 50-kg sacks at 550 meticais for each ton-kilometer.

[7] The cost of capital was based on the 46 percent annual interest rate (including commissions) on commercial loans and one week for each transaction.

[8] In Malema, waiting for transport may take up to 10 days.

Looking at the Maputo prices as 1994 progressed can give an idea of what would have happened if a trader had stored white maize for later sales. The purchase price in early August 1994 in the production zones was close to the government minimum price of 550 meticais/kg, with a Maputo retail price of 1050 meticais/kg, leaving a gross margin of 500 meticais/kg. The average monthly price in the Maputo retail market of Xipamanine reached its highest level for 1994 in September with 1750 meticais/kg (nominal price), gross margin of 1200 meticais/kg. The average white maize retail price did not reach or surpass that level again until May of 1995, so a trader with white maize supplies would have done best selling the maize long before the hungry season. Note that in real terms, the retail price of white maize was declining gradually through the September 1994 - March 1995 period, such that real net returns on any maize stored would have been declining over time as well, in comparison with the returns to be achieved in early September, without even including storage costs.

In 1995, a different story emerges, with prices for white maize continuing to rise from August through mid-January 1996. Traders with maize stored are seeing much higher returns. The combination of average local production, reduced yellow maize food aid, and high levels of local purchases of food aid supplies makes the difference between the two years. The expectation of temporal arbitrage opportunities may encourage investments in storage facilities for white maize or other marketing infrastructure. Such investments are unlikely in an environment in which the price risks are high, few risk bearing mechanisms exist (as will be discussed below), counter cyclical price declines are not uncommon, and temporal arbitrage has negative expected returns.

3.6.3 Risk-bearing mechanisms

Price and other risks are common in agricultural product markets. In order to manage price risks, various mechanisms have been developed in markets throughout the world. One major way to manage risk in the US and other countries is the use of futures markets, in which traders and producers buy and sell futures contracts that offset their production or trade positions. There are no futures markets in Mozambique.

Instead, producers tend to minimize their risks through diversification of production. Rather than specialize in the production of a single cash crop, producers have a combination of cash and subsistence crops. In Mozambique, there is not just the threat of a low price for the crop, but there is also the possibility that traders will not be present to purchase maize at all.

The history of a strong public sector presence has conditioned traders to rely upon administrative pricing to remove price risks, setting pan-territorial, pan-seasonal prices, and then serving some of the intermediary functions, as well as some retailing functions in urban areas. In the new market environment, traders reduce their risks through involvement in other activities. In Mozambique, formal traders may buy other agricultural commodities, such as beans, cashews or manioc, for sales to processors or retailers. During the RA, the formal traders had warehouses stocked with processed consumer goods, including imported rice, wines, beer, sugar, paper products, and batteries, rather than agricultural goods.

These mostly imported goods provide higher expected returns on investment than the agricultural products. In particular, for maize, the formal traders indicated a reluctance to become active in maize markets unless there was some kind of guaranteed transaction, such as a commitment from a donor or from the government parastatal to purchase. Lack of capital to invest and problems with the public sector were cited as well during the RA as limiting factors for business expansion in white maize markets.

In the months since the Peace Accords were signed, the variability in maize prices has declined considerably.[14] The remaining variability has three identifiable sources, both on the supply side: 1) weather variability; 2) seasonality, and 3) food aid arrivals. There may be additional volatility added to prices by changing transport costs. Weather variability and seasonality are common sources of risk and have not stopped trading activities and investments in other countries. Food aid arrivals are different. Administrators can remove some of the uncertainty by developing a highly transparent process for decision-making and delivery. Arrivals can be gradually released in order to smooth out the flows to the markets, as will be discussed in Chapter 4.

3.7 Brief summary of the observed marketing functions

Figure 3.5 presents a stylized view of white maize trading as observed during the 1994/95 marketing season. The main marketing outlets for producers were the itinerant informal traders, particularly in the south and center. Urban consumers relied upon informal and

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[14] Chapter 6 will describe the characteristics of prices in the war/drought period and in the post-war period.

formal marketplaces for their purchases, with nonmarket sources still important. The figure does not capture the routes traveled by the nonmarketed output.

The formal sector, when it operated in white maize markets, dealt with other formal sector commercial agents or the public sector. The lack of rural stores in many areas of the center and south limits the effectiveness of traditional trading systems. Itinerant traders do not generally sell to the formal wholesalers because higher prices can be obtained by itinerants in the urban markets. As will be discussed in Chapter 4, the wholesalers and informal sector have traded major quantities of yellow maize, and in that case, the wholesalers are the supply source.

The government role with ICM and the direct donor purchases were important in providing the guaranteed price environment for white maize in which formal wholesalers were willing to operate. How long the formal sector can depend upon such an environment remains to be seen.

3.8 Characteristics of the markets relevant for food aid analysis

The following characteristics of the Mozambican white maize markets are critical for the food aid analysis:

- fragility of nascent markets;
- need for investments in marketing infrastructure;
- bias against informal sector;

- high risks due to price volatility; and
- consumption versus market incentives

3.8.1 Fragility of nascent markets

In the past, the public sector has served as risk bearer and disciplinarian of the private sector, such that the formal private traders have not yet developed as independent, risk-bearing agents in the market. With the public sector withdrawing, there has not been a strong movement for the formal commercial sector to step into the gap. There are cases in which private wholesalers have taken advantage of arbitrage opportunities, as occurred when a southern wholesaler traveled in August 1994 to Beira and Chimoio to purchase white maize for later retail sales in the south. Price volatility makes this risky, especially when hungry season food aid shipments arrive, as will be seen later.

3.8.2 Need for investments

The participation of the formal sector in white maize markets has been limited in recent years to supplying guaranteed markets with fast turnover of stocks. Investment in storage and transport infrastructure for the maize markets and related agricultural goods markets is very slow in taking place, in spite of the deterioration and destruction that occurred during the war. Formal traders state that the maize markets are too unreliable, too volatile for other than very short-term activities, and the interest rates on bank credit are too high to justify investments. The informal traders, using their limited available funds for operating capital, lack the capital for investments in anything more than tarps and sacks, and have no access to bank credit.

3.8.3 Bias against the informal sector

As is true in many parts of the world, the informal sector is disparaged by many people in Mozambique, including government officials. In Manica Province, one official wanted to control their activities, accusing informal traders of extracting too much maize from the province, threatening food security. This is a concern that is reiterated by local authorities throughout the country. The formal traders want a level playing field, in which the informal sector becomes formalized, paying taxes and observing rules just as the formal sector must do. Meanwhile, the informal sector is constantly under the threat of sanctions or extortion, yet they are active in the markets. To eliminate the informal sector would take the dynamism and competitiveness out of the white maize markets.

3.8.4 High risks due to price volatility

As will be discussed in later chapters, maize price volatility and unpredictable price fluctuations may be limiting investment and participation in the domestic maize markets. Sources of the volatility and fluctuations include weather shocks, transport constraints, food aid arrivals, and changing government policy.

One aspect that contributes to the price instability is the lack of interseasonal storage. With predictable interseasonal price changes, traders who buy maize at harvest, can store maize and sell it later in the hungry season, realizing profits above their storage costs. In Mozambique, food aid arrivals in the hungry season can depress prices such that there are losses with interseasonal storage. The unpredictable nature and quality of these arrivals contribute to the perception of risk in storage.

Looking at the food aid arrival information, yellow maize arrived in September, October, and November of 1994, placing a damper on the expected seasonal increase in white maize prices. The same phenomenon of a counter cyclical decline or stabilization in white maize prices can be seen in September - November 1992, December 1993 - March 1994, and again in late 1995, and all can be associated with food aid arrivals of yellow maize. This is exactly why the formal traders in Maputo, when attending meetings with government and donor officials, ask quite pointedly, "How much food aid is coming, when is it coming, and what quality will it be?" This ties in directly with the difficulties of food aid planning and objectives, in which traders want incentives to operate and consumers need food at an accessible price.

3.8.5 Consumption versus market incentives

Food security is defined as "a situation where each person has economical and physical access at all times to an adequate food supply allowing each person to live a productive life, in good health, and without malnutrition or undernourishment" (Laval University 1995). One of the objectives of the commercial food aid is food security, to assist low income consumers, providing a consumption staple at an accessible price. With the war and drought, extreme scarcity meant that the white maize prices soared out of reach as in June 1992, when food aid yellow maize became available as a cheaper alternative. Mozambique did not produce enough food nor generate enough foreign exchange to import food, so food aid was used to fill the gap in the most difficult period, the hungry season.

Now, as local production of the white maize comes back into the markets, finding the appropriate price and the relevant food aid quantities is the challenge. The food aid arrivals are deliberately timed to diminish the rising hungry season prices, yet traders need prices to rise over time in order to cover their storage costs. Policy makers and donors need to strike a balance between accessibility for poor urban consumers and price incentives for rural producers and traders to invest in maize production and marketing.

3.9 Review of key issues with white maize traders

Since domestic maize production began to recuperate after the drought and war, essentially two white maize market channels have developed in Mozambique. Figure 3.5 indicates the flows of these two channels. The formal sector, including commercial traders, the parastatal marketing board (AGRICOM and then ICM), and donors, combine to purchase maize from producers, transport to warehouses in deficit regions, and then distribute to ex-soldiers, returned refugees, internally displaced persons, and others identified as vulnerable groups with no effective purchasing power. Economies of scale in accumulation and transport may be obtained. Only the donors pay for long term storage, with little risk-sharing by the formal traders..

Urban consumers use the second market channel, whereby the informal itinerant traders travel to the production areas, purchase maize directly from the producers, use backhauling transport to return to the city. At that point, the informal urban retailers buy the maize, arrange for milling if necessary, and sell in nonstandard units in the local marketplaces. These informal white maize markets are characterized by small individual scale of operations, small investments of capital, and rapid turnover. Currently, the informal trading provides the information and physical trading links between surplus and deficit markets such that market integration may be obtained.

There are signs of continued change in the maize markets in Mozambique. In response to very high prices in regions hit by a cyclone in 1994 in Nampula Province, private traders in the north began traveling to Cabo Delgado to purchase maize and then traveling to Nampula to sell it. In August and September 1994, a formal trader from Gaza Province was up in Sofala and Manica, buying two truckloads of white maize to then take to Gaza and sell during the hungry season at retail level. The industrial mill CIM purchased 2,000 metric tons in Cabo Delgado in 1995 to ship to Maputo and mill, selling the flour on the Maputo market. In 1995, one formal trader brought in commercial white maize imports from South Africa. These are all indications that the formal sector is beginning to take advantage of arbitrage opportunities in the maize markets.

Local purchases provide a major impetus to the development of the formal sector trading. That is one of the objectives of such transactions. Local purchases, however, do not represent an addition to domestic supplies. If Mozambique is deficit in producing maize and no substitutes are available, imports will be needed to assure food security, whether those are private sector commercial imports or food aid imports.

Actions taken on the yellow maize markets will condition the opportunities available to both the formal and informal sectors. In the next chapter, the yellow maize food aid management and distribution system will be described, as well as the markets for yellow maize and their relationship with white maize markets.

Chapter 4

Food Aid in Mozambique[1]

4.1 Structure of food aid

The United States and other donors have imported large quantities of yellow maize as a food aid commodity since the late 1980s, when Mozambique was having production deficits due to weather, civil war, and the consequences of agricultural policies focused on the state sector (Kyle 1991). Averaging 58 percent of total marketed maize supplies between 1989 and 1995, as shown in Table 4.1, commercial yellow maize food aid has been critical in the food security of low income urban consumers in particular. This chapter details the decision making and delivery system for food aid and then presents an overview on how yellow maize markets are organized and how they are linked with white maize markets.

4.1.1 Making the decision on commercial food aid

USAID and the European Union (EU) have been the major donors involved in commercial yellow maize food aid, with the Ministry of Industry, Commerce, and Tourism (MICT) as

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[1] This chapter is based upon Tschirley, Donovan, and Weber 1996, and MOA/MSU Working Paper #10, 1993. Those works present more analyses and historical detail on food aid in Mozambique.

Table 4.1 Yellow maize food aid in total availability and market supplies

Marketing year	Total yellow maize food aid as a percentage of		Commercial yellow maize food aid as a percentage of		
	Total cereals food aid	Total cereals availability	Total cereals food aid	Total cereals availability	Total market supplies of maize[1]
1989/90	48.5	21.3	17.7	7.7	54.8
1990/91	63.8	27.2	23.1	9.9	57.3
1991/92	70.4	35.0	23.5	11.7	64.8
1992/93	83.3	59.7	35.1	25.1	90.8
1993/94	90.9	24.8	24.6	6.7	41.1
1994/95	61.6	15.7	22.3	5.7	39.2
1995/96	41.1	6.5	24	3.8	26.9

[1] The Early Warning Unit of the Ministry of Agriculture (1994) estimated that 23% of white maize produced for human consumption is marketed.

Source: See Table 1.1 for data, sources, and notes.

the GOM counterpart.[2] USAID has imported yellow maize for two reasons: 1) domestic US stock availability; and 2) desire to choose a commodity that is self-targeting for low income consumers. In view of domestic maize production shortfalls and the importance of maize as a staple, the MICT requests yellow maize. The EU and other donors have brought additional commercial food aid imports of wheat and rice, but in lower quantities.

When requesting commercial food aid, MICT indicates the quantities and the markets for which maize is needed. Maputo, the capital and the largest urban market with over one million inhabitants is high on the list of priorities, but Beira and Nacala are also port cities that receive commercial yellow maize food aid directly. This research focuses on Maputo since it is the largest consumption market in the country, receives the largest shipments, and thus if food aid does have an effect, it will be strongest in these markets.

The GOM requests specific amounts of yellow maize commercial food aid, corresponding to the anticipated excess demand over domestic production and imports, as well as the need for funds. There is no formula used in the calculation, just rough assessments on supplies and needs. The commercial trade sector has not been involved in the decisions on quantities to import and prices, although during the planning period in 1995, MICT held meetings with donors and consignees in order to get information, ideas, and concerns regarding commercial food aid for the October 1995 - March 1996 period.

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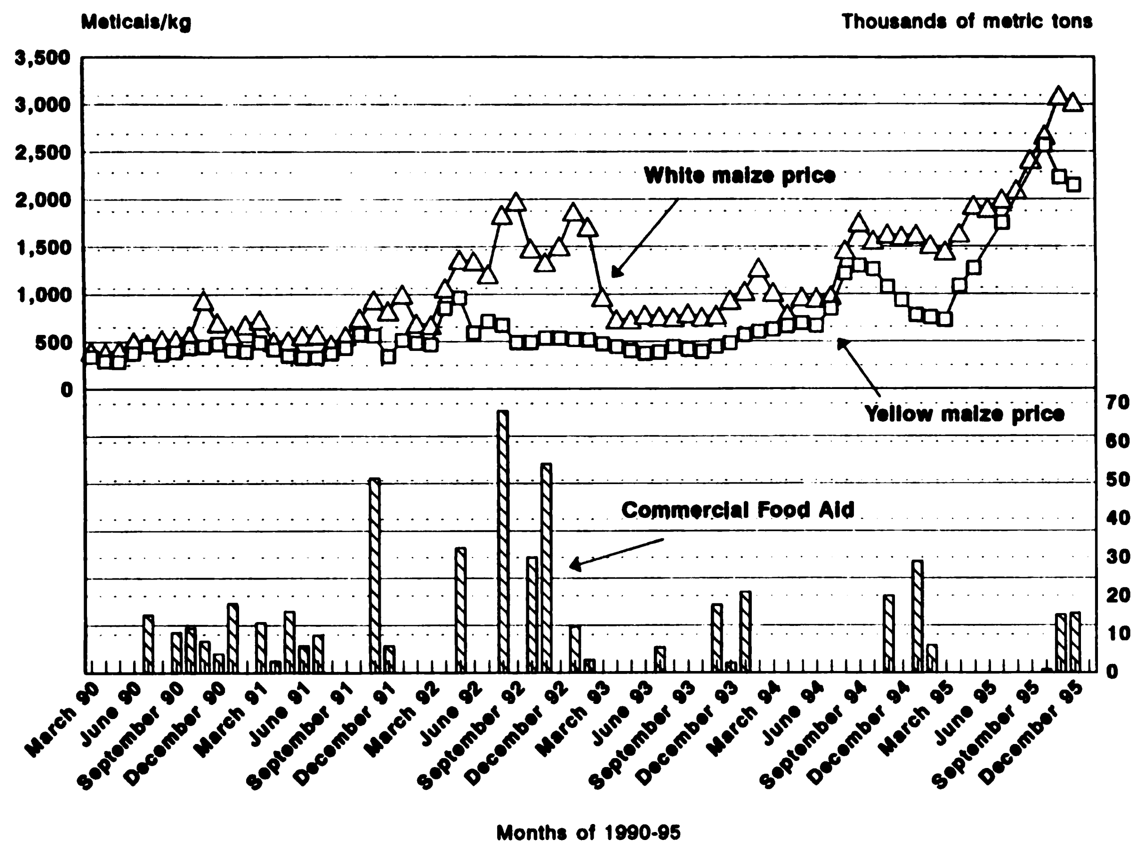
[2] The EU also imports white maize from international markets or from regional markets, however they brought in yellow maize during the drought.

In order to reduce the per unit transport and handling costs, USAID and other donors request shipments in large lots, 10,000 to 25,000 metric tons. Because of the proceeds from monetization, MICT has strong incentives to immediately sell all supplies upon arrival. Likewise, MICT stores the unsold quantities of maize in government warehouses or commercial warehouses at government expense, with high risk of losses through theft, mishandling, and deterioration.

The release of large quantities in a short period of time has obvious effects upon the prices in the markets. Figure 4.1 gives the monthly average retail price of yellow maize and the monthly total commercial food aid yellow maize deliveries in Maputo for April 1990 through November 1995. There are several periods of interest indicated on the figure. In November-December of 1991, a large shipments arrived in Maputo and prices for yellow maize grain decreased, even as white maize supplies were diminishing with the approaching hungry season, and the same happened in November 1994. In late 1992 and early 1993, a series of large shipments resulted in retail yellow maize prices decreasing once again during the hungry season and remaining low over almost a year. In each case, white maize was a scarce commodity, so only yellow maize own supply can explain the downward pressure on supply. Demand factors could also be responsible, but there are no know major demand shifters during the periods being discussed. Tschirley, Donovan, and Weber (1996) conducted initial analysis of the effects of food aid arrivals on the retail

Thousands of metric tons

Meticais/kg



Source: MAP/MSU SIMA dataset.

Figure 4.1. Maputo monthly yellow maize food deliveries and nominal yellow and white maize grain retail price, December 1992 - November 1995

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yellow maize prices in Maputo, analysis that will be extended in the empirical chapters of this dissertation.

4.1.2 Consignees and food aid allocations

"Consignees" is the word used to designate the private traders and parastatals who receive allocations of commercial food aid stocks for market sales. Originally, parastatal marketing agencies and industrial mills (including CIM) received the yellow maize grain either for direct sales in government ration shops or for milling and later distribution through the ration shops. After a 1991 assessment report (Louis Berger, International 1991) presenting evidence of the poor payment performance of the parastatals, USAID pressured for private traders to be authorized to receive and market the commercial food aid stocks. This also accorded with USAID policy reform efforts to reduce the role of government in the markets.

The wholesale traders who are consignees are often engaged in various activities: import of foodstuffs such as rice and wheat flour; purchase and resale of domestic agricultural products including white maize, rice, and cashews; milling of maize and wheat grain; and export of agricultural goods, particularly cashews, tobacco, and seafood.

The GOM has a set of criteria to determine which traders are eligible to purchase yellow maize stocks. Among the qualifications are ownership of warehouse facilities, access to means of transport, adequate liquidity, and good standing on payments for previous shipments (Austral 1992). USAID has pressured for the number of consignees to be expanded such that collusion is avoided in the markets. The EU experience based on only two consignees for a yellow maize shipment of 15,000 in 1992 demonstrates the potential for the exercise of market power in the Mozambican markets. In that case, detailed in MOA/MSU Working Paper #10 (1993), one of the consignees controlled sales to the market in order to maintain higher prices. Only when the next USAID shipment was about to arrive did the warehouse doors open for further sales. Since 1993, MICT has designated at least 18 consignees for each USAID shipment, avoiding that problem.

Increasing the number of consignees to receive maize at the port and diminishing the amount received by individual traders resulted in new problems at the port, with possible delays in unloading shipments. Every day that the ship is docked is costly, and so GOM and the donors want the ships unloaded rapidly and the delivery to consignees completed as quickly as possible. Procedures were modified, such that large scale traders were allowed at the port directly and the smaller scale consignees with less than 1,000 metric tons, went to warehouses to obtain their allotments, thereby reducing pressure at the port. However, thefts from port warehouses in December 1995 and January 1996 are putting this system (and the entire Title III program) in jeopardy.

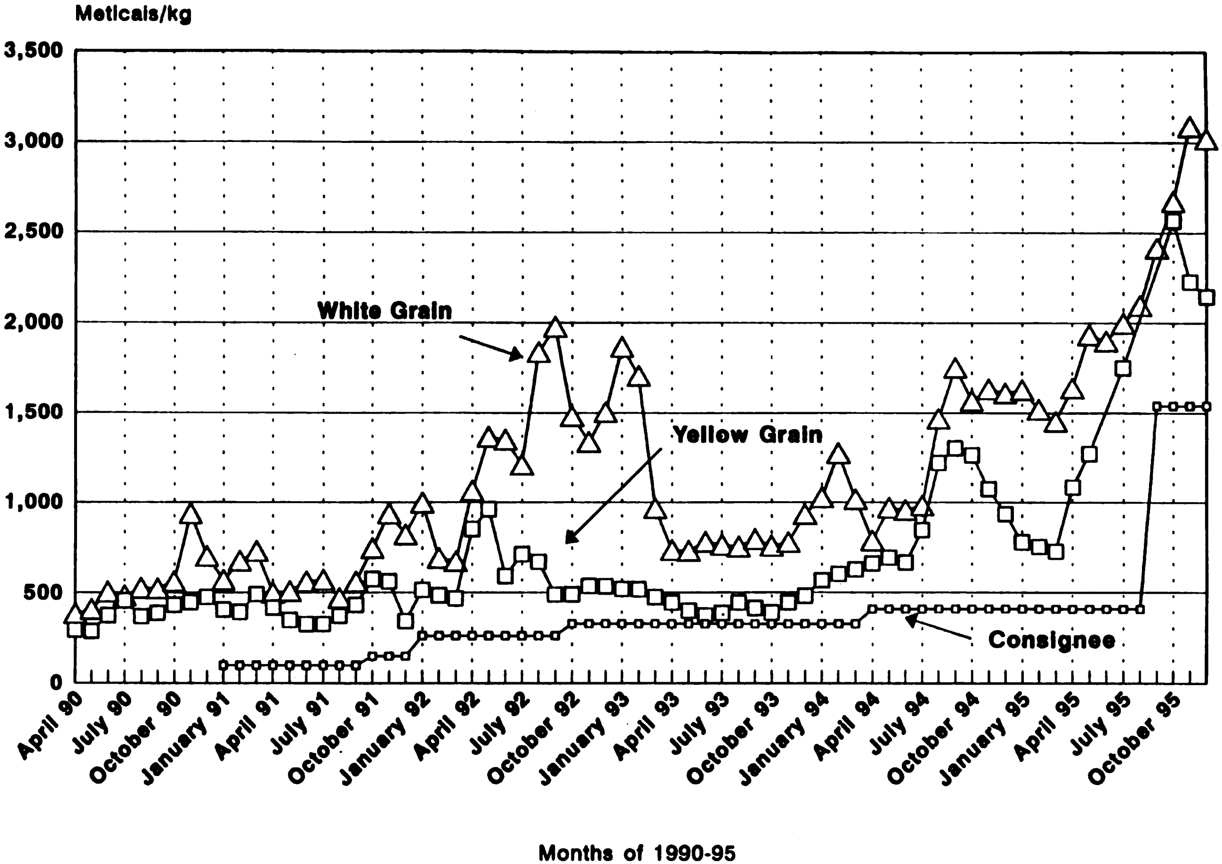
One of the other benefits of selling yellow maize directly to private traders has been the development of a small-scale milling sector (MOA/MSU Working Paper #10, 1993; MOA/MSU Working Paper #20, 1995). With the industrial mills in crisis and no longer receiving special concessions for the yellow maize, the informal traders and urban households took maize directly to local small hammer mills for grinding into a low cost, straight-run meal. Generating income and employment, the local hammer mills are now beginning to appear in towns and villages throughout the country.

4.2 Pricing of commercial food aid

The Title III Food for Peace Program of USAID is specifically designed to provide commodities for commercial sale by the receiving government, which then uses the funds generated for development purposes. The price paid by the consignees to the government is determined by the GOM, through its National Salaries and Prices Commission on the basis of recommendations from MICT; the donors make recommendations only. Regardless of the consignee price set by the government, USAID regulations state that the value (in FAS prices) be deposited by the government of Mozambique for development funds. Figure 4.2 shows the nominal consignee price, along with retail market prices in Maputo. Donors have recommended prices close to the free-alongside-ship (FAS) price.[3] The USAID regulations state that the equivalent value for the FAS price be covered in counterpart funds, regardless of the revenues generated by the government sales.

Consignees are charged a fixed metical/kg rate, and generally prices have not changed during the distribution of a given shipment, except when quality changes necessitate lowering the price. Prior to 1993, the government set a fixed resale price at which

[3] The FAS price is the price for the commodity placed at the ship in the Gulf Ports, in the case of US maize. It does not include the transcontinental shipping costs, the port handling costs, or any of the other additional costs that are in the import parity price, and so FAS is below the import parity price.



Source: MOA/MSU SIMA database, Ministry of Agriculture and Fisheries, Maputo.
Retail and official prices are nominal meticias/kg.

Figure 4.2. Maputo white and yellow maize grain retail prices and official consignee prices (nominal meticais/kg), April 1990 - December 1995

consignees could sell the food aid maize. However, since early 1993, traders have been permitted to sell the yellow maize on the market at the market prices.

The low consignee prices do not necessarily result in lower consumer prices. Tschirley, Donovan and Weber (1996) provide the analysis to show how low consignee prices may result in high rents that are captured by consignees rather than by lower prices for consumers. In a quantity constrained system, demand determines the prices in the market, so that as long as the price to consignees is below the market price by a "reasonable" margin, lowering the consignee price even lower makes no change in consumer price.

As Figure 4.2 indicates, the consignee prices are changed infrequently, usually just once each year with the first arrival for that marketing year's hungry season, between September and December. During 1991 and 1992, MICT offered the mills offered a price discount and longer payment periods than traders for food aid maize. The prices on Figure 4.2 do not reflect this price discount; the private trader price is shown. Since 1993, all receivers have been given the same conditions.

Prices have been lowered on a few shipments due to quality problems, some of which was sold at low prices to animal feed agents.[4] The arrival of damaged maize has caused difficulties with planning the allocations to consignees. In 1991 and 1992, MICT sold the shipments immediately to parastatals and wholesale traders, according to the allocations

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[4] The prices in Figure 4.2 do not reflect either the millers' discount as mentioned above, or the discounted price for animal feed agents of the deteriorated maize sold in 1993.

that had been pre-determined. In late 1992 and early 1993, with famine threatening, large quantities of both emergency and commercial food aid arrived, as can be seen in Figure 4.2. Some of the maize was in poor condition, and the consignees would not accept their allotments. The larger consignees, such as Ignacio de Sousa, Capela, and EURAGEL, evaluated the quality before accepting full consignments, because they intended to store the maize and sell gradually over the hungry season. Because the consignees did not accept delivery of their allotments, GOM had to store the deteriorating stocks of those 1993 shipments in grain warehouses. As shown in Figure 4.2, yellow maize grain retail prices in mid-1993 were close to the consignee price. For example, in June 1993, the consignee prices were 329 meticais/kg (and had been since October 1992) while the average monthly 1993 retail price was 374 meticais/kg, only 14 percent higher.

For the consignees, the relationship between quantities and prices determines the quantities that they will accept from food aid shipments. In a 1995 meeting between MICT, USAID, and consignees, the consignees would not address the issue of a consignee price level until information was released on quantities and dates for both commercial and emergency food aid arrivals and distribution.

4.3 Food aid in the markets

4.3.1 Agents and channels in the Maputo markets

In contrast with the white maize markets, there is active trade between the formal and informal sectors in the yellow maize markets. The formal sector consignees receive allotments of yellow maize which they pick up at the port or warehouses and then store or immediately sell. Both formal and informal sector redistribution wholesalers arrive at the traders' warehouses to purchase sacks of the grain (MOA/MSU WP#10, 1993) at the market prices, as indicated above.

There is little delay between the arrival of ship in port and the arrival of the yellow maize in the informal markets. In fact, trucks often leave directly from the port to go to Bazuka and other markets in Maputo. In 1993, "paper trading" developed.[5] This trading enabled consignees to sell part of their allotment before it arrived in the port to a trader who was authorized via a paper receipt to pick the maize up from the port directly, as a "representative" of the consignee. While not legally condoned, officials did not take action against it. It results in very fast delivery of yellow maize to the markets. In July of 1993, a USAID shipment began unloading at the Maputo port at 6:00 a.m. MOA/MSU researchers observed the first bags of that shipment arriving in Bazuka market by 10:00 a.m. on the same day.

Informal traders work in the markets in Maputo and other towns in the southern zone. They sell the maize in 50 kilogram bags, usually still in grain form, but a few traders take the maize to local hammer mills for grinding and then sell bags of the flour. The retail traders in the marketplaces then buy the bags of grain or flour to break down into smaller nonstandard units for sale. The informal retail and wholesale traders for yellow maize

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[5] Paper trading is described in greater detail in MOA/MSU WP#10, 1993.

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work side by side with the white maize traders in the marketplaces (MOA/MSU Working Paper #10, 1993).

<u>4.3.2 Agents and channels in other markets</u>

Traders of yellow maize work in many markets throughout Mozambique, either with commercial food aid or with leaked emergency food aid, as will be discussed further below. Wholesalers from urban areas in the south, including Xai Xai, Maxixe, and Inhambane, are on the list of consignees and take supplies from the port directly to the other cities, although if Maputo prices are high, the bags may never leave Maputo. In other cases, buses and trucks will leave the area around Bazuka market loaded with sacks of sugar and yellow maize for sales in those areas. In Maxixe, SIMA enumerators reported that yellow maize grain was present in the local market in 92 out of the 147 weeks of observations (63 percent) from December 1992 through November 1995.

In the production areas of the center region, SIMA enumerators reported no yellow maize grain present in the market in Chimoio 72 percent of the time (106 out of 147 weeks) in the January 1992 to November 1995 period. Further north in Nampula City, SIMA enumerators reported yellow maize absent in 92 percent of the weeks with recorded data (136 out of 148 weeks). There were scarcities in Maputo, particularly during 1995, when there was no yellow maize grain observed in the Maputo markets between July 22 and October 7. Over the entire 1992 - 1995 period, however, SIMA enumerators reported no yello

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yellow maize grain on the Maputo market in only 17 percent (26 out of 153 weeks) of the weeks recorded.[6]

The absence of yellow maize in the regional markets is a consequence of high transport and other transaction costs relative to the prices in Maputo and the prices of the substitute white maize. The price margins between wholesale in Maputo and retail in Chimoio may have been too narrow, resulting in an efficient no-trade equilibrium. In addition, as noted in Chapter 3, demand in the regional markets is weak while supplies of white maize are relatively abundant. The result is little yellow maize actually moving from urban port regions to more distant towns. The issue of market integration will be discussed in Chapter 9.

4.3.3 Competitiveness in the markets

Tschirley et al. (1996) present evidence supporting the hypothesis of competitive markets for yellow maize, at least in Maputo. USAID requested that MICT expand the number of possible consignees in 1992 in order to avoid market concentration issues, and since then shipments have been at least 18 consignees per shipment. Tschirley et al. (1996) determined that the four firm concentration ratio for the seven shipments between August 1992 and January 1993 was 28 percent, an indication of lack of concentration. Recently, MICT personnel have been more concerned about excessive numbers of consignees,

[6] For comparison, from January 1992 to November 1995, SIMA enumerators reported white maize grain absent from the Chimoio, Nampula, and Maputo markets for 2 percent, 1 percent, and 1 percent of the weeks, respectively.

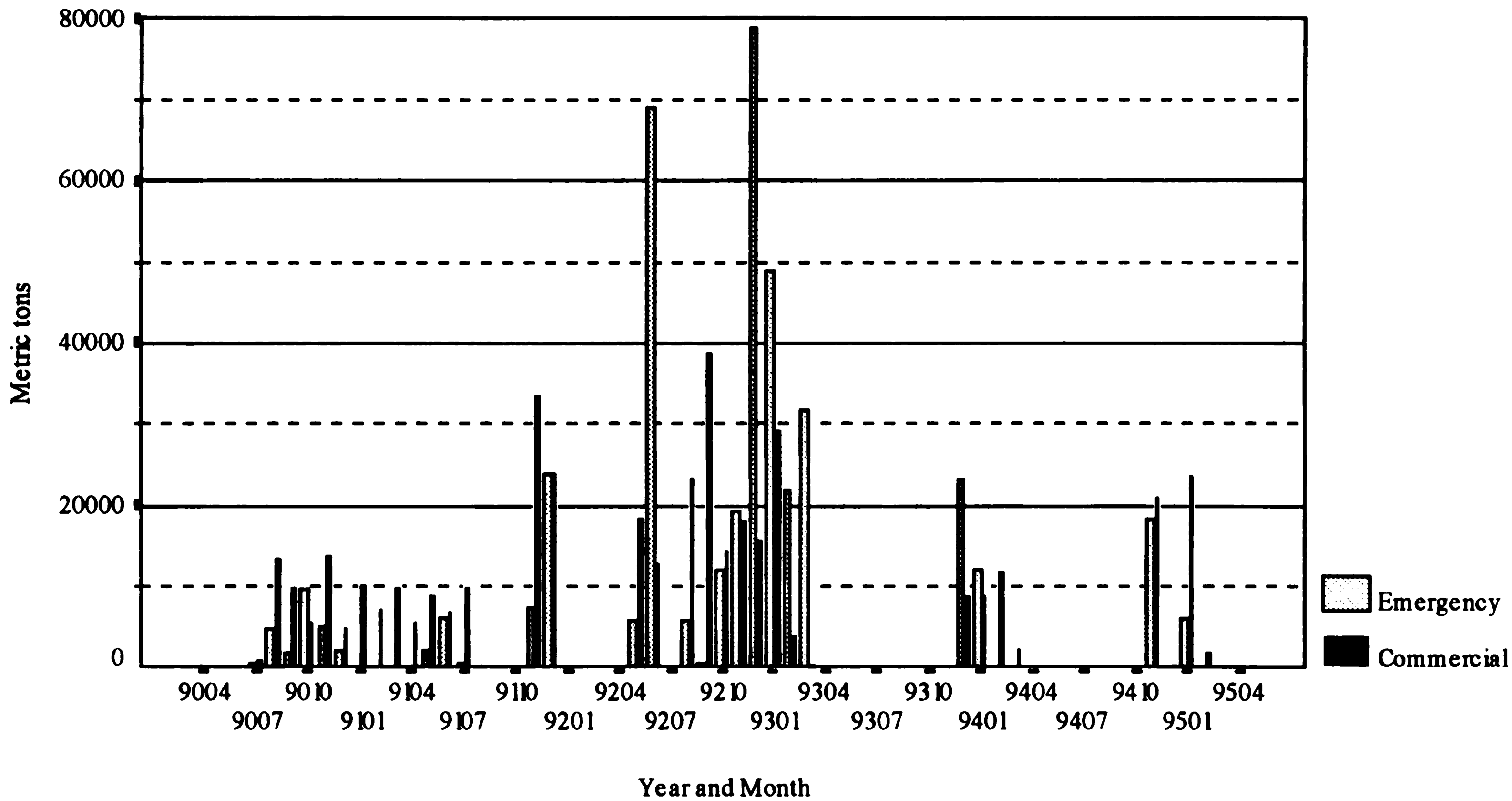
resulting in problems with certification and unqualified traders causing delays in the delivery of 1995 shipments.

4.3.3 Potential diversion to animal feed

In other countries, people have diverted food aid supplies from human consumption into animal rations, particularly when poultry, swine, and beef industries are willing and able to pay more than poor consumers. In Mozambique, the war decimated small animal husbandry, such that this problem has not arisen in any large scale. There were sales in 1993 and 1994 of deteriorated maize grain to those industries. Examiners for MICT declared the yellow maize grain "unfit for human consumption" and so it was sold at a reduced price to traders and small animal producers, particularly in the poultry industry. It is possible that some of these supplies made their way to the human food chain. However, the deterioration of the grain was perceptible both to the eyes and the nose, lessening the likelihood that large quantities were bought and sold for human consumption.

4.4 Emergency yellow maize food aid in the markets

As Figure 4.3 indicates, large volumes of emergency yellow maize food aid also arrived in Mozambique during the 1989 to 1996 period, particularly during late 1992 and early 1993. There are two basic ways in which emergency food aid enters the market. First it may be stolen from ports, warehouses, or railcars before it ever reaches the targeted receivers or distribution point. Prior to 1993, knowledgable sources indicate that up to one-third of emergency supplies were leaked this way. MOA/MSU researchers identified some emergency supplies in the Maputo markets in 1992. Changes in administration and



Source: MAP/MSU Food Aid dataset

Excludes arrivals to government warehouses and animal feed agents.

Figure 4.3. Monthly food aid deliveries in Maputo, March 1990 - April 1995

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transport lowered these percentages. Nevertheless, these leaked quantities exert downward pressure on prices in Maputo. Alternatively, recipients of emergency food aid may sell the food they receive in order to purchase other articles or services. The GOM and non-governmental organizations targetted internally displaced persons, returning refugees, and demobilized soldiers for emergency relief. Most of these populations were in rural areas or in the smaller urban zones of the center and north such that supplies sold by them are unlikely to have affected Maputo markets.

4.5 Summary of yellow maize in the markets

Formal and informal traders have developed business relationships based upon the yellow maize commercial food aid deliveries, with the formal sector as wholesalers and the informal sector the middlemen and women, as well as the retailers. This is in contrast to the dual marketing channels in domestic white maize marketing, with the formal sector serving the public sector needs and the informal sector serving the urban consumers.

GOM sets the consignee prices at levels below the FAS and much below the retail market prices. By involving at least 18 consignees with each shipment, MICT helps to ensure that prices to be charged are established through competition, rather than collusion. Nevertheless, there are substantial rents to be obtained by the consignees due to the limited quantities. At the retail level, traders of white and yellow maize work in close proximity in the markets, providing a competitive environment.

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When MICT delivers the maize to consignees at the port of Maputo, traders immediately begin taking supplies to the local markets for sale. The effects of the deliveries in the Maputo and Beira markets can be almost immediate. This research uses the weekly SIMA data in an effort to capture some of the rapid prices movements.

USAID and other donors bring in yellow maize in order to provide government budget subsidies and to help temper consumer price spikes for the basic staple of low income urban consumers. That the yellow maize arrivals dampen yellow maize prices can be seen in the price graphs. Since the government has strong incentives delivery all the maize as quickly as possible to avoid losses in storage, large quantities are released onto the market. These shocks of yellow maize food aid deliveries will be further analyzed in the empirical chapters to follow.

The lack of yellow maize products on the market has important implications for any white maize price declines on these markets. Emergency yellow maize supplies are not leaking onto these markets in large amounts and traders do not bring large quantities of yellow maize commercial food aid supplies to the production regions. Thus, if there is an effect of yellow maize food aid on white maize prices, it does not come from yellow maize supplies introduced directly in those rural markets. This points to the need to assess how food aid affects the white maize prices in the main consumer markets and how those consumer prices then affect the prices in producing regions.

Chapter 5

Data and Preliminary Analysis

5.1 Introduction

This chapter explores the data characteristics and identifies a structural break in the data which separates the sample into a war/drought period and a post-war/drought period. Unit root and stationarity tests confirm that the data do not have stochastic trends, once potential mean and trend shifts are incorporated into the analysis.

5.2 Data sources

Data series were constructed from several different sources. Both white and yellow maize prices were collected at the retail level in urban marketplaces in Maputo. From April 1990 through December 1992, retail prices in Maputo were collected by USAID in Mucoriama market on Saturday mornings, with a single purchase of each product.[1] The commodity is then weighed and the price converted to a standard per kilogram price. The price data from January 1993 through April 1995 were collected by SIMA in the Xipamanine market in Maputo. Each week on Saturdays, enumerators visited Xipamanine and other Maputo

[1] As in many markets in developing countries, commodities are sold to consumers in nonstandard units. In Maputo, the most common unit for retail maize sales is the used 850 milliliter infant formula can, which is filled for the customer and then the contents emptied into plastic sacks or paper. There are very few scales in the markets, so sales are not based upon volume, not weight.

markets to collect three observations on each product for retail and wholesale market levels. To calculate the per kilogram price for retail sales, the quantity of the nonstandard unit was measured by volume in a plastic beaker, and then the per kilogram price was calculated using calculated conversion ratios for each product.

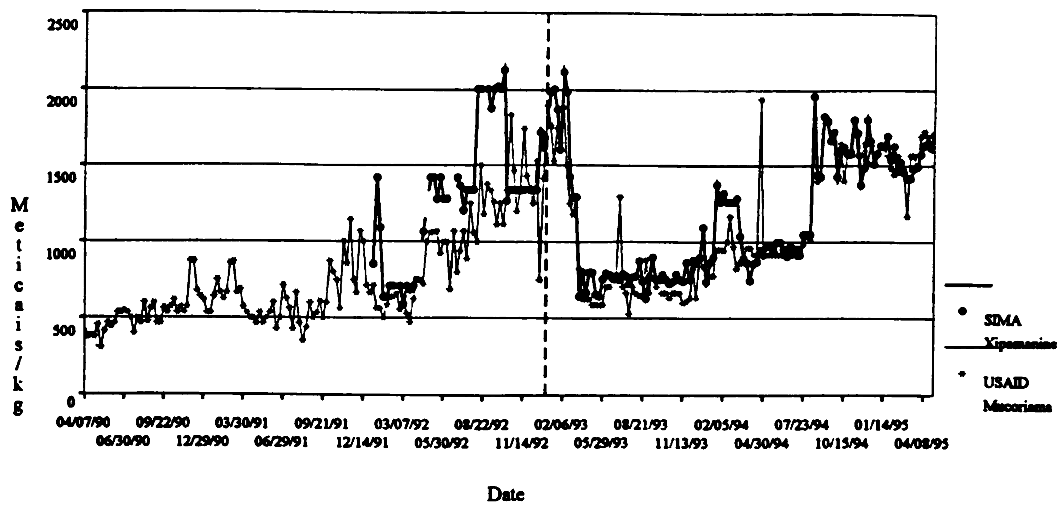
Both Mucoriama and Xipamanine are markets are active in retail maize trade and serve low-income clientele. The USAID/Mucoriama data begin in 1990, whereas the SIMA/Xipamanine data collection for basic staples began collection in 1991, adding grain price collection in late 1992. Figure 5.1 shows the close relationship between the SIMA and USAID data. The SIMA sampling and measuring methodology is more accurate than the single sample of the USAID data, and the SIMA enumerators have extensive training on quality differentiation, thus the SIMA data may be of higher quality. Rather than lose the information for the early period, the two sets were merged with January 1993 chosen as the switching date.

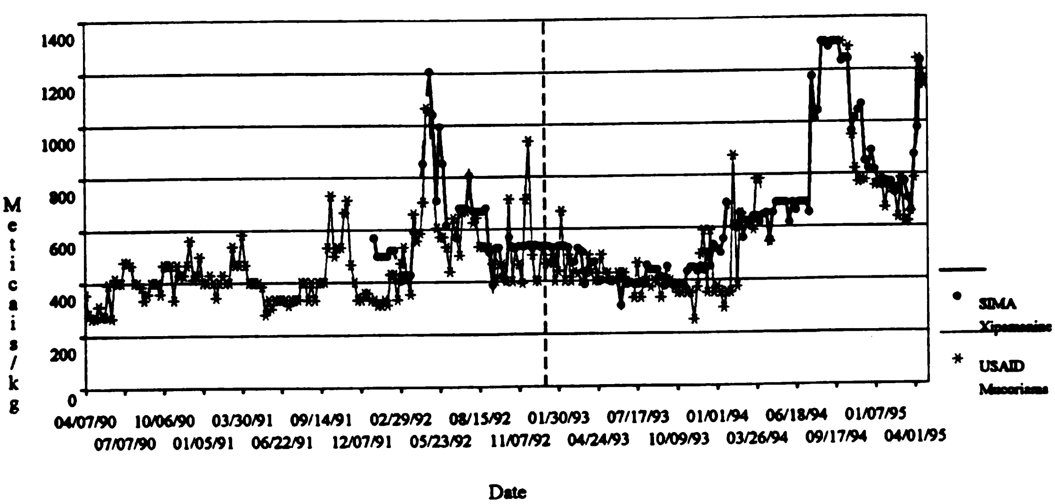
During the 265 week period from April 7, 1990 through April 31, 1995, there were 14 missing values in the white price series and 17 missing values for the yellow price series. Those values were replaced by the mean of the values for the week before and the week after the missing week.

Weekly commercial food aid data set were constructed from data sets and information provided by donors, the Ministry of Finance, Ministry of Industry, Commerce, and Tourism (MICT), World Food Programme, and non-governmental organizations active in

Mozambique. Although a database is being maintained by the MICT in Mozambique for all food aid arrivals, there are gaps due to lack of funding for data collection and revisions. During 1992/93, it was particularly difficult to update the information because of large arrivals, swapping between commercial and emergency programs, variations in record keeping methods by the donors, and delays in shipping. For this analysis, daily off-loading data for commercial food aid were obtained from USAID and SOCOTEC, the firm responsible for overseeing the unloading and delivery of shipments. Detailed arrivals information was also obtained on EU arrivals. The USA and EU account for all of commercial food aid maize arrivals in Mozambique during the study period.

Weekly data are based on the actual delivery of maize into the hands of commercial agents. The numbers may not agree with official USAID or GOM statistics because only commercial sector deliveries are included in the data. If the maize arrived and entered a government warehouse, it would not be included until it is delivered out of the warehouse. Parastatals such as the Empresa de Abastecimento da Cidade de Maputo (Maputo Wholesale Supply Firm, known as EACM) are considered commercial sector agents and are included. During late 1993 and early 1994, some of the yellow maize in stocks deteriorated so badly it was deemed unfit for human consumption and subsequently sold to animal feed operations. Those deliveries were also excluded from the data set on the belief that the inferior maize did not enter the market for human consumption due to its obvious deteriorated state. Losses from the warehouses due to theft are also not included in the food aid deliveries data.





Source: USAID dataset and SIMA dataset.

Note: Dashed line indicates Jan.2, 1993. Spaces indicate missing cases.

Figure 5.1 SIMA and USAID maize grain retail prices, April 1990 - April 1995

The Consumer Price Index (CPI) data were obtained from GOM. The CPI is estimated on a monthly basis, so conversion to a weekly series was needed. Linear interpolation of the monthly CPI was used to fill in the missing weeks. Data were not available for March and April 1995 for the CPI and so linear trend values were estimated for those two months.

5.3 A structural shift in the data

Plots of the data and of their first differences (y_t - y_{t-1}) are presented in Figures 5.2 - 5.7. Inspection of the real maize price charts, there is an obvious shift in the price series. For yellow maize, a sustained downward shift began on November 28, 1992 with a high in real prices of 309 meticais/kg, rapidly reaching a low of 128 meticais/kg by December 12, 1992. This period coincides with the arrival of two large shipments of yellow maize commercial food aid: 1) the Lash Atlantic/Vitoria on Nov. 2 with 33,000 metric tons; and 2) the OMI Missouri/Argo Explorer on Nov. 12 with 21,250 metric tons. In addition, over 50,000 metric tons of yellow maize arrived through emergency programs before the end of December. These arrivals were scheduled to ensure supplies during the hungry season when domestic food supplies would be critically low due to crop failure in the 1991/92 cropping season.

For white maize prices, there was a structural break between February 6 and March 20, 1993. The average real white maize price on February 6 was 644 meticais/kg., but by March 20, 1993, the real price was down to 186 meticais/kg. This period marks the beginning of the first harvest and marketing after the drought, when forecasts of domestic production were high and regional production prospects were also good. Not only had production prospects improved, but the Peace Accords had been signed in late 1992 and travel within the country began to resume. Thus, domestic maize could more easily be transported from surplus to deficit areas. With all of the yellow maize available and good prospects for the domestic white maize crop, markets were no longer operating under severe supply constraints.

Maize prices are less volatile after the structural break. This is indicated by a reduction in the variance of real maize prices.[2] The simple sample variance of real yellow prices is 4.4 times greater in the war/drought period than in the post-war/drought period. For real white maize prices over the same periods, the sample variance in the earlier period is 9.4 times greater than in the later period.

Given the structural shifts in supplies and the shifts in the prices, the analysis was divided into two distinct periods, using February 1993 as the separation point. From April 1990 through February 1993, a combination of war and drought limited the domestic and regional supplies of white maize, as well as the internal transport of maize. From March 1993, weather conditions returned to more normal patterns and the Peace Accords were firmly in place. The month of March 1993 is left out of the analyses because it was a transition month in which maize market conditions shifted as both domestic and regional supplies began to reappear in the markets.

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[2] Tables 5.1 and 5.5 in the following sections report the sample variances along with other basic descriptive statistics.

5.4 Unit root and stationarity tests

The statistical properties of the variables are important in determining how multivariate time-series models should be specified and estimated. Various tests were implemented to evaluate whether or not each data series was stationary. Hamilton defines **stationarity** as follows:

> "If neither the mean μ_t nor the autocovariances γ_{jt} depend on the date *t*, then the process for Y_t is said to be *covariance-stationary* or *weakly stationary*.... Notice that if a process is covariance-stationary, the covariance between Y_t and Y_{t-j} depends only on *j*, the length of time separating the observations, and not on *t*, the date of the observation." (1994, p.45-46).

The term stationarity here will mean covariance stationarity, using Hamilton's definition. If a variable is stationary, we will say that it is integrated of order zero (I(0)), whereas if the variable is not stationary but its first differences are stationary, we will say that the variable is integrated of order one (I(1)).

5.4.1 Stationarity and unit roots

Stationarity of the data is necessary for the usual distribution theory to be used in hypothesis testing and estimation. In some cases, transformation of a variable into log form may be used to achieve stationarity or seasonal cycles may need to be removed. First differencing will also induce stationarity in I(1) series. Recent literature abounds in theoretical and empirical work on cointegration between I(1) series in which common stochastic trends can be determined to identify stationary linear combination of I(1) variables. Several tests are available to test for these properties, each with its advantages and disadvantages.

Dickey-Fuller tests were designed to test the null hypothesis that a series is I(1) against the alternative that it is I(0), (Hamilton 1994). The Augmented Dickey Fuller test (ADF) includes lagged first differences in the estimation to account for autocorrelation n the series. Rejection of the null hypothesis provides evidence that the series is stationary, i.e. distributed I(0). Hamilton (1994) provides a summary of the Dickey Fuller and Augmented Dickey Fuller tests, as well as Fuller's tables of critical values for the test statistics. However, these tests are not reliable if the data generating process includes moving average terms, if the residuals are heteroskedastic, or if there is remaining serial correlation in the residuals (Myers 1992).

Phillips and Perron (1988) developed additional tests that are more general than the ADF tests, appropriate when serial correlation and heteroskedasticity is present and allowing for drifts and trends in the series. The Phillips-Perron (PP) tests for unit roots are based upon three regressions, with test statistics for different null hypotheses on the coefficients for level and trend stationarity. A summary of the tests and tables of critical values for the test statistics can be found in Banerjee et al. (1993).

With the PP and ADF tests, there must be strong evidence against the null hypothesis, so these tests may have low power. For this reason, Kwiatkowski, Phillips, Schmidt, and Shin (1992) have developed tests that have stationarity as the null hypothesis. The number of lags chosen is important because increasing the number of lags results in decreasing the power of the tests, while helping to correct for autocorrelation. Therefore, the choice of how many lags to include must be balanced with the number of observations and the resulting power of the tests.

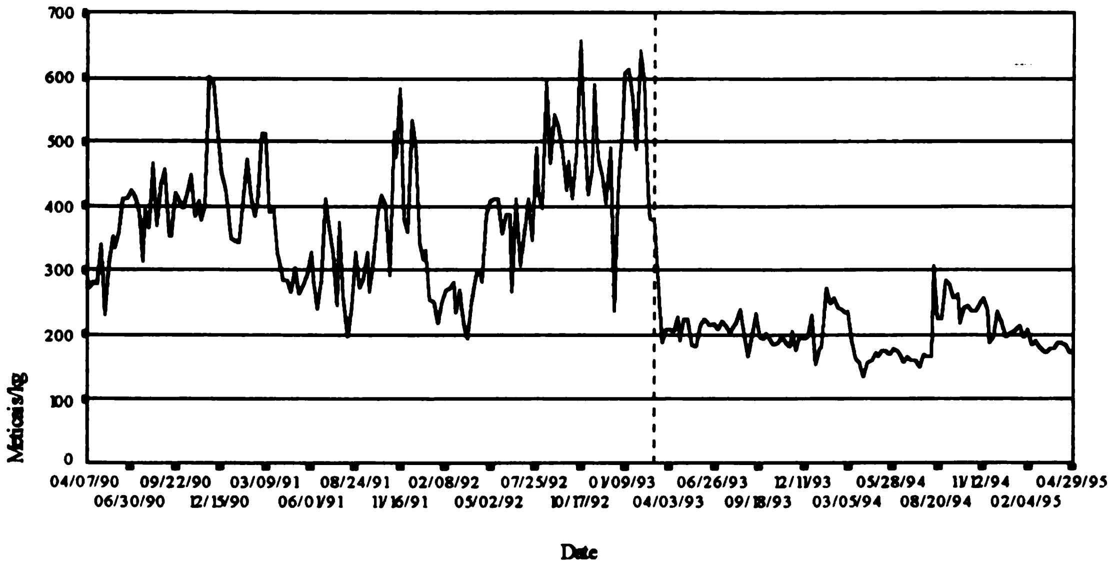
5.5 Unit root and stationarity tests in the initial war/drought period

Table 5.1 gives the descriptive statistics for real white maize prices, real yellow maize prices, and quantity of food aid deliveries over the initial war/drought period. Figures 5.3 - 5.8 show the data and first differences, with a vertical dotted line to indicate the end of the war/drought period. Results of the ADF tests, PP tests, and KPSS tests are reported in Tables 5.2, 5.3, and 5.4, respectively.

Table 5.1 Descriptive statistics of war/drought period

Statistic	Real White Price (meticais/kg)	Real Yellow Price (meticais/kg)	Food aid quantity (metric tons)
Mean	384.30	234.04	2,276.30
Standard Deviation	102.08	66.38	3,738.17
Variance	10,420	4,406	13,973,915
Median	386.19	222.30	0.00
Maximum	658.71	413.92	21,660.00
Minimum	191.19	126.50	0.00
Skewness	0.48**	0.49**	2.02***
Kurtosis	-0.21	-0.51	4.77***

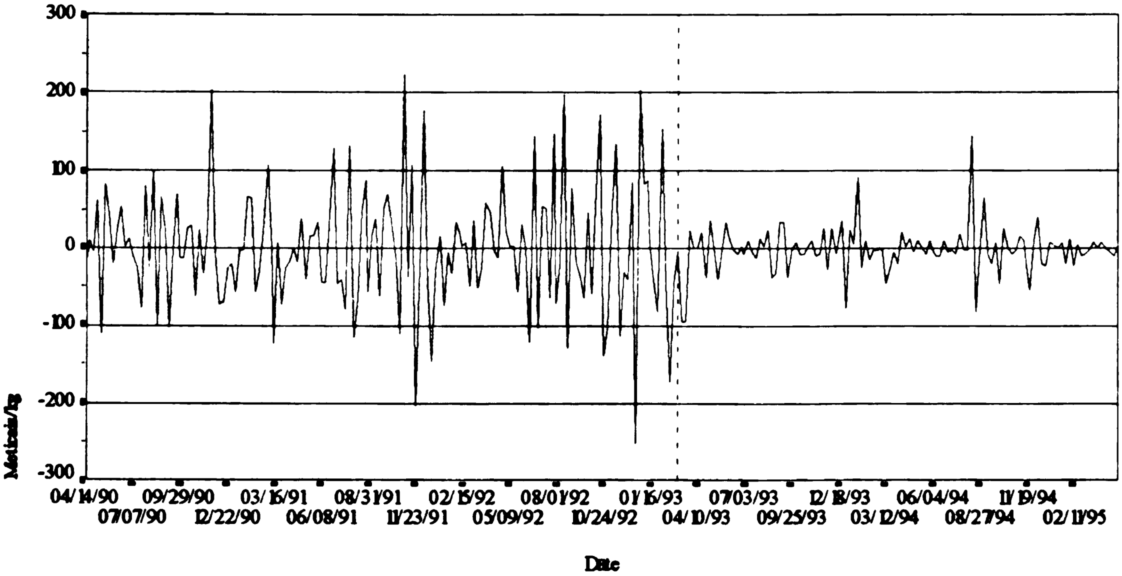
* indicates significance level of 10%
** indicates significance level of 5%
*** indicates significance level of 1%



Source: SIMA dataset

Note: Dotted line indicates end of war/drought period.

Figure 5.3 Real white maize prices, April 1990 - April 1995



Source: SIMA dataset

Note: Dotted line shows end of war/drought period.

Figure 5.4 First differences: Real white maize prices, April 1990 - April 1995

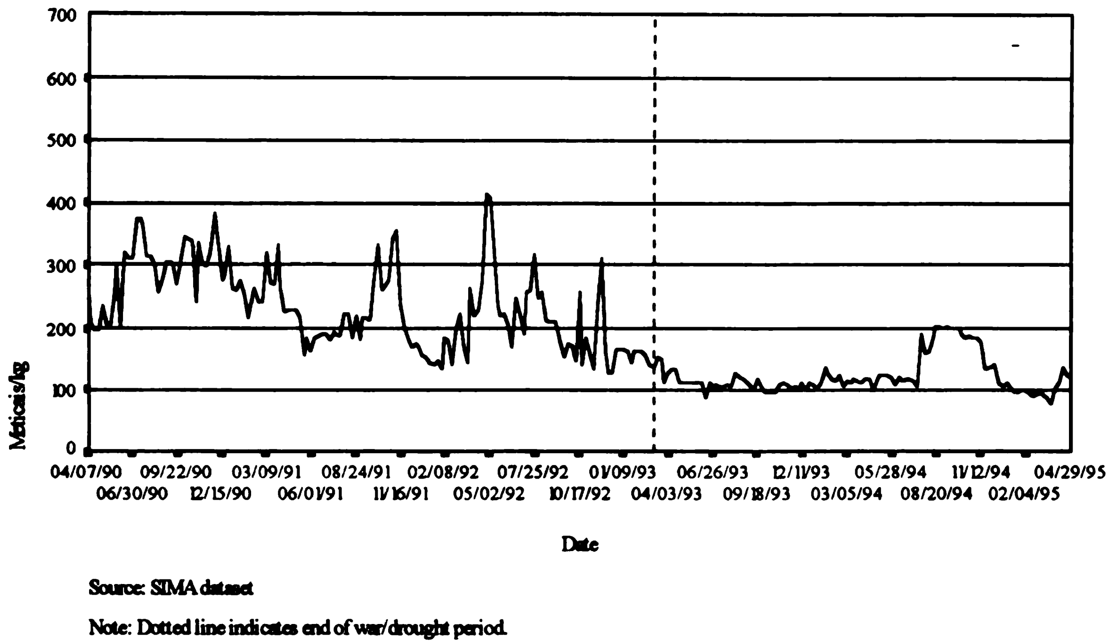


Figure 5.5 Real yellow maize prices, April 1990 - April 1995

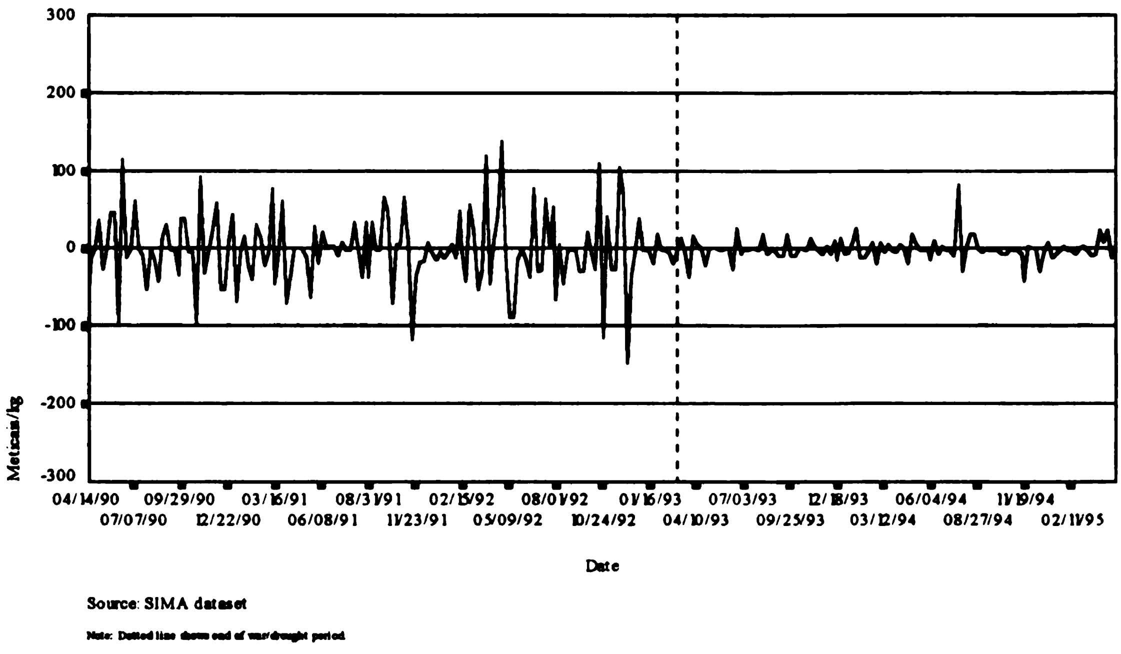
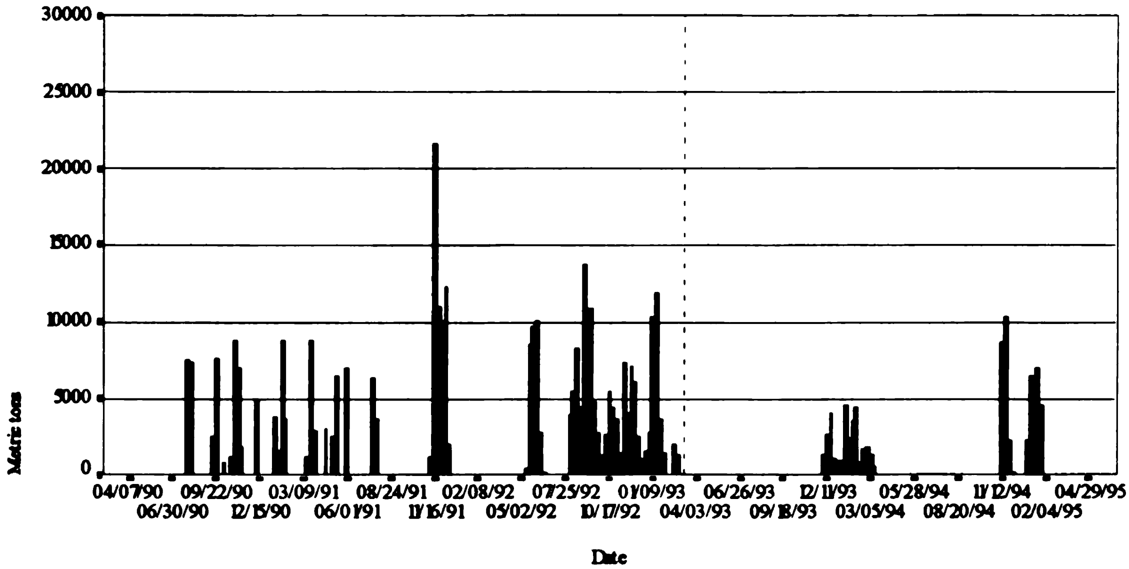


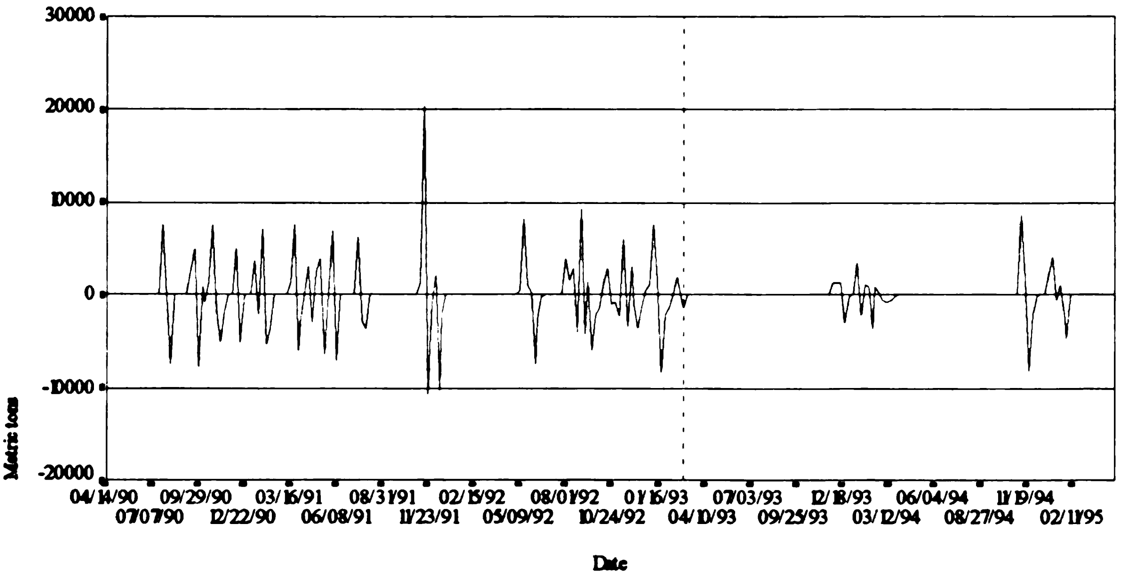
Figure 5.6 First differences: Real yellow maize prices, April 1990 - April 1995



Source: SIMA dataset

Note: Dotted line indicates end of war/drought period.

Figure 5.7 Yellow maize commercial food aid deliveries to Maputo, April 1990-April 1995



Source: SIMA dataset

Note: Dotted line shows end of war/drought period.

Figure 5.8 First differences: Yellow maize commercial food aid, April 1990-April 1995

Table 5.2 Augmented Dickey Fuller (ADF) t-tests for war/drought period

Test	White price	Yellow price	Food aid quantity
ADF: no trend	-3.28**	-2.81*	-5.61***
ADF: trend	-3.37*	-3.91**	-5.92***
Lags	2	2	2

* indicates significance level of 10%
** indicates significance level of 5%
*** indicates significance level of 1%

Note: Significance levels using critical values found in Hamilton 1994.

Table 5.3 Phillips Perron test results for the level series for war/drought period

Test statistic	White price	Yellow price	Food aid quantity
Z(phi_2)	7.38***	7.24***	15.26***
Z(phi_3)	11.06***	10.80***	22.89***
Z(t_ alpha~)	-4.09***	-4.19***	-6.24***
Z(phi_1)	10.13***	6.12***	20.67***
Z(t alpha*)	-3.76***	-3.13**	-5.31***
Z(t alpha^)	-0.66	-1.05	-4.15***
NW lags	4	4	4

* indicates significance level of 10%
** indicates significance level of 5%
*** indicates significance level of 1%

Note: Significance level determined according to Banerjee et al. 1993.

Table 5.4 KPSS tests for war/drought period

Trend/ no trend	Lags	White price	Yellow price	Food aid quantity
No trend	0	1.81***	4.38***	1.01***
No trend	2	0.79***	1.81***	0.54**
No trend	4	0.53**	1.21***	0.46*
No trend	8	0.36*	0.81***	0.43*
With trend	0	1.03***	0.27***	0.10
With trend	2	0.46***	0.12**	0.06
With trend	4	0.31***	0.10	0.05
With trend	8	0.21**	0.07	0.05

* indicates significance level of 10%
** indicates significance level of 5%
*** indicates significance level of 1%

Note: Significance level as determined by Kwiatkowski, et al. 1992.

For white maize prices over the initial war/drought period, the ADF tests rejected the null hypothesis of a unit root at the 0.10 significance level when two lags are included with a trend. Without a trend, ADF tests were rejected at the 0.05 significance level with two lags included. The PP tests were rejected at the 0.01 significance level with two Newey-West lags included. These tests provided evidence of weak trend stationarity. The KPSS tests rejected stationarity around a mean or a trend at the 0.10 significance level or better when up to 8 lags were included.[3] We conclude that these data are weakly stationary around a trend in the initial war/drought period.

With the yellow maize prices, the unit root tests all indicated that this is a trend stationary series. The ADF tests rejected the null with from 0 to 4 lags included, both with and without the trend component. The PP tests provided strong evidence against the null hypothesis of a unit root with the lag truncation at 4 lags. With the KPSS tests, the test statistic failed to reject at the 0.10 significance level or lower with 4 or more lags and a trend included. Thus, we find that real yellow maize prices are trend stationary as well.

Figure 5.7 shows the bar graphs of the deliveries. A week of very high deliveries in November 1992 resulted when two ships were simultaneously off-loading bulk maize. In general, the port capacity limited the weekly deliveries to less than 10,000 metric tons. In testing the food aid deliveries, the ADF and PP unit root tests reject the null hypothesis of

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[3] As Kwiatkowski et al. (1992) state regarding rejection of both hypotheses (stationarity and nonstationarity), "it is not clear what to conclude" (p.175).

a unit root. The KPSS tests failed to reject the null hypothesis of trend stationarity, at the 0.10 significance level, with one or more lags included.

5.6 Unit root and stationarity tests for the post-war/drought period

5.6.1 Introduction

The data for the post-war/drought period are presented in Figures 5.3, 5.5, and 5.7, shown with the earlier period as well. An examination of the figures of real prices and food aid deliveries and their first differences clearly shows that changes have been dramatic. Table 5.5 details descriptive statistics for each series in this later recovery period. Comparing Tables 5.5 and 5.1, the sample means of all three series have declined along with their variances. Nevertheless, the mean white price is 63 percent higher than the mean yellow price in this period, quite close to the 64 percent margin in the war/drought period.

5.6.2 White maize prices and food aid deliveries

For both the white maize prices and the food aid deliveries, unit root tests provide evidence of stationarity around a trend, although the test results are weak for the white maize price series (Tables 5.6- 5.8). ADF tests results, reported in Table 5.6, were stronger for stationarity around a mean rather than around a trend. However, the PP tests of white maize prices rejected the null hypothesis of a unit root at the 0.01 significance level, with four Newey-West lags included, both with and without trend terms included. The KPSS tests failed to reject to null hypothesis of stationarity when four or more lags were included with a trend.

Table 5.6 Descriptive statistics for post-war/drought period

Statistic	Real White Price (meticais/kg)	Real Yellow Price (meticais/kg)	Food aid quantity (metric tons)
Mean	201.72	123.52	733.86
Standard Deviation	32.99	31.21	1,867.42
Variance	1088.00	974.00	3487257.00
Median	196.69	113.04	0.00
Maximum	306.70	204.46	10,414.35
Minimum	135.32	78.63	0.00
Skewness	0.64***	1.48***	3.16***
Kurtosis	0.18	1.17**	10.50***

* indicates significance level of 10%
** indicates significance level of 5%
*** indicates significance level of 1%

Note: Significance level determined by Doan 1994.

Table 5.7 Augmented Dickey Fuller (ADF) t-tests for post-war/drought period

Test	Real White Price	Real Yellow Price	Food Aid Quantity
ADF: no trend	-2.75*	-2.03	-4.40***
ADF: trend	-2.74	-2.06	-4.30***
Lags	2	4	2

* indicates significance level of 10%
** indicates significance level of 5%
*** indicates significance level of 1%

Note: Significance levels using critical values found in Hamilton 1994

Table 5.8 Phillips Perron test results for the level series for post-war/drought period

Test statistic	Real White Price	Real Yellow Price	Food Aid Quantity
Z(phi_2)	5.64***	1.36	5.78***
Z(phi_3)	8.45***	2.04	8.68***
Z(t_ alpha~)	-3.57**	-1.98	-3.92**
Z(phi_1)	8.37***	1.90	8.35**
Z(t alpha*)	-3.37**	-1.91	-3.81***
Z(t alpha^)	-0.61	-0.50	-3.47**
NW lags	4	4	4

* indicates significance level of 10%
** indicates significance level of 5%
*** indicates significance level of 1%

Note: Significance level determined according to Banerjee, et al. 1993

Table 5.9 KPSS tests for post-war/drought period

Trend/ no trend	Lags	Real White Price	Real Yellow Price	Food Aid Quantity
No trend	0	0.32	3.95***	0.61**
No trend	2	0.15	1.44***	0.29
No trend	4	0.1	0.90***	0.24
No trend	8	0.07	0.54*	0.2
With trend	0	0.33**	1.48***	0.16**
With trend	2	0.15**	0.56***	0.08
With trend	4	0.1	0.35***	0.07
With trend	8	0.07	0.22**	0.06

* indicates significance level of 10%
** indicates significance level of 5%
*** indicates significance level of 1%

Note: Significance level as determined by Kwiatkowski, et al. 1992.

The ADF and PP tests (Table 5.7) rejected the null hypotheses for food aid deliveries, with or without the trend included. In Table 5.8, the KPSS results support that result, with a failure to reject the null hypothesis of stationarity around a mean or a trend. There were two main periods of food aid deliveries from April 1993 through April 1995, designed to meet the hungry season needs of the urban areas. Most shipments arrived in late October, early November and were distributed through February (in 1994) and through January (in 1995). Due to months without deliveries, the mean was only 734 metric tons per week, with a median of 0. A linear time trend becomes insignificant as soon as any lagged own values are included in simple univariate regressions. Nevertheless, the unit root tests indicate that trend stationarity can be accepted for this series.

5.6.2 Yellow maize prices

Th yellow maize series demonstrates no significant trend and very strong first order autocorrelation. In the initial testing with ADF, the null hypothesis of a unit root cannot be rejected (testing conducted with up to 4 lags) except in the case of the ADF with 4 lags at the 0.10 significance level. Further testing with the PP tests results in failure to reject the null hypothesis of a unit root. In the KPSS tests, the null hypothesis of mean stationarity fails to be rejected at the 0.10 significance level with 5 or more lags included, although trend stationarity is rejected through 8 lags at least.

In evaluating the series and thinking about the maize markets, there was a significant upward shift in prices during the week of July 23, 1994. In terms of the harvest, this is early for scarcities to occur, yet the traders' qualitative assessment of the markets in Maputo, as recorded by the SIMA for that week, showed a decline from "large quantities" to "moderate" quantities, with some traders indicating "very little". A rapid appraisal team was in the center region of the country, the major production zone for the southern consumption areas at this time. They found that the quantities available for purchase were diminishing, as evaluated by local officials and itinerant traders. The government parastatal received funds the last week of July to purchase white maize to be sold to the donors for their local purchase efforts. The World Food Programme (WFP) signed a contract with ICM, such that WFP would buy local white maize from the parastatal rather than from private traders.

The entrance of ICM as a major buyer introduced a new factor into the domestic markets, a new source of demand for white maize. In the past, regional purchases had been made to meet Mozambican needs for white maize, with donors buying in Zimbabwe and importing; however, large quantities of white maize had not previously been purchased locally. In order to further investigate the effects of the maize price shifts in July, August, and September, special unit root tests will be used that incorporate knowledge of exogenous breaks in evaluating stationarity.[4]

[4] In the earlier decision to divide the analysis into two different time periods due to a break, the differences between the time periods were in mean **and** in variance. In this case, the difference is though to be a mean shift only.

Perron (1989) has developed tests that are appropriate to use when a single break in trend or mean is though to occur in a series. As Perron noted, researchers would find nonstationarity when the data generating process may actually be stationary fluctuations around a mean or trend with a single break. Because of the limited number of observations (before and after the break), testing the period before a break and after a break separately may have very low power against the null of unit roots. Hence, Perron developed the appropriate test statistics to test for a unit root using the full length time series, including the possible mean or trend shifts. There are two cases developed by Perron that we will use here: 1) a single exogenous mean shift at a specified point in time; and 2) that allows for both a shift in the mean as well as a shift in the slope of the trend.

Both models are based on the premise that the shift is "not a realization of the underlying data-generating mechanism of the various series" (Perron 1989, p.1362), but rather from a rare event that can be considered exogenous. Perron used Monte Carlo techniques to evaluate the distribution of the coefficient on the lagged dependent variable in each case in order to determine the appropriate test statistics when the shift variables are included in the unit root tests. The critical values vary in accordance with when the shift is thought to occur. The July 23, 1994 date is around the 60 percentile of the observations, that is, about 60 percent of the cases occurred prior to July 23, 1994. Once the shift is incorporated into the test statistics, Perron found rejection of the unit root hypothesis in series that were previously thought to be nonstationary.

Table 5.9 Perron's unit root test for the post-war/drought period with a single exogenous mean shift or mean and trend shifts on July 23, 1994

Test	White price	Yellow price
Model A: mean shift	-8.63***	-3.79**
Model C: mean and trend shift	-8.63***	-4.31**

Note: Test is the t-test on the coefficient for the lagged price variable in the regression including trend, mean shift indicator, and 5 lags of own prices. Trend shift indicator was also included in Model C. Break occurred at the 60 percent point of the data.

* indicates significance level of 10%
** indicates significance level of 5%
*** indicates significance level of 1%

Note: Significance levels using critical values found in Hamilton 1994

In the Mozambican case, it was hypothesized that there was a shift in the mean of the price series when the local purchases began. As indicated earlier, the test statistics must be modified in the presence of a mean shift. Using the Perron test statistics for a unit root with a single shift in mean at July 23, 1994, the tests reject the null hypothesis of a unit root at the 0.05 significance level for yellow maize prices (Table 5.9). The t-statistic for the coefficient on lagged yellow maize price in the mean shift model was -3.79 compared to a 0.05 critical value of -3.76 for a shift that is within the first 60 percent of the time series. Included in the regression were 5 lags of yellow maize price, as well as the indicator variable for the periods before and after the shift, a time trend, an indicator variable for the day of the shift, and a constant. Testing the white maize series for non-stationarity around the shift resulted in a t statistic of -8.63, significant at the 0.01 significance level.

Testing based on a break in mean as well as a break in trend also resulted in rejection of the null hypothesis of a unit root, with the t statistics on the lagged price coefficient of -4.31 and -8.63 for yellow and white maize prices respectively. As a result of this testing, the inclusion of a mean shift variable or of both mean and trend shift variables in the VAR modeling would be appropriate.

5.7 Seasonality

Seasonality does not appear to be present in data during the war/drought period. Seasonal elements would not be expected to be important, given limited domestic production and storage, the lack of regional white maize production, and the arrival of food aid yellow maize during most months of the period at fixed prices to the consignees. In the post-war/drought period, seasonality may be a concern since there is both regional and domestic production during a single annual crop cycle. Also, food aid tends to be delivered during the hungry season, when there is scarcity of domestic supplies. This means that the food aid tends to exert a counter-cyclical downward pressure on white maize prices. During the marketing season, the price of white maize drops, as is expected for storable agricultural commodities. There are too few observations to be able to thoroughly model seasonality in the present context. By not modeling the seasonality, the estimated impact of food aid shocks on maize prices will be lessened, since maize prices in general would tend to be increasing during the hungry period. In the post-war/drought period estimations, dummy variables were included to at least begin to capture the broad seasonal movements that might be present.

5.8 Implications for time-series modeling

The data were split into the war/drought period (April 1990 - February 1993) and the post-war/drought period (April 1993 - April 1995) in accordance with the changes in the economic structure, apparent in the time series plots. The series were all tested for stationarity by period. Only the late period yellow maize prices indicated potential nonstationarity. Further testing incorporated a mean shift for the period when local purchasing began, and rejected the null hypothesis of nonstationarity around this structural break in the series. These results are used in the next chapter to help specify an appropriate VAR model for white maize prices, yellow maize prices, and quantity of food aid deliveries.

Chapter 6

VARs and the Estimation of the Effects of Food Aid Deliveries

6.1 Introduction

In this chapter, vector autoregressions models (VARs) are used to show that shocks in food aid quantities delivered on the market significantly affect Maputo white and yellow maize prices, and that these effects vary from the war/drought period to the post-war/drought period. VARs can be interpreted as reduced-form equations, useful when data are limited or knowledge of underlying economic structure is extremely uncertain or both (Sims 1980; Fackler 1988; Myers, Piggott, and Tomek 1990). VARs estimated with weekly data are used to evaluate the effect of food aid quantity shocks as they impact Maputo maize prices. The following chapter will extend the analysis to study the effects of price shocks on markets outside Maputo.

6.2 Structural and reduced form models

6.2.1 Structural models

Structural models are commonly used to determine the relationship between variables in a economic system. Consider a structural model for the endogenous variable y_t:

$$y_t = \beta_0 + \beta_1 x_{1t} + \beta_2 x_{2t} + \dots + \beta_k x_{kt} + \epsilon_t \qquad \textbf{(6.1)}$$

where β_i are structural parameters, x_{it} are pre-determined variables (exogenous or lagged endogenous), and ϵ_t is a structural error. This can be generalized to a vector process with a vector of endogenous variables $\mathbf{y}_t$ and vectors of β_k, $\mathbf{x}_{it}$ and ϵ_t. In that case, current values of endogenous variables may enter into each equation. Economic theory is needed to provide restrictions that identify a unique set of structural parameters. For example, it is often the case that standard supply equations do not include income, while income does enter the demand equation. The parameter for income is thus restricted to zero in the supply equation. In large structural models with many exogenous variables, the models are frequently over-identified with many zero restrictions on parameters.

6.2.2 Vector Autoregressions

VAR models can be thought of as reduced-form equations for a structural system, including lagged dependent variables (Hamilton 1994). VARs assume an underlying relationship that holds through time between the variables in the system. Interest lies not in the reduced form parameters but in the error terms, or "innovations", i.e. the components in the variables that are "new" in the sense of not being predicted from past values of variables in the system. VARs can be viewed as a structural simultaneous equations system in which there are no truly exogenous variables in the system (Judge et al. 1988). The reduced form parameters are unrestricted. The basic VAR model for a vector y_t takes the following form:

$$y_t = c + \Phi_1 y_{t-1} + \Phi_2 y_{t-2} + \dots + \Phi_p y_{t-p} + \epsilon_t \qquad \textbf{(6.2)}$$

The lagged values (at some chosen lag length p) of all of the endogenous variables appear in each equation, with the Φ_i unrestricted.

6.2.3 VARs in the economic literature

In 1980, Sims wrote of the potential uses of VARs for macroeconomic policy analysis. Previously VARs had been used primarily for forecasting, but new research developed applying VARs to policy evaluation (for example, Orden and Fackler 1989; Myers, Piggott and Tomek 1990; Kamas 1995; Lastrapes 1992). VARs have also been used to evaluate commodity price relationships in both spatial analysis of homogeneous products (for example, Ravallion 1986) and in intercommodity research with two commodities in the same market (for example, Alderman 1993).

In recent literature, many analysts have used error correction models with cointegration to look at short and long-run price relationships, and the effects of policy changes (for example, Goodwin 1992; Fisher, Fackler, and Orden 1995). Cointegration analysis entails using common stochastic trends between series in order to evaluate long run relationships. Cointegration analysis has proven useful when individual series are not stationary and yet the series are thought to have some long-run equilibrium relationship connecting them. In other words, while an individual series may "wander extensively," some of the pairs may stay basically together over time (Engle and Granger 1987).

6.2.4 Advantages and Limitations of VARs

VARs have been useful in economic analysis, particularly in cases where structural models are difficult to estimate. When knowledge of the underlying economic structure is weak, or the required data are not available, formulating a structural model is difficult and entails arbitrary decisions on variables and lag lengths to include in each equation, resulting in over-identification of the system.

Typically, all deterministic trends and seasonal components are removed from the series prior to VAR estimation; or trend and seasonal variables can be included directly in the VAR. VARs are designed to trace out the effects of structural shocks to help predict the effects of a shock in one series on all of the variables in the model. For example, an unanticipated large delivery of food aid may occur one week; yellow maize prices may then experience previously unanticipated declines in price which can then be associated with the food aid shock.

VARs must generally be parsimonious models, with only a few variables included. As the number of variables included expands, the economic interpretation of the shocks becomes difficult, identification restrictions increase in number; and data requirements increase rapidly with the number of variables and their lags.

Identification of VARs has been the source of considerable controversy. Early analysis focused on using assumptions regarding the contemporaneous relationships between variables to identify the system. More recent efforts by Blanchard and Quah (1989), Lastrapes (1992), and others use information on the long-run effects and the infinite moving average representation of the VAR to impose identifying restrictions on the system. When there are nonstationary series and the possibility of cointegrating relationships, the use of long-run identifying restrictions is key. In the current research, stationarity of the data series rules out the existence of cointegration and unit root restrictions.

6.3 Modeling the Mozambique case

6.3.1 Data constraints

Data needed for estimating a full structural model for maize supply and demand in Mozambique are unavailable. Furthermore, as indicated in Chapter 4, the Mozambican economy is undergoing major shifts and the markets are changing. White maize supply modeling is the most problematic. Dispersed family-level production and marketing hinders data collection efforts, and estimates of marketed surplus vary from 13 percent of total production to 23 percent of total production. After years of controlled producer prices and active government purchasing on the market, only recently have private markets expanded and prices deviated from the official prices. As discussed in Chapter 3, interseasonal storage is mainly conducted at the farm level, with little information available concerning quantities and locations.

Commercial white maize imports are generally unrecorded transactions of the informal sector, through the southern borders with Swaziland and South Africa, as well as the center and northern borders with Zimbabwe and Malawi. White maize exports have been small in recent years, but once again the informal sector activities are unrecorded.

On the demand side, consumption parameters remain a subject of debate, particularly the cross-price elasticities of demand for white and yellow maize as well as for rice and bread. The 1991 consumption surveys conducted by the National Directorate of Statistics (DNE) with Cornell University were conducted in a different market environment than exists now. Substitution possibilities were limited when the surveys were conducted because of the scarcity of white maize on the markets. This biased the surveys towards finding a lack of substitution.

6.3.2 Emergency food aid arrivals

Since a substantial portion of the yellow maize grain arrives as emergency food aid, it is important to look at the factors which influence emergency arrivals. First, the timing of emergency food aid coincided more or less with the commercial food aid deliveries, as can be seen in the monthly chart of arrivals (Figure 3.2). Since all food aid in Mozambique was programmed to meet needs, it is logical that there be a correspondence in emergency and commercial arrivals during the hungry season. Without explicitly including emergency food aid in the models, the models may over-estimate the effect of commercial food aid, attributing the full impact of the total food aid shock to the commercial food aid arrivals.

The amount of emergency food aid supplies that enter the Maputo markets is thus important. Emergency food aid stocks that arrive in Maputo port are intended for distribution in rural areas to targeted populations, and so only stolen quantities of emergency aid appear in the Maputo markets. In the war/drought period under study, losses in the emergency distribution system may have been as high as 50 percent, however by mid-1993, the distribution system had become more efficient in avoiding losses, so the potential quantity of leakage into the markets has diminished since 1993. Thus, it is plausible to attribute supply shocks of yellow maize mainly to the commercial food aid deliveries, recognizing that emergency grain may play a role in part of the effect during some periods.

6.3.3 Weekly data and price analysis

A unique aspect of this research is the use of weekly data on retail prices and food aid deliveries. Previous research on food aid using time series methods is limited to yearly or monthly analysis (for example, Farzin 1991). Since the short-term and medium-term effects of the prices may be important in determining trader incentives and hence producer marketing options and prices, the weekly data may provide quite different results.

Price analysis in general has been criticized for interpreting statistical relationships as representations of economic relationships, without knowledge of the price formation process (Harriss 1979). Faminow and Benson (1990) indicate the importance of the underlying market structure in determining what price analysis across markets (or across products) can reveal. The analyst must evaluate whether or not the markets are competitive in price setting, and determine the appropriate models for price analysis. As Chapter 3 details, in the retail markets in Maputo, the retail sellers of yellow and white maize grain act competitively with little evidence of collusion or price fixing. At the wholesale level, there were signs of market power being used during a brief time in 1992 when only two private traders received maize. However, more maize arrived within two weeks and market power could no longer be exercised by the two wholesalers because many more consignees received maize allotments.

6.3.4 Data used

The current research focuses on the potential price effects of commercial food aid delivery shocks. Thus, the data consist of weekly price data at the retail level for white maize grain and yellow maize grain in Maputo consumer markets, as was detailed in Chapter 5. To capture the food aid arrivals, data on the weekly commercial food aid deliveries to consignees were selected as the best indicator of yellow maize supplies in the market.

6.4 VAR model in the war/drought period

6.4.1 Modeling in the war/drought period

During the war/drought period, from April 1, 1990 through February 27, 1993, there was substantial variability in prices and in food aid, due to a combination of drought, civil war, lack of private market development, and changing government policies and role. The VARs will evaluate the sources of fluctuations within the three variable system.

Before estimating the VARs, exogeneity testing presents evidence of the ability of each series or a pair of series to help forecast other series. The researcher must determine the appropriate number of lags to include in the system. Then an identification scheme must be selected and the system estimated. Impulse responses and forecast error variance decompositions indicate how shocks work through the system and trace the fluctuations back to sources, while historical simulations evaluate alternative scenarios.

6.4.2 VAR order selection

Choosing the appropriate lag length entails determining how many lags are sufficient to capture the dynamics without the loss of efficiency that occurs when unnecessary lags are included. Braun and Mittnick (1993) stress that the use of higher order autoregressions helps to alleviate problems with omitted moving average components. This will have to be balanced with the limited times series observations available and the need for efficient estimation.

There are several different tests to determine the appropriate lag length to use in a VAR. Each of the tests involves estimating the VAR and then evaluating the improvement in explanatory power with each additional lag added. Akaike's Information Criterion (AIC) and Schwarz' Criterion (SC) are well known (Judge, et al. 1988). The Chi-squared Likelihood Ratio test is also used (Hamilton 1994).

As is noted in Kamas (1995), when choosing between the different criteria, the AIC will tend to over-parameterize as sample size grows, while the SC in small samples tends to under-parameterize. Hamilton (1994) uses the Sims' Likelihood Ratio test, which under the null hypothesis, (no significant difference between j lags and j+1 lags), has a χ^2 distribution. All three of the tests are reported in Table 6.1. The AIC criterion indicates 7

Table 6.1 Testing on lag lengths for early period with trend variable

Number of Lags	Test Statistic Akaike's Information Criterion	 Schwartz Criterion	 Likelihood Ratio Test χ^2	 p-value
1	31.93	**32.25**	221.21	0.00
2	31.82	32.45	13.33	0.15
3	31.62	32.56	30.35	0.00
4	31.49	32.75	**18.80**	0.03
5	31.44	33.01	6.37	0.70
6	31.37	33.26	9.92	0.36
7	**31.34**	33.54	4.09	0.91
8	32.22	33.73	**16.45**	0.06

lags, while the SC criterion indicates 1 lag. The LR test suggests 4 lags are needed. In view of the results, the model was estimated with four lags.

6.4.3 Multivariate Granger causality

Vector autoregressions are used to answer questions about the relationships between variables over time and, in particular, the ability of different variables to help forecast other variables. A related concept in a single equation model is "Granger causality," developed by Granger (1969). When extended to apply to a multivariate framework, the term "exogeneity" is used to indicate that, among the relationships of interest, one variable (or group of variables) can add no further information for a forecast beyond what past values of the other variables already contribute (Hamilton 1994). This is a helpful diagnostic tool and may provide support for hypotheses concerning relationships among the variables.

A multivariate version of the Granger-Sims causality tests was used to evaluate possible exogeneity, based on a likelihood ratio test with a chi-squared distribution in which the restricted regression excludes the lags of one or more of the variables, and the unrestricted regression allows the coefficients on those lags to be non-zero (Doan 1992, Hamilton 1994). The results of the tests can be seen in Table 6.2. The null hypothesis of the first test is that food aid deliveries are exogenous, i.e. that white and yellow maize prices do not significantly improve forecasts of food aid deliveries. The null hypothesis was rejected, providing evidence that food aid is not exogenous in the time series sense to white and yellow maize prices. Further testing indicates that white maize prices contribute

Table 6.2 Exogeneity testing on the war/drought period series

Null hypothesis	χ^2	p-value	Results
YP and WP do not help to predict FA	20.6	0.01	Reject at 1%
FA does not help to predict YP and WP	14.31	0.08	Reject at 10%
FA and WP do not help to predict YP	10.88	0.07	Fail to reject at 10%
YP does not help to predict WP and FA	11.13	0.21	Fail to reject at 10%
YP and FA do not help to predict WP	9.61	0.29	Fail to reject at 10%
WP does not help to predict YP and FA	11.23	0.19	Fail to reject at 10%

significantly to improving forecasts of the food aid deliveries, whereas yellow maize prices are not significant.

This result has important economic implications. One interpretation is that the donors base their deliveries on the weekly prices, responding quickly to white maize price shifts in order to avoid large price spikes that threaten food security. However, knowledge of the food aid distribution system rules out this interpretation. Food aid stocks held by the government were supplies that formal traders were unwilling to purchase, rather than stocks retained specifically for later release. Foreign food aid supplies take 3 months or more to arrive in response to requests. Had the model been based on monthly data, with sufficient lags, it is logical that food aid deliveries can be predicted from prices, for food aid officials seek to avoid extreme scarcity and price jumps that threaten the food security of the urban poor.[1] It is possible that the long run relationship between white maize scarcity and food aid arrivals is reflected in the short-run events.

An alternative interpretation is that the lack of exogeneity of food aid may reflect forward-looking behavior on the part of traders in the system. Today's white maize prices serve as indicators of trader profitability. When white maize prices are rising, traders know that the white maize price will fall only at harvest or when food aid arrives, because there are no other downward pressures on white maize prices in this period. While the quantity of

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[1] This is related to the seasonality issues that will be discussed further below.

yellow maize that arrives indicates the yellow maize supply, only white maize prices are available to indicate supply of the white maize.

Due to the substitutability between white and yellow maize products, the prices that traders will face for yellow maize products in the markets will depend upon the white maize prices. As noted earlier, a preference survey in Maputo in 1994 found that 40 percent of households interviewed would switch from white to yellow if the yellow price was 29 percent lower than the white. Low white maize prices mean that the traders would face low yellow maize prices in the markets. Since the consignees know the price that they must pay the government for the commercial food aid, their profitability hinges on the market prices.

While the commercial food aid is delivered to traders on the basis of allocations determined by the MITC, traders may not allocate the transport resources to receive delivery at the port if there are other more profitable activities to pursue. In addition, they may decide not to use the available bank credit to obtain food aid maize. Current white maize prices figure into expectations on profitability, guiding these decisions.

6.4.4 VAR Model

The structural form of the VAR model in food aid deliveries (FA) and prices (WP_t for white maize prices and YP_t for yellow maize prices) at time t can be written as follows:

$$A_0\, y_t = k + A_1\, y_{t-1} + A_2\, y_{t-2} + \ldots + A_p\, y_{t-p} + u_t$$

where:

$$y_t = (FA_t\,,\ YP_t\,,\ WP_t)' \tag{6.3}$$

$$u_t = (u_{1t}\,,\ u_{2t}\,,\ u_{3t})'$$

$$k = (k_1\,,\ k_2\,,\ k_3)'$$

$$A_0 = \begin{bmatrix} 1 & \alpha_{12} & \alpha_{13} \\ \alpha_{21} & 1 & \alpha_{23} \\ \alpha_{31} & \alpha_{32} & 1 \end{bmatrix} \tag{6.4}$$

$$E\, u_t\, u_t' = \Omega = \begin{bmatrix} \omega_{11} & 0 & 0 \\ 0 & \omega_{22} & 0 \\ 0 & 0 & \omega_{33} \end{bmatrix} \tag{6.5}$$

and the A_s are (3x3) matrices, with s=1,2,...p (number of lags). The A_0 matrix contains the coefficients on the contemporaneous values, $\mathbf{y}_t$. The matrix $\mathbf{u}_t$, containing the structural disturbances, is assumed to have zero mean and contemporaneous covariance matrix Ω. Time trends are included in the regression. Pre-multiplying both sides of the equation by A^{-1}_0 results in the VAR reduced form representation:

$$y_t = c + \Phi_1 y_{t-1} + \Phi_2 y_{t-2} + \ldots + \Phi_p y_{t-p} + \epsilon_t$$

where

$$\begin{aligned} c &= A_0^{-1} k \\ \Phi_s &= A_0^{-1} A_s \\ \epsilon_t &= A_0^{-1} u_t \end{aligned} \tag{6.6}$$

$$E\epsilon_t\epsilon_t' = \Sigma = \begin{bmatrix} \sigma_{11} & \sigma_{12} & \sigma_{13} \\ \sigma_{21} & \sigma_{22} & \sigma_{23} \\ \sigma_{31} & \sigma_{32} & \sigma_{33} \end{bmatrix} \tag{6.7}$$

There are three parts (Σ, A_0, and Ω), that characterize the identification process. Equations 6.5, 6.6, and 6.7 combine to give the following relationships:

$$\Sigma = E (\epsilon_t \epsilon_t') = A_0^{-1} E (u_t u_t') (A_0^{-1})' = A_0^{-1} \Omega (A_0^{-1})' \tag{6.8}$$

One of the usual conditions for identification is that the structural disturbances, $\mathbf{u}_t$, are uncorrelated with each other as well as serially uncorrelated. Some further restrictions are still necessary to identify the A_0 and Ω matrices. If Ω is diagonal, it has n parameters (number of variables, equivalent to the number of diagonal elements in Ω). Knowing that Σ has n(n+1)/2 distinct values and that Ω is diagonal, A_0 should have no more than n(n-1)/2 free parameters in order to be identified. With a 3-variable VAR, A_0 must have no more than 3 free parameters to satisfy this order condition, if only contemporaneous relationships are used to identify the system.

6.4.5 Identification with a recursive structure

The A_0 matrix contains the coefficients on the contemporaneous relationships, with the superscripts referring to time period. With a recursive structure, the 3 coefficients in A_0 above the principal diagonal are all set equal to zero:

$$A_0 = \begin{bmatrix} 1 & 0 & 0 \\ \alpha_{21} & 1 & 0 \\ \alpha_{31} & \alpha_{32} & 1 \end{bmatrix} \quad \textbf{(6.9)}$$

A coefficient value of 0 means that there is no **contemporaneous** effect of that variable in the specified equation. In A_0 above, the first series is unaffected contemporaneously by shocks from the remaining two; the second series is affected contemporaneously by the first but not by the third; finally, the third series is contemporaneously affected by both of the preceding series. With A_0 structured as a lower triangular matrix, the Choleski decomposition of the Σ matrix enables estimation of Ω and A_0 using the relationships between Ω, Σ, and A_0 (Hamilton 1994).

6.4.6 Selected model: Recursive identification with WP, FA, YP ordering

In order to allow white maize price shocks and food aid delivery shocks to contemporaneously affect yellow maize prices, a recursive model was chosen with the ordering white price (WP), food aid (FA), and yellow price (YP). A trend term is included, in accordance with the unit root test results. The exogeneity tests showed that white maize prices were significant in predicting food aid deliveries, suggesting forward-looking behavior on the part of traders, based upon white maize prices. The recursive identification system was developed based upon the premise that white maize prices are the driving force in the relationships between the two maize prices and food aid deliveries, and that food aid shocks will have contemporaneous effect on yellow maize prices. The A_0 matrix can be represented in Equation 6.9, in which the first row refers to the WP_t equation, the second to the FA_t equation, and finally the third equation is for YP_t.

In this system, yellow maize prices are contemporaneously influenced by both white maize price shocks and food aid shocks. Food aid is contemporaneously affected by white maize prices only. Placing the white maize price first in the ordering has implications for the hypothesis that white maize prices are influenced by food aid deliveries. This recursive identification system would tend to minimize effects of food aid shocks and yellow maize price shocks on white prices. Finding a significant effect of food aid delivery shocks on white prices over time would therefore be strong evidence of feedback from food aid and yellow maize prices to white maize prices.

The shocks from the white maize prices can be interpreted as the effect of white maize aggregate supply and demand shocks. The lack of white maize supply data inhibits the ability to separate the supply and demand effects. The market conditions prevalent in Mozambique during this period suggest that supply shocks are predominant, since the drought limited production and the war limited transport and distribution of supplies.

The yellow maize price shocks can be considered aggregate demand-side shocks while the commercial food aid shocks are the yellow maize supply shocks, given that commercial food aid is the main source of yellow maize for the market. The demand shocks may be capturing some of the quality differences in the maize available in the markets and the consumers' reactions to poor or high quality grain, but also incorporate other shifts in demand for yellow maize. Ideally, the prices would be collected on a homogeneous good, however, this source of variability remains in the data and is picked up in the demand shocks. Thus, when old food aid supplies on the market are of low quality and low price, the delivery of food aid that is of better quality may result in a rise in price, even though additional supplies are entering the market.

6.4.7 Impulse responses and simulations

The parameters estimated with the VAR can be used to generate impulse responses, i.e. the response of a given series after a one unit or one standard deviation structural shock. For example, if the standard deviation of the food aid delivery structural shock is 2,600 metric tons, what is the effect of that single shock over time on white maize prices? The moving average representation of the model is obtained by inverting the estimated VAR:

$$\begin{aligned} y_t &= (I - \Phi_1 L - \Phi_2 L^2 - \ldots - \Phi_p L^p)^{-1} \epsilon_t \\ &= C(L)\epsilon_t \end{aligned} \qquad \textbf{(6.10)}$$

C(L) is a polynomial in the lag operator L, where $L\ \epsilon_t \equiv \epsilon_{t-1}$ (Hamilton 1994). It would be easy to estimate the change in y at period t+s with respect to a change in a VAR innovation ϵ_{jt}, however $\epsilon_{jt} = A_0^{-1}\ u_t$ are the combined effects of different shocks, not the response of one variable to a single structural shock. What is needed are the **orthogonalized impulse responses** "based on decomposing the VAR innovations (ϵ_{1t}, ...,

ϵ_{nt}) into a set of uncorrelated components (u_{1t}, ..., u_{nt}) and calculating the consequences of a unit impulse in u_{jt}" (Hamilton, 1994, p.322). For ease of understanding, the shock can be set to equal one standard deviation of **the innovation**, and the responses are also stated in those terms.

Figure 6.1 shows the impulse response plots from the recursive identification scheme with four lags and a time trend. In this estimation, the one standard deviation values for the innovations are 2,600 metric tons for the food aid deliveries, 65 meticais/kg (in real 1989 meticais) for white maize prices, and 34 meticais/kg for yellow maize prices. Looking at the top plot in Figure 6.1, each line represents a single series' response over time to a single shock from white maize prices, including the white maize price response to its own shock. The impulse responses to a one standard deviation positive food aid delivery shock, as seen in the second plot in Figure 6.1, are negative over time for both price series. Logically, if the supplies of yellow maize are increased in the market by 2,600 metric tons, prices for yellow maize and its substitute, white maize, would be expected to drop. White maize prices are not affected contemporaneously because of the identification assumption. The effect on the yellow maize prices is immediate, a drop of about 0.4 standard deviations of the innovation, lasting for 4 weeks, after which time it gradually returns to previous levels. White maize prices drop about 0.25 standard deviations, but they begin to return to the steady state level much faster.

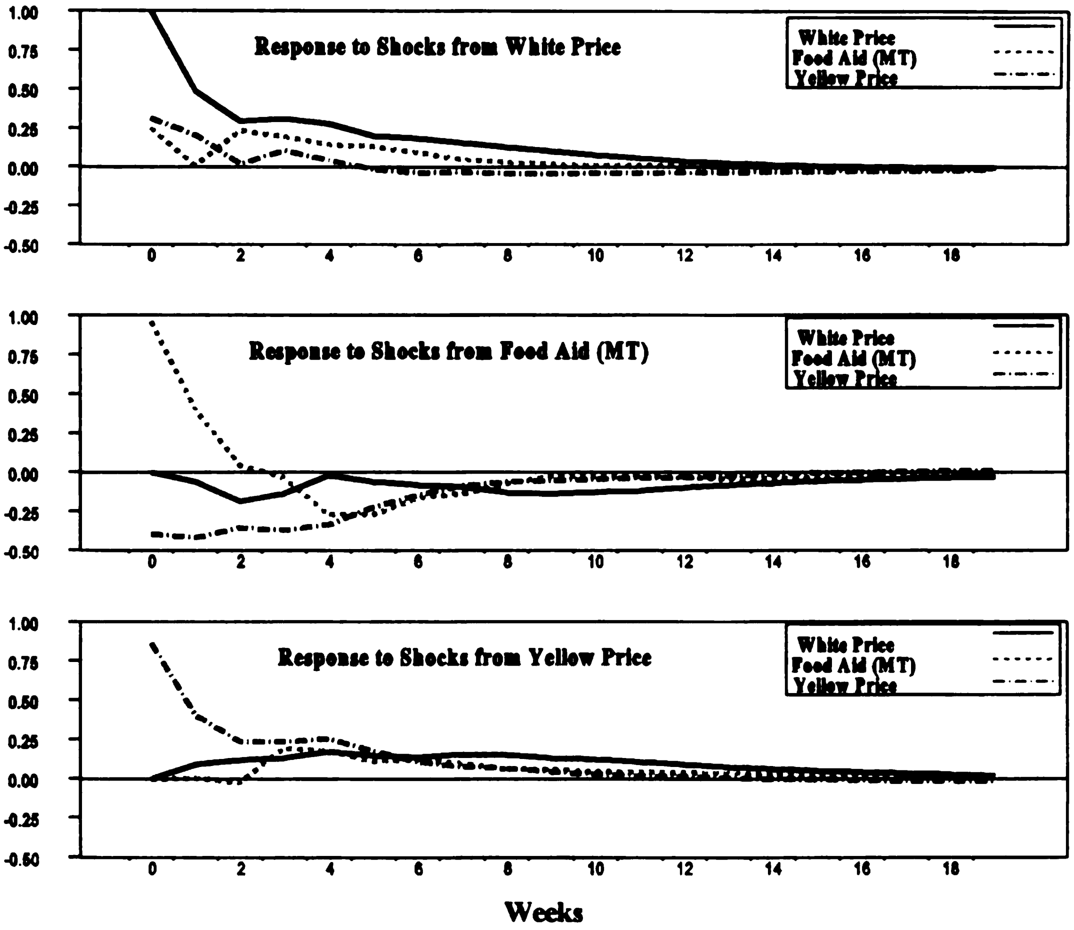

Figure 6.1 Impulse responses for the recursive model WP, FA, YP, war/drought period

The sharp fall-off of food aid deliveries after the 2,600 MT shock in delivery reflects the compensation that traders, and possibly donors and the GOM, make when a large delivery occurs that results in high supplies and low prices in the markets. The responses to white maize price shocks (shown in the top plot) and to yellow maize price shocks (shown in the bottom plot) also accord with economic logic and observation. A positive white maize price shock increases food aid deliveries, as traders demand more food aid. Initially, the yellow maize prices increase with the white maize price shock, but with increased food aid supplies, the yellow maize price does fall over time.

6.4.8 Forecast error variance decompositions

Another way to use the information from the VARs is to estimate the percentage of the variance in forecast errors that can be attributed to the different structural shocks over the forecast period (Fackler 1988). In the current research, the total forecast error variance for each series is broken into the three potential sources, estimating the percentage that can be attributed to each. Table 6.3 shows the forecast error variance decomposition (FEVDs) for twenty periods forecasted. In all three of the series, by the twentieth period, approximately 85 percent of the forecast error variance is explained by own shocks, rather than shocks from the other series. For the white maize price series, food aid shocks reach about 2 percent of error variance by the fifth period and stay that way through 20 periods, so the effect of food aid delivery shocks on white maize prices is relatively small. However, the effect of yellow maize price shocks on white maize prices gradually increases, accounting for about 10 percent by the thirteenth period. For yellow maize prices, the food aid shocks gradually reach about 12 percent of error variance by the fifth

Table 6.3 Forecast error variance decomposition for recursive model, war/drought period

Step	Variance Decomposition (% of total variance due to each shock)								
	White maize price			Food aid			Yellow maize price		
	Own shock	FA shock	YP shock	WP shock	Own shock	YP shock	WP shock	FA shock	Own shock
1	100.0	0.0	0.0	0.0	100.0	0.0	0.0	0.0	100.0
2	99.2	0.0	0.7	0.1	99.8	0.1	1.3	2.7	95.9
3	96.4	0.8	2.8	4.1	95.5	0.3	1.9	6.4	91.7
4	95.7	1.5	2.8	4.4	93.2	2.4	2.2	10.3	87.5
5	94.6	1.8	3.6	4.5	89.7	5.7	2.0	11.9	86.1
6	93.4	1.9	4.7	5.3	88.1	6.6	2.1	12.2	85.7
7	92.7	1.9	5.5	5.4	87.2	7.4	2.1	12.3	85.6
8	92.0	1.8	6.2	5.4	86.7	7.9	2.2	12.3	85.5
9	91.0	1.8	7.1	5.4	86.5	8.1	2.3	12.3	85.4
10	90.2	1.9	8.0	5.4	86.4	8.2	2.4	12.3	85.3
11	89.5	1.9	8.6	5.4	86.3	8.3	2.5	12.3	85.2
12	88.9	2.0	9.2	5.4	86.2	8.4	2.6	12.3	85.1
13	88.4	2.0	9.6	5.4	86.2	8.4	2.6	12.3	85.0
14	88.1	2.1	9.9	5.4	86.1	8.5	2.7	12.3	85.0
15	87.8	2.1	10.1	5.4	86.1	8.5	2.7	12.3	85.0
16	87.6	2.1	10.3	5.4	86.1	8.5	2.8	12.3	84.9
17	87.5	2.1	10.4	5.4	86.1	8.5	2.8	12.3	84.9
18	87.4	2.1	10.5	5.4	86.1	8.5	2.8	12.3	84.9
19	87.3	2.1	10.6	5.4	86.1	8.5	2.8	12.3	84.9
20	87.2	2.1	10.6	5.4	86.1	8.5	2.8	12.3	84.9

period and maintain that percentage through 20 periods. Thus food aid shocks account for error variance in yellow maize prices, while the yellow maize price shocks are important in the white maize price forecast error variances.

6.4.9 Historical simulations

Policy makers are often interested in the question of what paths prices might have taken if supplies had been different or if multiple shocks are involved, rather than the single shocks evaluated with the impulse responses. Historical simulations are used to answer those questions, based upon the appropriate VAR model.

Historical simulations were conducted, using the parameter estimations and the innovations from the recursive identification scheme. In the these simulations, the path of innovations for the food aid deliveries was controlled to generate simulated food aid deliveries of zero. The innovations for white maize prices (white maize demand and supply shocks) and yellow maize prices (yellow maize demand shocks) were maintained at the originally estimated values. The effects of the new food aid shocks were then traced through the system, estimating new paths for each of the price series.

In the war/drought period simulation, all food aid deliveries after July 31, 1992 were set to zero. In reality a total of 44,800 metric tons of yellow maize commercial food aid was delivered during the August 1992 through February 1993 period. As demonstrated in Figure 6.2, the direction of shifts in white maize prices was not affected by the change in food aid, being driven by the extreme scarcity, instead. However, the magnitude of

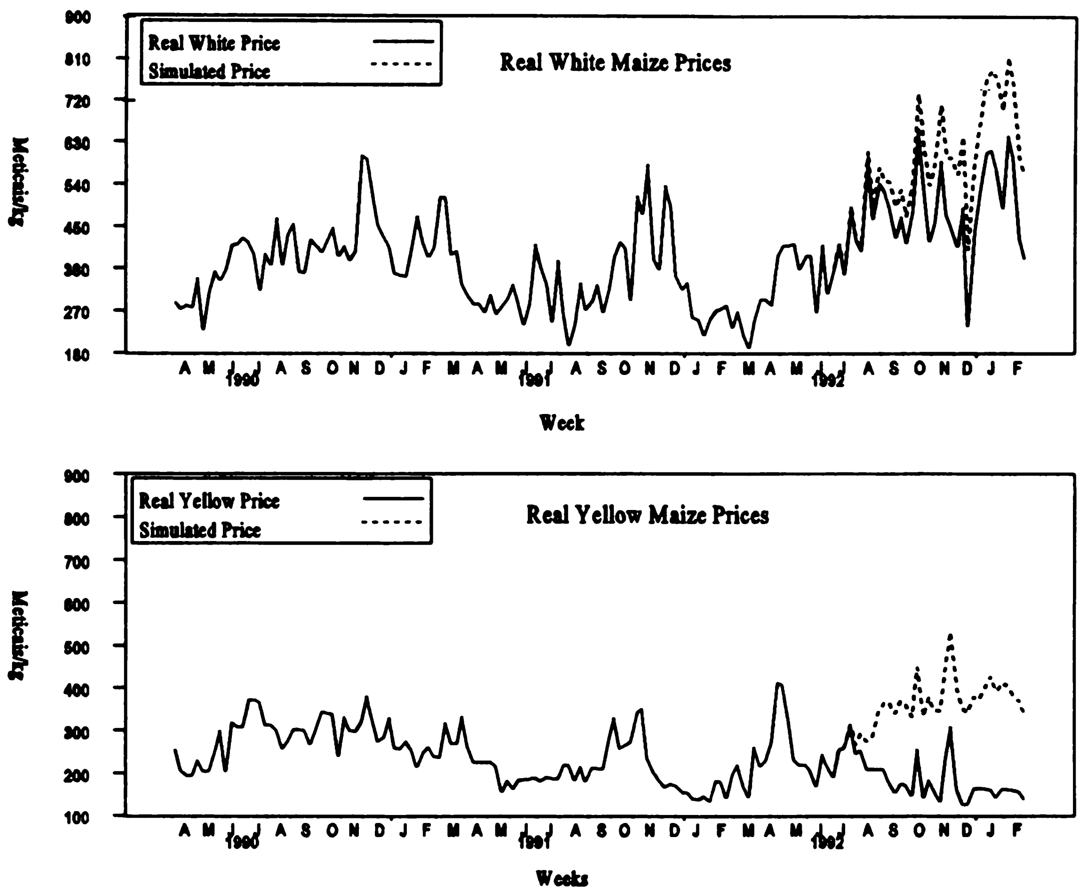

Figure 6.2 Simulation in war/drought period, recursive model with no food aid after July 31, 1992

changes in the white prices was affected, with prices that would have been higher in January and February 1993 by 33 percent on average. For yellow maize prices, the simulation shows prices increasing throughout the hungry season, with simulated prices an average 150 percent above the observed prices for January and February 1993. That yellow maize prices are strongly affected by the removal of food aid is not surprising since the food aid deliveries are the major supply source. This simulation clearly shows that the objective of lowering consumer prices for maize products was achieved by the actual deliveries. Consumers would have faced the high simulated prices otherwise.

The modeling does not have a constraint on the relative prices for white and yellow nor a ceiling constraint for the white maize and so may over-estimate the upward movement of prices without the arrivals. White maize grain prices in general should not exceed rice prices or prices for imported South African fine processed maize flour, for these are the preferred consumption substitutes, nor should yellow maize grain prices exceed white maize grain prices for more than brief periods.

6.4.10 Alternative identification schemes

Bernanke (1986) and Sims (1986) developed methods for using non-recursive restrictions that would still yield information on the A_0 and Ω matrices if the rank and order conditions are met. Rather than the Choleski decomposition, assumptions on selected coefficients in the A_0 matrix are used to then decompose the errors. Since the restrictions used for identification are just identifying, they cannot be tested, as is true for the recursive scheme.

A simultaneous identification scheme was estimated based on the A_0 matrix:

$$A_0 = \begin{bmatrix} 1 & 0 & \alpha_{13} \\ \alpha_{21} & 1 & 0 \\ 0 & \alpha_{32} & 1 \end{bmatrix} \quad \textbf{(6.11)}$$

This simultaneous identification scheme allows each of the series to have contemporaneous effects from the shocks of at least one other series. With this identification, yellow maize prices are allowed to contemporaneously affect white maize prices, whereas white maize prices affect yellow maize prices with a lag. The informal traders with white maize must have rapid turnover and hold little stocks to make a profit, given the high storage costs; whereas, the large wholesalers of yellow maize may wait before reacting to the shocks.

The impulse response results and simulations are for the most part qualitatively similar to the recursive estimations and can be found in Appendix B. The FEVDs for this identification are shown in Appendix B, Table B.1. As was true with the recursive identification, yellow maize prices are affected by the food aid delivery shocks within four periods, whereas the white maize prices are affected by the yellow maize prices rather than by the food aid deliveries directly. The strength of the effects is much greater with the simultaneous estimations, with 30 percent of the error variance of yellow maize prices accounted for by shocks from food aid, and a similar percentage of white maize error variance accounted for by yellow maize price shocks.

An alternative recursive identification scheme was also estimated with the ordering food aid deliveries, yellow maize prices, and white maize prices. This computes impulse responses and FEVDs under the following assumptions: 1) food aid deliveries are not contemporaneously affected by shocks from either yellow or white prices; 2) yellow maize price is contemporaneously affected by food aid delivery shocks but not white maize price shocks; and 3) white maize prices are contemporaneously affected by shocks from both food aid and yellow maize prices. The results of this model were not good in terms of reflecting what economic theory and market structure would predict. For example, the response of white maize prices to a food aid delivery shock (approximately 2600 metric tons) was to increase, rather than to decrease. The lack of correspondence led the researcher to reject this identification scheme.

6.4.11 Summary of war/drought period results

During this period, white maize price fluctuations cannot be attributed solely to food aid deliveries, but this is not surprising given the extreme scarcity of the grain. White maize prices are used by donors and traders to determine the deliveries, making white maize prices a key indicator and predictor for the deliveries. Yellow maize prices are strongly affected by the deliveries, a fact best shown in the simulations of retail prices if the deliveries had not occurred.

That the results for the recursive and nonrecursive estimations are similar for white maize price effects provides evidence that the white maize prices are leading indicators in these markets. That white maize prices are influenced by yellow maize demand and supply shocks even under these identification restrictions, is strong evidence that food aid can change prices for substitutes, even when the substitute is a preferred consumption good.

6.5 Post-war/drought period: April 1993 through April 1995

6.5.1 Identification considerations

Under the new, relatively open marketing system of this period, white maize supplies are more readily accessible and yellow maize commercial food aid supplies are diminishing. In the past, the white maize price played a key role in expectations, but the same may not hold in a competitive market environment with greater white maize supplies and the increasing likelihood of commercial imports, including yellow maize from South Africa.

Yellow maize supplies may begin to have greater importance than before in forming expectations. Formal traders make the connection between white maize price variability and yellow maize food deliveries. When formal traders outside of Maputo were interviewed and asked about their general unwillingness to engage in white maize trade, they mentioned price uncertainty and yellow maize food aid arrivals as sources of problems. Traders in Maputo only accept deliveries when the yellow maize price is high enough (or expected to be high enough) to ensure profits.

This trend of enhanced private maize markets is expected to continue, provided that risks from war and other sources do not increase in the markets. There have been commercial white and yellow maize imports during this period, an indication that markets have recovered and that formal traders are increasingly willing to take actions in both white and yellow maize markets. With the new market structure, yellow maize food aid deliveries and weather shocks to white maize production provide the main sources of unpredictable fluctuations.

As was indicated in the univariate analysis of white and yellow maize, there was an abrupt upward shift in maize prices in July 1994, corresponding to the announcement of donor commitment to make local purchases and the entrance of ICM on the maize market to make most of those local purchases. Thus, the modeling of the later period includes an indicator variable for a one-time mean shift in the prices in July 1994.

6.5.2 VAR order selection

Testing to determine the appropriate number of lag lengths resulted in differing recommendations from each test used. Table 6.4 indicates the results of testing for lags in the three-variable VAR with the mean shift and trend indicator variables. The likelihood ratio tests indicated four lags might be adequate, although increasing to seven lags might contribute significantly. The Schwartz Criterion and the Akaike Information Criterion indicated one lag and eight lags, respectively. The modeling was conducted with four lags.

Table 6.4 Testing on lag lengths for post-war/drought period with mean shift and trend variables

Number of Lags	Test			
	Akaike Information Criterion	Schwartz Criterion	Likelihood ratio test	
			$\chi 2$	p-value
1	23.5	**24.0**	237.6	0.00
2	23.4	24.3	23.2	0.01
3	23.3	24.6	17.1	0.05
4	23.1	24.7	**19.7**	0.02
5	22.7	24.7	13.2	0.16
6	23.5	25.0	3.0	0.96
7	22.9	24.8	**21.6**	0.01
8	**22.5**	24.8	13.2	0.16

6.5.3 Exogeneity testing

As white maize production in the region increases with improved rainfall, the extreme scarcities no longer drive the market and thus white maize may not be the dominant market force that it was earlier. Exogeneity testing of the three series in the later period, with the mean shift and trend parameters added, indicates that white maize prices are not exogenous to yellow maize prices and food aid deliveries in this post-war/drought period.

Market conditions from April 1993 to July 1994 included substantial yellow maize stocks in the hands of consignees and deteriorating quality of yellow maize, such that the nominal prices approached the consignee price paid to the government. Additional exogeneity testing was conducted to evaluate whether or not the yellow maize prices help to predict the food aid deliveries and white maize prices. As Table 6.5 indicates, in both the first part of the post-war/drought period and the full post-war/drought period, exogeneity testing found that the predictions of food aid deliveries were not significantly improved by including the yellow and white maize price series although food aid deliveries do significantly improve white and yellow maize price predictions.

6.5.4 Recursive ordering: FA, YP, WP

The exogeneity testing for this period suggests that white maize prices may no longer be driving the markets. The recursive structure used in the war/drought period, with white maize prices, food aid, and then yellow maize prices, was based upon the extreme scarcity of white maize and its critical importance in the maize markets as a whole. With increased supplies of white maize and decreasing food aid supplies, markets for white maize

Table 6.5 Exogeneity testing in the post-war/drought period

Null hypothesis	Full post-war/drought period			Early part of post-war/drought period		
	χ^2	p-value	result	χ^2	p-value	result
WP, YP do not help to predict FA	6.31	0.61	fail to reject	7.40	0.49	fail to reject
FA does not help to predict WP, YP	19.90	0.01	reject	28.50	0.00	reject
FA, WP do not help to predict YP	15.35	0.05	reject	5.50	0.70	fail to reject
YP does not help to predict FA, WP	21.26	0.01	reject	6.12	0.63	fail to reject
YP and FA do not help to predict WP	26.17	0.00	reject	30.27	0.00	reject
WP does not help to predict FA, YP	9.90	0.27	fail to reject	4.74	0.78	fail to reject

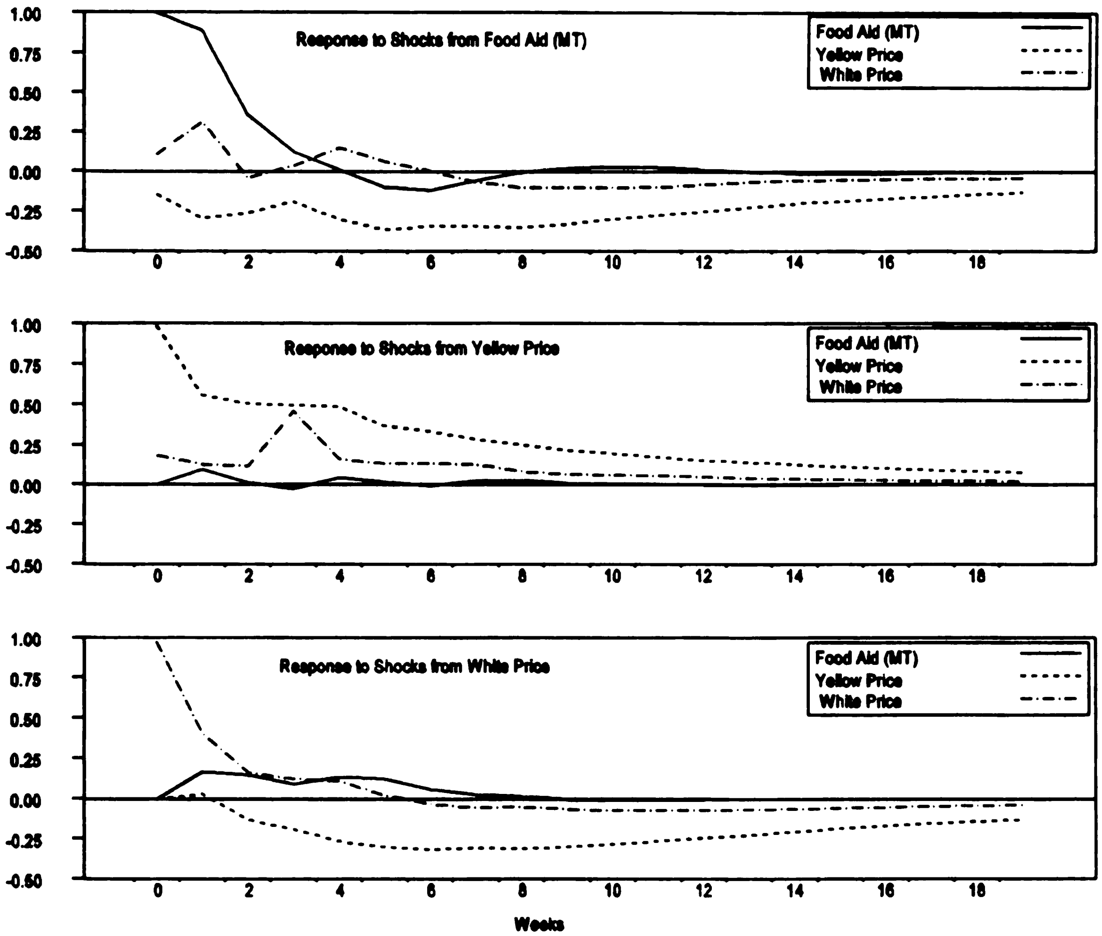

Figure 6.3 Impulse responses to shocks, based on recursive model, FA,YP, WP, with trend and mean shift, post-war/drought period

products become more stable. Yellow maize traders may react with a lag to changes in prices in the less volatile market, such that food aid deliveries would not be affected contemporaneously by shocks from white maize prices. Instead, food aid deliveries may respond only with a lag to changes in either of the price series. White maize prices become more sensitive to the shocks from both food aid deliveries and yellow maize prices, as the substitutability between white and yellow maize becomes key in the relative prices of the two commodities. Thus a recursive ordering with food aid, yellow maize, and then white maize will be used here.

The results of this model, including four lags and the mean shift and trend variables, are presented in the impulse responses of Figure 6.3 and the FEVDs in Table 6.6. In this post-war/drought period, a food aid shock of one standard deviation is about 1250 metric tons; standard deviation of the yellow maize shock is 12 meticais/kg; and the standard deviation of white maize shock is 20 meticais/kg.[2]

A food aid delivery shock initially has an unexplained positive effect on white maize prices. By the sixth period a slight negative effect on white prices is observed and continues through the remaining periods. The price shocks of white maize have little effect on own prices by the sixth period, with prices rapidly falling after the initial shock, indicating market supply and demand responses to the high prices, in addition to the food aid delivery response. In contrast, the yellow maize prices are slow to return to steady

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[2] This compares with war/drought period one standard deviation values for innovations in food aid, yellow and white maize prices of 2600 metric tons, 34 meticais/kg, and 65 meticais/kg, respectively.

Table 6.6 Forecast error variance decompositions for recursive order FA,YP,WP, post-war/drought period, 4 lags

Step	Variance Decomposition (% of total variance due to each shock)								
	Food aid			Yellow maize price			White maize price		
	Own shock	YP shock	WP shock	FA shock	Own shock	WP shock	FA shock	YP shock	Own shock
1	100.0	0.0	0.0	2.0	98.0	0.0	1.1	3.6	95.3
2	97.9	0.6	1.6	7.6	92.3	0.1	8.5	4.2	87.4
3	96.9	0.5	2.5	9.9	89.1	1.0	8.3	5.1	86.6
4	96.5	0.6	2.9	10.1	87.4	2.5	7.2	17.9	74.9
5	95.5	0.7	3.8	12.1	83.1	4.9	8.3	18.9	72.8
6	94.8	0.7	4.5	15.2	77.4	7.3	8.5	19.7	71.8
7	94.7	0.7	4.6	17.3	73.0	9.7	8.4	20.6	71.0
8	94.6	0.7	4.7	19.2	69.3	11.5	8.5	21.4	70.2
9	94.6	0.8	4.7	21.1	65.7	13.2	9.0	21.5	69.5
10	94.6	0.8	4.7	22.6	62.9	14.6	9.5	21.6	69.0
11	94.6	0.8	4.7	23.6	60.7	15.7	9.9	21.6	68.5
12	94.6	0.8	4.7	24.3	59.0	16.6	10.3	21.6	68.1
13	94.6	0.8	4.7	24.9	57.7	17.4	10.6	21.6	67.8
14	94.6	0.8	4.7	25.4	56.6	18.0	10.8	21.5	67.7
15	94.6	0.8	4.7	25.7	55.8	18.5	10.9	21.5	67.6
16	94.6	0.8	4.7	26.0	55.2	18.9	11.0	21.5	67.5
17	94.6	0.8	4.7	26.2	54.6	19.2	11.1	21.5	67.4
18	94.6	0.8	4.7	26.4	54.2	19.4	11.2	21.5	67.3
19	94.6	0.8	4.7	26.5	53.8	19.6	11.3	21.5	67.3
20	94.6	0.8	4.7	26.7	53.5	19.8	11.3	21.5	67.2

state values after any one of the three shocks. A shock in food aid deliveries results in decreasing yellow maize prices, and those prices stay around 10 meticais/kg below steady state through twelve periods after the shock. White maize price shocks have a similar direct effect on yellow maize prices.

The FEVDs for this model are presented in Table 6.6. Yellow maize prices show strong influence from food aid with 27 percent of forecast error variance attributed to food aid shocks by the twentieth period. In comparison with the war/drought period, food aid becomes important in explaining forecast error variance only gradually over time, with food aid deliveries accounting for only 10 percent of yellow maize price forecast error variance in the third period, and only reaching twenty percent by the ninth period. As would be expected in this period, white maize prices respond more directly to food aid shocks, with 8 percent of forecast error variance explained by food aid by the second period. Yellow maize prices gradually become more important in explaining forecast error variance, explaining about 21 percent by the seventh period and staying at that figure. The food aid series forecast error variance was mainly explained by own shocks, rather than shocks from other series, even after 20 periods.[3]

6.5.5 Seasonality issues and results

As domestic production and marketing has recovered and food aid has arrived during the hungry season, seasonality of the data series may be present, particularly with the food aid

[3] A simultaneous model equivalent to the war/drought period simultaneous model was also estimated. The results were qualitatively similar and are presented in Appendix A.

deliveries and the white maize prices. Food aid deliveries during the hungry season are intended to dampen the increases in white maize prices in this period. During the early part of the marketing season, the price of white maize drops, as is expected of storable agricultural commodities. Initial inclusion of a market season dummy and a hungry season dummy showed that the market season dummy did not help the explanatory power in the three variable VAR model, and so just the hungry season variable was included, along with the mean shift variable. As would be expected, the coefficients for hungry season in both the food aid and the white maize price equations were positive and significant.

In Figure 6.4, changes in the impulse responses with the addition of the hungry season variable are most obvious in the top box with the responses to a food aid shock. White maize response becomes negative by the second week, gradually returning to the previous level over the next six periods. The pronounced oscillation in the food aid response to own shock may reflect the overshooting and undershooting of supplies over time,or may reflect underlying problems with the distribution of the food aid series, with arrivals mainly in the hungry season.

6.5.6 Historical simulations with reduced food aid deliveries

There were two commercial food aid shipments to Maputo during the November 1994 - January 1995 period, the first with 21,480 MT and the second with 26,100 MT.

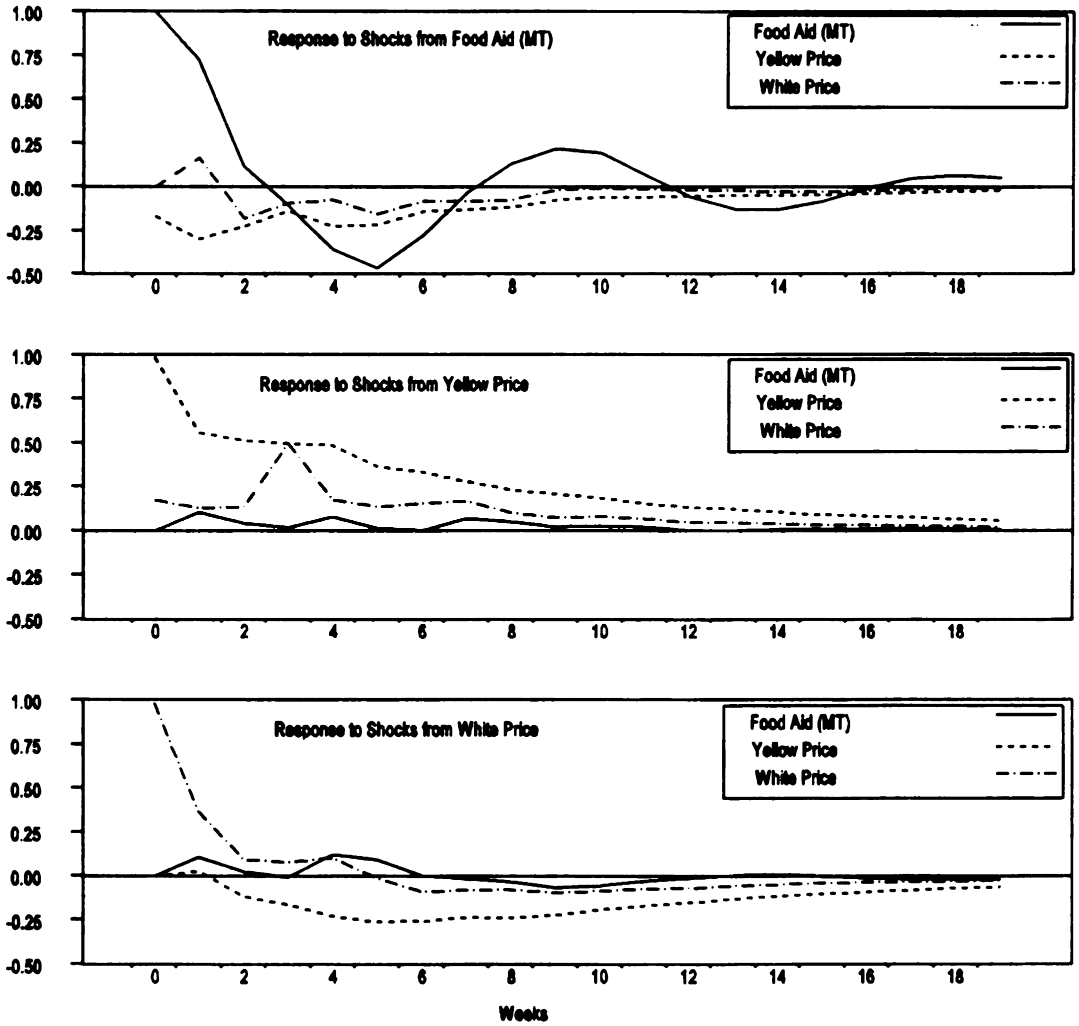

Figure 6.4 Impulse responses to shocks, based on recursive model FA, WP, YP, with hungry season variable, in post-war/drought period

Historical simulations were conducted to understand how the white and yellow maize prices might have been affected had one or both of the major shipments not occurred for the hungry season that year. Removal of both major shipments was simulated by setting the actual food aid arrivals to zero and estimating a new path for the food aid shocks, while maintaining the previously observed shocks in yellow and white maize prices. As can be seen in Figure 6.5, yellow maize prices would have been higher throughout the simulation period. The average price in January was 99 meticais/kg; the simulated average price was 147 meticais/kg, almost 50 percent higher; for February, the average yellow maize prices were 94 and 149 meticais/kg for actual and simulated, respectively, almost 60 percent higher in the simulation.

In the November - January period, the simulation shows little difference between the actual and the simulated white maize prices, but by February and March, the actual average price was 183 meticais/kg whereas the simulated prices rise to 202 meticais/kg, about 10 percent higher than the observed.

In the belief that there may be seasonality in white maize prices and food aid deliveries, the simulation was also estimated with the hungry season variable included. The results are presented in Figure 6.6. The actual white maize price of 183 meticais/kg compares to 208 simulated, 14 percent higher than the actual. For yellow maize, the simulated prices averaged 160 for February and March, a 76 percent increase over the observed price average of 91 meticais/kg during the period.

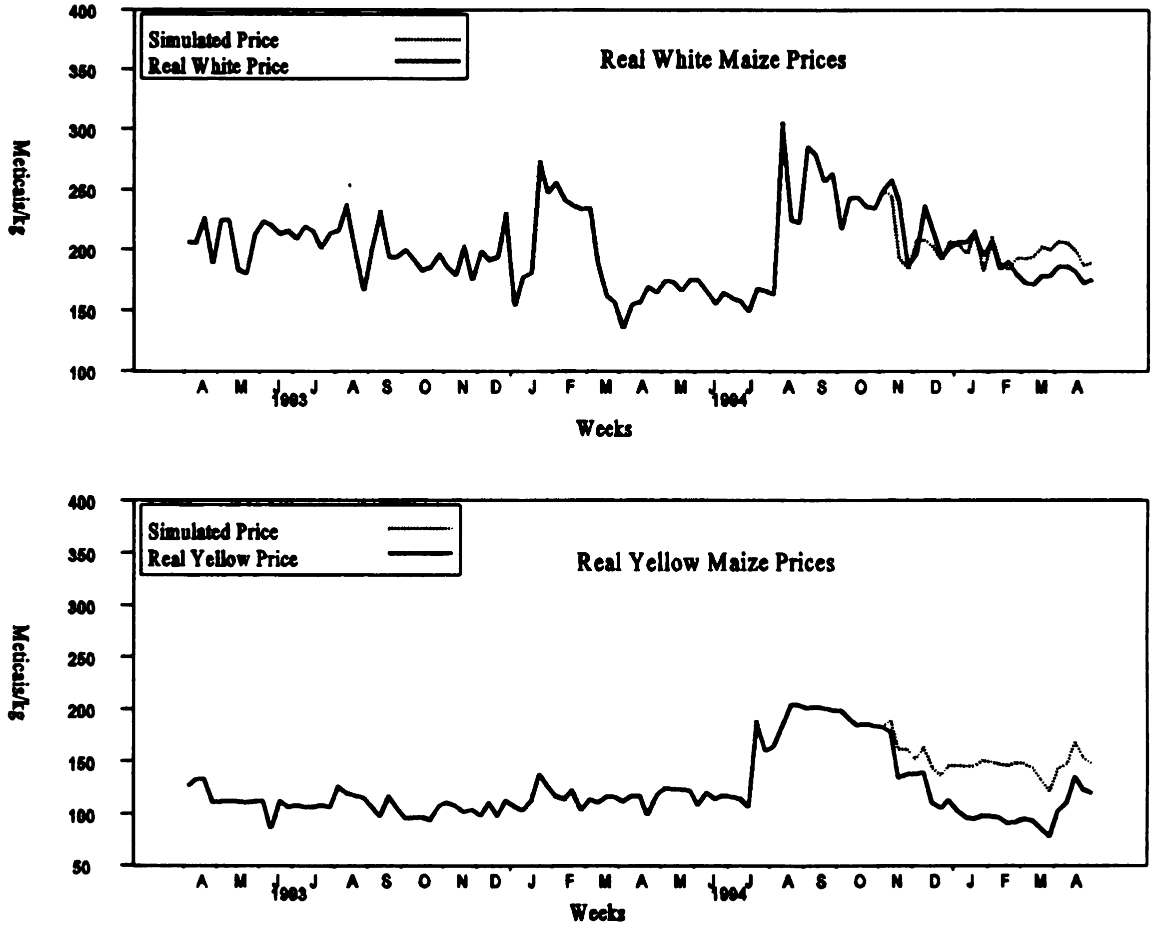

Figure 6.5 Simulation in the post-war/drought period with no food aid from November 1994 - January 1995 (recursive, 4 lags)

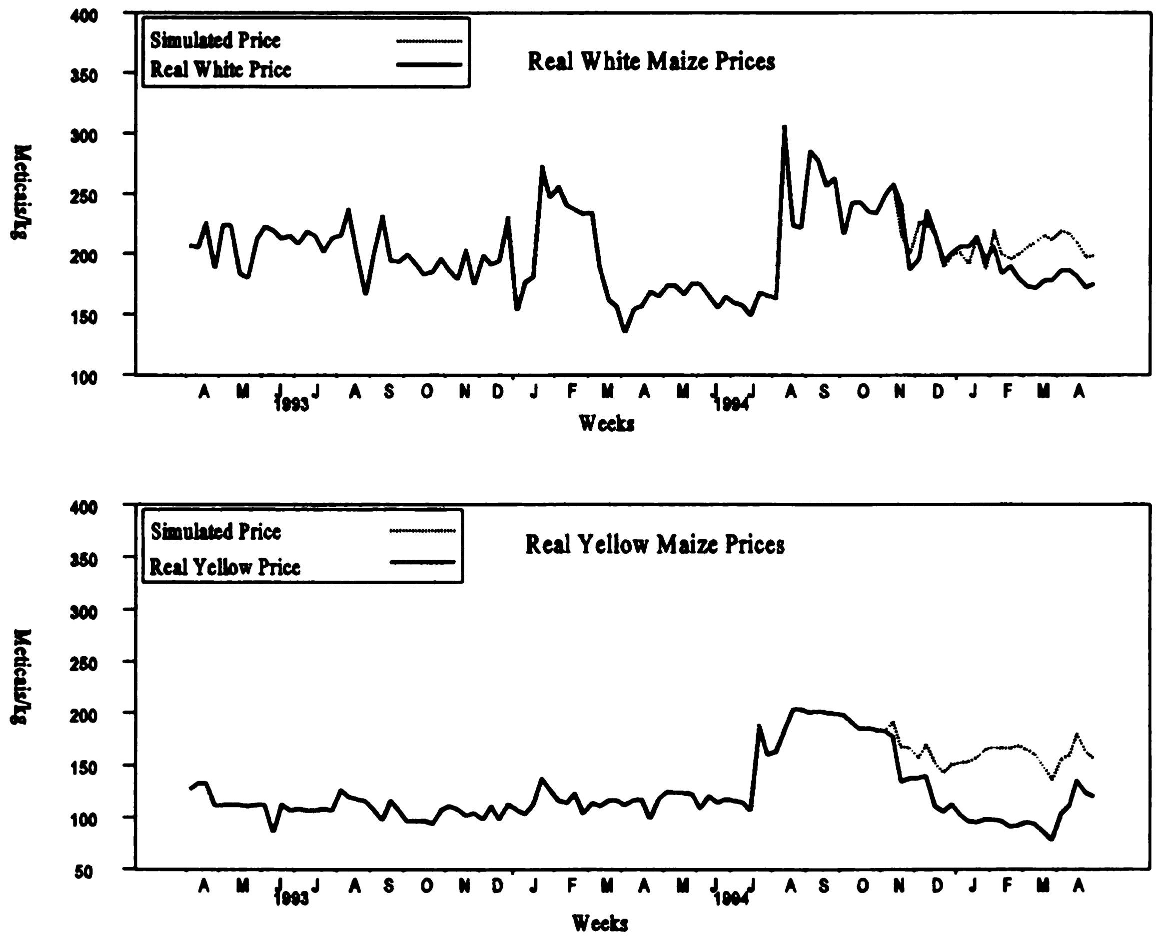

Figure 6.6 Simulation in post-war/drought period with no food aid from November 1994 - January 1995, with hungry season variable

Excluding only the January shipment had a diminished impact, as shown in Figure 6.7. [4] The impact on white maize prices was felt gradually over time, whereas the impact on yellow maize prices was immediate, but for both series, the effects extended into March and April. As all of these simulations demonstrate, consumers in Maputo benefited from the commercial food aid arrivals through the lower maize prices, with both yellow and white maize prices lowered by the food aid arrivals.

In the post-war/drought period, with greater availability of white maize products and more active markets, the food aid effects appear to be important in determining prices in the Maputo market, more so than in the war/drought period when the white maize prices were driven by scarcity. Thinking of the underlying market structure, shocks from the white maize markets would decline in importance as supplies become more available and production recuperates, providing a more regular flow of maize to the urban markets, with expected seasonal fluctuations. Food aid arrivals remain a source of shocks in the system, due to difficulties in planning and lack of information available in the markets concerning arrivals, quality of product, and government price. Thus, significant price effects, sustained over time, are probable with large food aid arrivals during the current period of greater market activity and renewed domestic white maize production and trade.

[4] The simulation for excluding the January shipment based on the recursive model with the hungry season variable included was estimated, with qualitatively similar results, and so the plot is not included here.

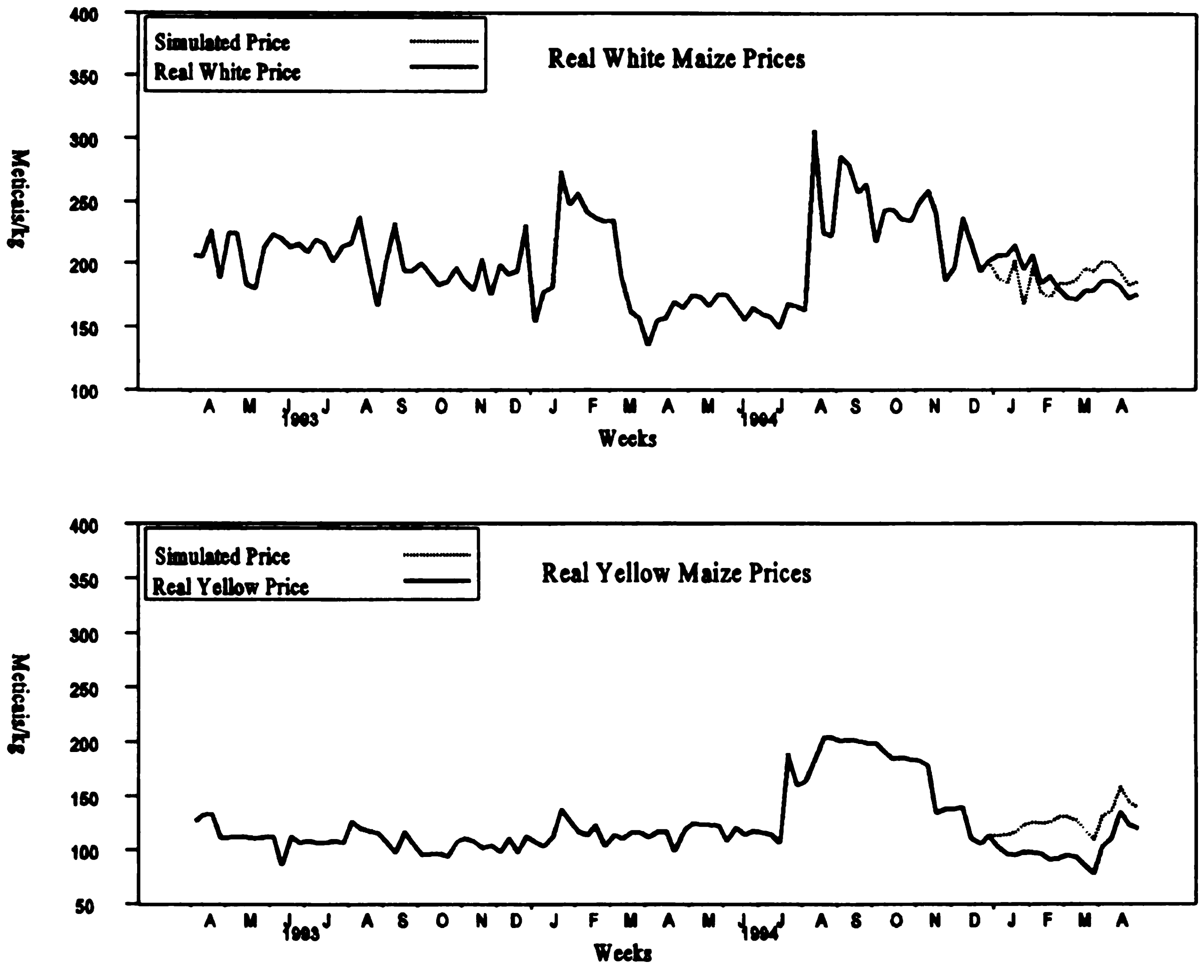

Figure 6.7 Simulation in the post-war/drought period with no food aid in January 1995 (recursive, 4 lags)

6.5.7 Alternative identification schemes and orders

In order to judge the robustness of the model for the post-war/drought period, the impulse responses and forecast error variance decompositions were estimated for alternative models. The historical simulations were also estimated with alternative identifications. The results of the same simultaneous identification used in the war/drought period, as well as the same recursive identification (white maize price, food aid deliveries, yellow maize price) are reported in Appendix B. In the case of the simultaneous model, the impulse responses are very similar for white and yellow maize price responses to a food aid delivery shock. White maize prices respond negatively to food aid arrivals only after six periods, with the initial response positive, as was the case with the recursive model without the hungry season variable included.

The results of a recursive model with white maize price first, then food aid deliveries, and finally yellow maize price, as was used in the war/drought period, show no dramatic differences from the chosen recursive model in this period, with food aid quantities forst, followed by yellow maize price and then white maize price. Estimating the recursive model with seven lags, rather than the selected four lags, gives results that are qualitatively similar to the four lag model, with the exception of a more pronounced oscillation of food aid deliveries to own shocks (Figure B.6). Thus, the results of the alternative specifications indicate the robustness of the realtionships between food aid deliveries, yellow maize prices, and white maize prices.

6.6 Summary of the VAR results

The VARs presented in this chapter are designed to evaluate the effects of *ex ante* unpredictable fluctuations in prices and food aid deliveries, allowing unrestricted dynamic interactions between the variables. This focuses on market uncertainty, a major concern for traders in these markets and the policy makers who are trying to foment private market development. Identification of the shocks with meaningful economic interpretation is critical and involves judgment and knowledge of the markets. The results may over-estimate the influence of commercial food aid if emergency food aid supplies were also contributing to the fluctuations, although leakage of emergency supplies into the markets is thought to be substantially lower in the later period when greater administrative controls were placed on supplies.

In the war/drought period, the analysis brought out the importance of white maize prices in the markets. In a country without a futures market and little large-scale, off-farm interseasonal stocking, white maize prices play an important role and may be the key factor forming expectations in the maize trade sector. The extreme scarcity of white maize in the markets enhances its role in the formation of expectations for highly volatile markets. Yellow maize prices do not form the basis for expectations since yellow maize prices are influenced by quantities that the formal traders withdraw, whereas the white maize prices establish an observable reference price.

During this war/drought period with high volatility, it is possible that much of the dynamics between food aid deliveries and maize prices is captured in the structure of the lagged relationships. The forecast error variances for each series explained mostly by each series' own shocks rather than by shocks from the other series. The standard deviation in food aid delivery shocks in this war/drought period is twice the volume (2600 metric tons) of the later period (1250 metric tons), and prices are also more variable. It would be inaccurate to assume that the food aid arrivals are the cause of the instability of prices during this period. The VARs demonstrate that much of the variability in white maize prices is due to own supply and demand shocks, rather than yellow maize demand and supply effects.

In the post-war/drought period, food aid takes a more important role in determining fluctuations in the yellow maize prices, which in turn account for a substantial amount of white maize price variations. Food aid remains, in the short run, exogenous to the other two series, determined through the policy process. Given the infrequency of the food aid shipments during this period, the deliveries in port and the factors influencing those delivery dates take precedence over domestic supply and demand factors in the short run. Yellow prices sustain the downward effect of food aid delivery shocks, while white maize prices become lower only after seven periods with the food aid shocks.

Food aid deliveries do affect the white maize prices in both periods, more strongly in the post-war/drought period. The simulations indicate that both yellow and white maize prices would have been higher without the maize food aid deliveries in late 1994 and early 1995. The lower **average** price with food aid deliveries, though, is coupled with *ex ante* unpredictable fluctuations from those deliveries. The formal traders view this as the worst of both worlds: lower mean prices and higher downside price risk, when risk is interpreted as unpredictable fluctuations. The consumers clearly benefit in the short run from the lower average retail prices for both yellow and white maize when there are positive food aid shocks.[5] In the long run, if formal traders withhold investments in the marketing system and the government is withdrawing from market participation, marketing costs for domestic maize will be very high, and there will be no yellow maize food aid arrivals to dampen the prices. Informal traders are currently operating in this environment with unpredictable risks, but the per unit marketing costs are relatively high with individual quantities small. World market prices will place a ceiling on the domestic white maize prices, as supplies in South Africa and elsewhere become available for import into Mozambique, so reducing marketing margins may be important in improving competitiveness of the domestic white maize in the major urban markets, especially Maputo.

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[5] Recent events in Mozambique, with the possible suspension of Title III yellow maize shipments that were expected to arrive in early 1996, may cause great hardship for consumers. Traders, both formal and informal, may have acted upon the expectation of at least some food aid arrivals, not engaging in intraseasonal storage of white maize. Unexpected withdrawal of all of the yellow maize supplies in the hungry season may cause extreme price spikes in markets unprepared for the scarcity. In this case, donors did announce the arrivals with at least 3 months anticipation.

Chapter 7

Market Integration and Transmission of Shocks

7.1 Issues

The previous chapters have shown that food aid delivery shocks in Maputo, the capital city, have important effects on market prices for white and yellow maize in Maputo. This chapter takes that analysis one step further by examining the extent to which prices in the Maputo market have effects on prices in the markets of Chimoio, a small city in the central production regions (see Figure 7.1).

The analysis uses weekly white grain retail prices from Maputo and Chimoio from April 3, 1993 through November 25, 1995, shown in Figure 7.2. The earlier analysis of food aid and prices in Maputo only went through April 1995 because detailed food aid data for the May through December 1995 period were not available at the time the analysis was undertaken. Market price data are more readily available, and given the possibility of incorporating an additional marketing season, the data through November 1995 were selected for this market integration work. Due to structural changes in the markets, as evidenced by changes in distribution of the data, the analysis is broken into two periods: 1) war/drought period, April 3, 1993 - August 6, 1994; and 2) post-war/drought, August 13, 1994 - November 25, 1995. The war/drought period in this case begins later and

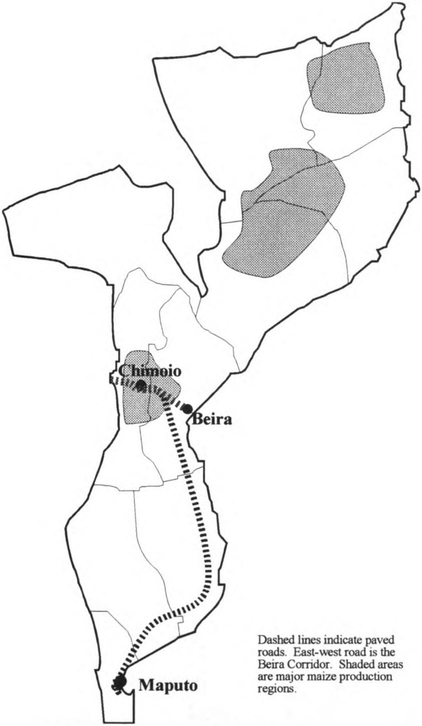
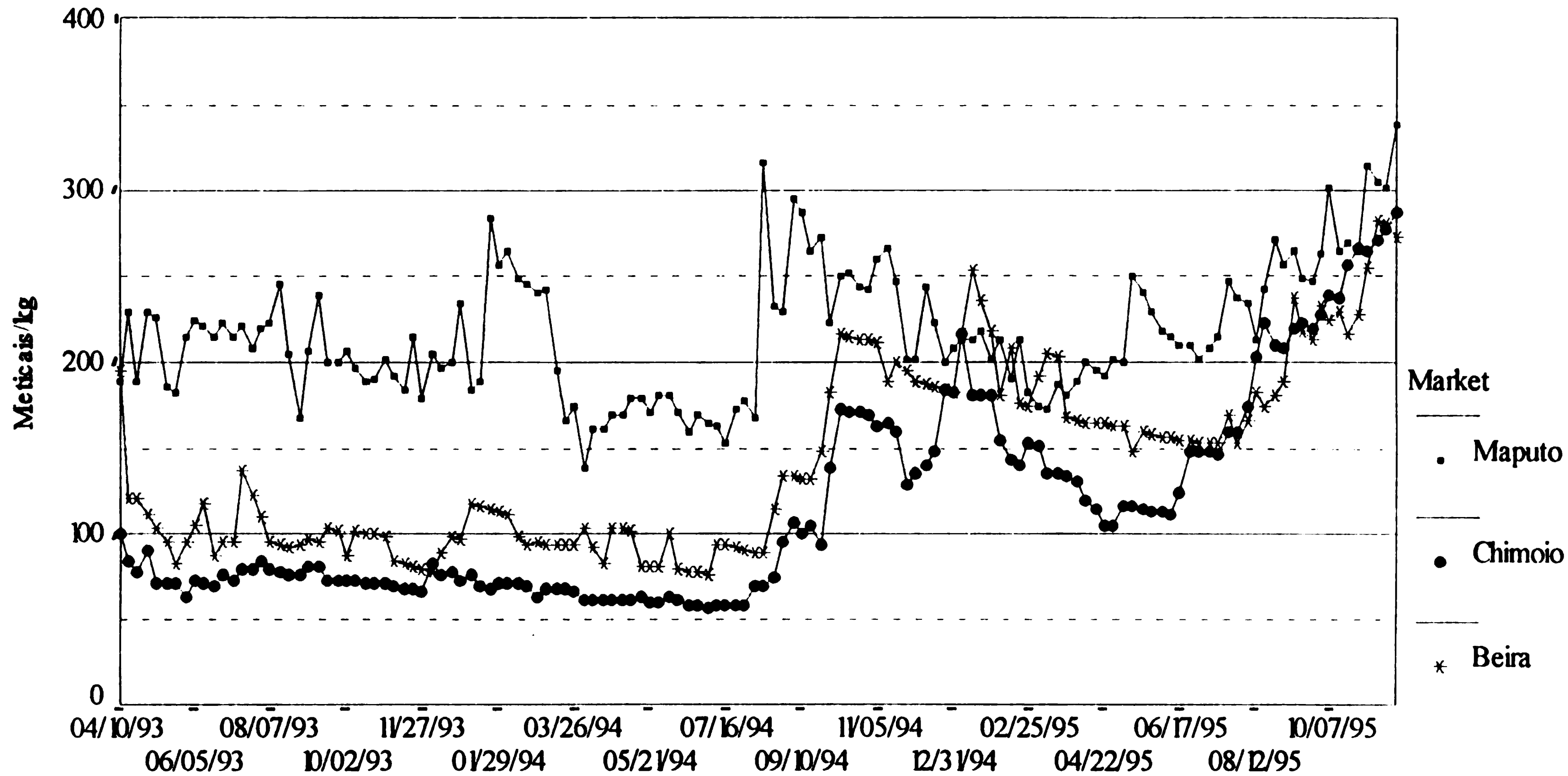


Figure 7.1 Map of Mozambique with Chimoio, Beira, and Maputo



Source: MAP/MSU SIMA database. CPI deflator: 1989=100

Figure 7.2 Real white maize grain prices for Maputo, Chimoio, and Beira continues through August 6, 1993. While the Peace Accord was signed in October of 1992, the recovery period in different parts of the country has varied. In the case of Chimoio, visual inspection of the price data confirms that the structural changes in the market happenned at a later date. Analysis will show the war/drought period as one of relatively poor market integration, whereas the post-war/drought period demonstrates improved market integration.

Stationarity testing of the time series with the more recent months indicates that the price series may have stochastic trends, indicating that shocks could have permanent effects. This issue will be addressed in detail later in the chapter.

Market integration issues have been developed since the mid-1970s using a variety of econometric methods. An integrated market is defined as a "market in which prices of differentiated products do not behave independently" (Monke and Petzel, 1984, p.482). That differentiation can take the form of spatial or temporal differences for identical products or product differences in the same market location. The VAR analysis of white and yellow maize prices in the previous chapter could be classified as market integration for the **cross-product** markets. Clearly the white and yellow maize markets within the Xipamanine marketplace in Maputo are integrated, at least to some extent. In this chapter, **spatial** market integration will be the focus, evaluating how white maize prices in Maputo and white maize prices in Chimoio are related over time. More specifically, the reaction of each market to shocks from own demand and supply as well as from the other market factors, will be evaluated.

7.2 Concepts

7.2.1 Law of One Price and spatial equilibrium

The Law of One Price, as stated by Fackler (1994), is an arbitrage condition such that, "in an efficient market, prices at any two locations will differ at most by the cost of transport between the two locations and that this difference should be exact if there are any commodity flows between the two locations" (p.1). Takayama and Judge (1971) formalized this condition with the concept of spatial market integration and spatial equilibrium. Given prices for identical goods in separate market locations between which there is no trade currently, the margin between prices should be less than the transport costs, resulting in the no-trade equilibrium.

The transaction cost literature has suggested broadening the margin between the two prices to include all transaction costs, not just transport costs. When transaction costs are high, there can be a wide no-trade band in which price differences between the two markets may be high but the differences do not cover the transaction costs and there is no trade (Baulch 1994). These market locations may have constant information flows, leaving open the possibility of actual trade if the margins widen or the costs go down, and so the markets may be integrated without actual trade. Poor market integration would be indicated by repeated cases of a margin that would cover or exceed transaction costs, without any trader taking advantage of the arbitrage opportunities.

7.2.2 Market integration

Considering market integration as an absolute concept in which markets are classified either as "integrated" or "not integrated" reduces the value of the concept. The interest in market integration in the current research is not in whether or not the Chimoio market is integrated with the Maputo market. We know from field observations that there is some integration between the two markets, such that a "yes-no" classification would have little value. Of greater interest is the degree of market integration or the speed and degree to which price shocks from one market may be transmitted to prices in the other market and how long those effects may be felt. The important policy question is whether market integration is improving as investments are made in infrastructure and market institutions, including the market rules and information systems. This relates to Ravallion's question: "how long can an initially localized scarcity be expected to persist?" (1986, p.103). Do the Chimoio markets respond when there is a scarcity in Maputo, and if so, to what extent? Has this responsiveness changed over time? Similar questions can be formulated with regard to yellow maize gluts in Maputo and the response of markets to excess supply.

As Faminow and Benson (1990) stress, the interpretation of correlation coefficients and other statistics on prices across markets depends upon market organization. High correlation between prices may be accounted for by base-point pricing, by oligopoly with spatially dispersed buyers, by oligopsony with spatially dispersed sellers, by government administration, or by effective, competitive markets (Faminow and Benson 1990).

Knowledge of market structure thus becomes important in interpreting the statistical relationships found.

Fackler (1993) discusses the issue of direction of causality in price movements, when researchers attempt to attribute price movements in one market to price changes in another. "This makes sense in an oligopolistic market structure in which firms are acting as price setters" but in the competitive framework, prices are endogenously determined such that the effects of a change in price in one region on prices on other regions depend upon what caused the price change and how the regions are related. On the cause of the change, Fackler gives the example of the different effects of lowering transport costs and of shifting excess demand. The source of a price change (whether demand, production, transport, etc.) at one level will affect the price changes at other levels. Thus, the conclusions drawn from spatial price analysis may be limited.

7.2.3 Recent additions to the literature

Barrett (forthcoming) classifies market analyses based upon the data used for analysis, and the consequent ability to answer key questions. Analyses that use solely prices for commodities are considered Level I methods, with a limited ability to examine causality. Much of the early work on market integration and the current work using cointegration methods is based solely on prices. With the advancement of econometric theory on nonstationary time series, researchers have used cointegration theory to evaluate relationships between prices, as in the work of Mendoza and Rosegrant (1994), Goletti (1993), and Alderman (1993).

The second direction of research, Barrett's Levels II and III, is based upon dissatisfaction with the information that prices alone can give. Level II methods incorporate transport and other transaction cost information in order to evaluate margins and trade. Finally, Level III includes price and trade flow data, enabling researchers to use margins as a reflection of expected trade profitability. Loveridge (1988) included flow information in his bivariate correlation analyses for market integration in Rwanda. Fackler (1994), Baulch (1995), and Barrett (forthcoming) include transport or transaction costs along with prices in determining relative price movements and trade. In particular, Baulch (1994) develops a parity bounds model, evaluating the price differential between markets and comparing it to transport and other transaction costs. If the differential is higher than the transaction costs, there is a lost arbitrage opportunity and the parity bounds are violated. The parity bounds model allows for periods in which there may be no actual trade because the differential is insufficient to cover the transaction costs, yet the markets remain connected in terms of information exchange.

7.2.4 Mozambique research

The VAR approach chosen for this research only requires data on prices and can investigate the extent to which shocks in one market get transmitted to other markets. However, the VAR approach cannot address some of the traditional market integration issues. For example, the flow or direction of trade cannot be determined using only price data. The supply and demand relationships are left unrestricted over time in the VARs while the focus is placed upon the *ex ante* unpredictable fluctuations in prices.

Without restrictions on supply and demand, and using only price data, the VAR methodology cannot trace back shocks to their specific sources, whether from changes in transport costs or other transaction costs or from food aid arrivals or weather shocks. For purposes of the present analysis, the question is confined to studying the degree to which the *ex ante* unpredictable price fluctuations are related between products in two key spatially separated markets. More specifically, we wish to determine if shocks to Maputo prices influence Chimoio prices, as well as whether Chimoio shocks affect Maputo prices.

Furthermore, if a shock does have some effect, how many periods does it take to be transmitted from Maputo to Chimoio and in the other direction? The rapid appraisal found that itinerant informal traders take about two days to leave Maputo, arrive in the vicinity of Chimoio, and begin buying. It then takes the informal traders at least one to two weeks in order to purchase sufficient quantities of maize and return to the Maputo markets with the maize. At a minimum then, it should take at least a week for price shocks from Chimoio to reach Maputo, since traders rely upon personal communication and observation for their information. It could take much less than that in the Maputo - Chimoio direction, because traders travel directly from Maputo and begin buying and communicating the relevant Maputo prices. It is the reliance of the informal traders on direct observation and personal communication with other trades than may result in lags in the flow of information.

Another aspect to consider is the price information that farm producers obtain. If there is no competition between traders for the product, and market information is scarce, farmers may not know about positive price shifts in the urban markets and traders may be able to capture the difference. This would mean a lack of price movement in the production areas. With competition between traders or improved market information or both, farmers may be able to negotiate a better price. When there are price increases in Maputo due to an increase in demand, farm producers will be able to bargain for a higher price as well.

7.3 Organization of the markets

7.3.1 Maputo, Chimoio, and Beira maize markets

As will be seen, markets in Chimoio and Maputo were chosen for the current analysis, however a look at the broader market context is needed. Maputo is a consumption market with strong demand pull for white maize. The population of Maputo is estimated at over one million people with only low-potential agricultural land nearby. In the 1994 preference study, almost 95 percent of households said that they rely primarily upon the market for their maize supplies (MAP/MSU WP#18 1994). As was discussed in Chapter 3, the Maputo markets are active in maize trading, with both white and yellow maize products available to consumers. The yellow maize commercial food aid arrivals are greatest in Maputo; 65 to 70 percent of all shipments arrive in Maputo, with the rest arriving in Beira. Given the large population living in poverty, the political importance of the capital city, and the reliance of the population on market maize supplies, Maputo will continue to be the most likely distribution point for commercial food aid.

On the production side of the maize markets, the center region of the country is recognized as a surplus production area. The map of Mozambique (Figure 7.1) shows the small city of Chimoio, located in Manica Province in the center region, near the Zimbabwe border. Provincial production in the 1993/94 agricultural year for Manica Province was estimated to be 100,000 metric tons, the largest in the country that year. The Chimoio region is the nearest major production area to Maputo, but it is still 1,150 kms from Maputo (at least 18 hours driving time) along paved roads, as shown in Figure 7.1.

The Beira Corridor is the main road transport route from Zimbabwe (on the west) to the port city of Beira. The road was maintained open throughout the war, but there were periods when transport had to travel in convoys with a military escort in order to safely transit, so trade has been limited in the recent past. There is a north-south connecting highway from the Beira Corridor that ends in Maputo, as noted in Figure 7.1, however that road was unsafe and unusable during the war due to landmines and attacks. After the Peace Accords, during late 1992 and 1993, the road was de-mined and repaired, and road transport began to move again between the Beira Corridor and Maputo.

Although the northern provinces (Nampula, Zambezia, and Cabo Delgado) each produce larger quantities of maize in most years, the infrastructure linking them to major markets is weak and transport is costly between the southern consumption zones and the northern production zones. North-south trade is increasing but infrastructural investments (roads, rails, and ports) are necessary for the northern maize to compete in the consumption markets of the south with imports from South Africa and elsewhere and with domestic production from the center.

At the east end of the Beira Corridor, Beira is the other large consumption market for Chimoio maize. Beira is the capital of Sofala province, has major international port facilities, and has an estimated population of 400,000. It is located only 200 kilometers from Chimoio, about three hours of travel along the fairly good roads of the Beira Corridor. According to the household survey of provincial capitals, 67 percent of the households in Beira have agricultural plots of some kind, however the value of own consumption was only 3 percent of total estimated household income (Mozambique, Republic of, CNP/DNE 1992), so reliance on the market is still high to meet maize consumption needs. Chimoio is the nearest major production region for Beira traders, because the agriculturally rich regions of Zambezia province are separated from Sofala province by the Zambezi River, for which only a ferry crossing has been available until recently.

As noted in Chapter 3, interviews with traders in Beira and Chimoio revealed actual trade between these two markets, as well as between Maputo and Chimoio. The quantities traded vary through the seasons, with informal traders still present in the rural areas of Manica province during the hungry season months. There is no evidence of reversed white maize trade flows from Maputo into Chimoio, although that may change if there are imports with relatively low prices from South Africa or elsewhere into the ports, and there may already be such reversalsfrom Beira.[1] In the future, trade reversals might develop for

[1] Yellow maize trade issues will be discussed below.

white maize if formal traders begin to take advantage of interseasonal arbitrage opportunities, buying and storing white maize.

7.3.2 Static measures of price relationships between Maputo, Beira, and Chimoio

As Figure 7.2 shows, prices in the three markets are closely linked. The cross-price correlations of the nominal series are significant and high for all three possible pairs but that may be explained, at least partially, by a common inflationary trend so the real series were evaluated. The bivariate cross-price correlation between Maputo and Chimoio real prices was still significant, but with a value of 0.59, as shown in Table 7.1. The Chimoio and Beira real white maize prices are highly correlated.

First differences (y_t - y_{t-1}) can be thought of as the weekly changes in prices in a given market, but the correlations only capture contemporaneous correlation of those changes. If there is a lag in the response of one market to changes in the prices in another market, these simple correlations will not capture it. The cross-price correlation coefficient between the first differences of the real prices is not significant for Maputo and Chimoio, nor for Maputo and Beira. Only between Chimoio and Beira is there a significant correlation, with a value of 0.26.

It is clear that Beira markets influence the prices in Chimoio, in addition to the influence from Maputo markets. During the rapid appraisal, researchers observed Maputo itinerant traders competing directly with Beira itinerant traders in these rural markets. Most of the informal Maputo traders are women who are Changana speakers, while most of the Beira

Table 7.1 Cross-price correlation coefficients for nominal and real white maize grain prices: levels and first differences for April 1993 - November 1995 period, Maputo, Chimoio, and Beira

Market	Maputo	Chimoio	Beira
Nominal prices in levels			
Maputo		0.67***	0.92***
Chimoio	0.67***		0.97***
Beira	0.92***	0.97***	
Real prices in levels			
Maputo		0.59***	0.52***
Chimoio	0.59***		0.92***
Beira	0.52***	0.92***	
First differences of real prices			
Maputo		0.01	-0.13
Chimoio	0.01		0.26***
Beira	-0.13	0.26***	

Note: *** indicates significant at the 0.01 level.

Source: MAP/MSU SIMA database.

traders are men speaking Ndau or other languages, forming clear cultural as well as gender differences between the trading groups. The informal Maputo traders, however, do not pass through Beira on their way to the Chimoio region and there is no evidence that the Beira markets are considered an alternative sales point for the Maputo traders.

The Maputo and Chimoio markets were chosen for the analysis in this chapter, focusing on the arbitrage opportunities of the Maputo traders and Chimoio area producers. This continues the focus in the earlier chapters, in which food aid effects on Maputo prices are evaluated. Note that we cannot trace out the specific effects of food aid shocks on the Chimoio prices for there is limited data available on supply sources to Chimoio. Commercial food aid arrives in both Beira and Maputo, with each shipment of food aid partioned such that one-third goes to Beira and the rest to Maputo. Without detailed Beira arrivals data, food aid specific shocks cannot be identified.

Maintaining the focus on the Maputo-Chimoio link does not exclude the Beira influence, but leaves it in the underlying dynamics, particularly in the remaining unexplained sources of shocks in Chimoio after the effects of the Maputo shocks are identified. If Maputo and Beira price shocks happen at the same time, the estimated effects of Maputo shocks may be capturing some of the Beira effects. However, inspection of Figure 7.2 suggests that own price shocks in Chimoio, rather than Maputo price shocks, may incorporate much of the influence of Beira. The analysis of the relationship between all three markets (the production market and its two main consumption markets) would be an additional level of complexity, a valuable extension of this bivariate analysis.

Chimoio is the largest surplus production area most likely to be influenced by Maputo prices. Maputo is the largest market and receives the greatest quantities of commercial food aid. Finding no transmission of price effects from Maputo to Chimoio would be a strong statement that direct producer price disincentives of yellow maize food arrivals were not felt in the production region, given that yellow maize did not arrive in Chimoio for much of the period under analysis here.

7.3.3 Yellow maize

Yellow maize was not selected for this integration analysis for various reasons. Yellow maize products are not regularly available in the markets in Chimoio. Of the 131 weeks of recorded SIMA data in Chimoio during the April 3, 1993 - November 25, 1995 period, there was no yellow maize grain available in the Chimoio markets 81 percent of the weeks, as shown in Figure 7.3. The grain was considered scarce in Chimoio for another 3 percent of the weeks. This compares to Maputo numbers of 19 and 24 percent of cases for missing and scarce, respectively, as shown in Figure 7.4. For Beira, shown in Figure 7.5, about 44 percent of the weeks for which information is available, no yellow maize was found in the market and 22 percent of the time yellow maize grain was scarce in the market.[2]

In addition, the yellow maize available in production areas may come from several different sources: 1) commercial food aid sold in Maputo or Beira and transported by

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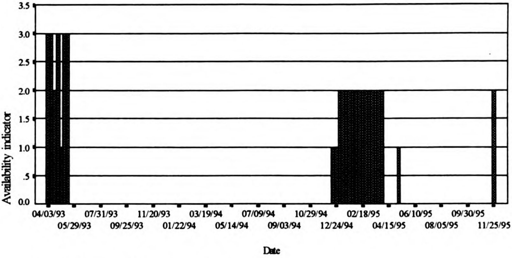
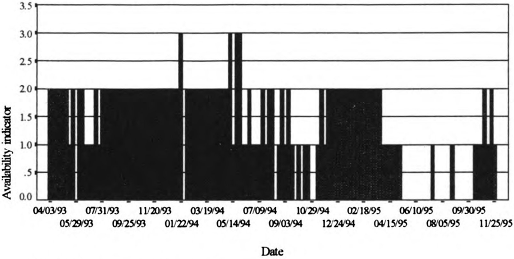
[2] There was no information available for 20 out of 137 weeks during the period in Beira.



Note: "0" indicates not available; "3" indicates plentiful in market.

Source: MAP/MSU SIMA dataset.

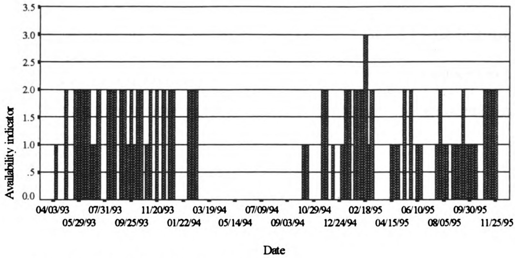
Figure 7.3 Qualitative assessment of yellow maize grain availability in Chimoio markets, April 3, 1993 - November 25, 1995



Note: "0" indicates not available; "3" indicates plentiful in market.

Source: MAP/MSU SIMA dataset.

Figure 7.4 Qualitative assessment of yellow maize grain availability in Maputo markets, April 3, 1993 - November 25, 1995



Note: "0" indicates not available; "3" indicates plentiful in market.

Source: MAP/MSU SIMA dataset.

Figure 7.5 Qualitative assessment of yellow maize grain availability in Beira markets, April 3 1993 - November 25, 1995 traders to Manica; 2) emergency food aid supplies distributed in the region and sold by recipients; 3) emergency food aid supplies stolen from distributors; or 4) informal commercial imports from Zimbabwe or elsewhere of yellow maize, primarily flours. This is in contrast to Maputo, where most of the yellow maize grain on the market has come from commercial food aid arrivals, and, in earlier periods, from leakages of emergency food aid supplies in transit.

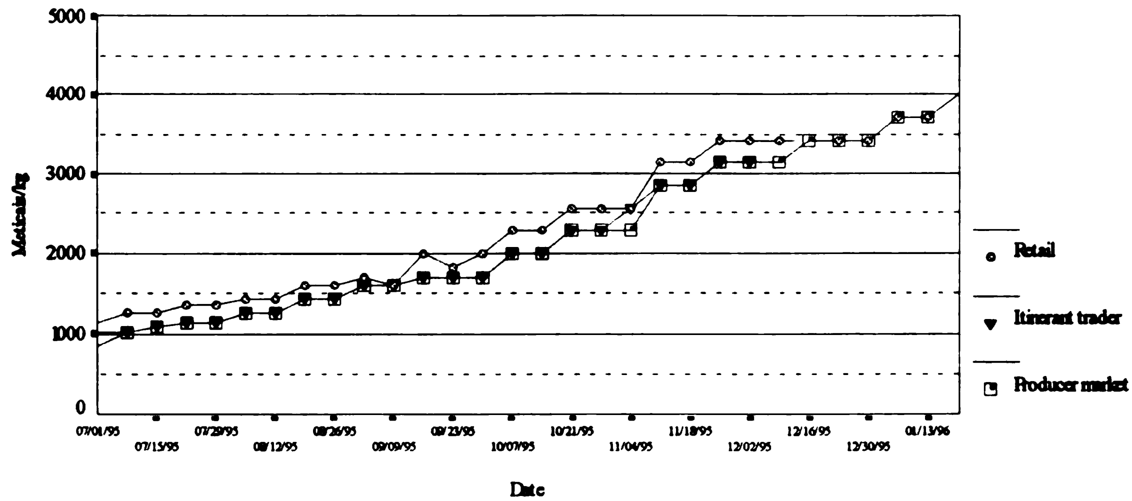
7.4 Data considerations

7.4.1 Weekly data

Weekly prices will be used in this analysis. As noted earlier, itinerant traders can easily make one round trip, and possibly two, in a month from Maputo, out to Chimoio to buy maize, and then back to sell the maize. Therefore, weekly price variations are important to capture changes in their behavior. As the earlier analysis showed, the food aid arrivals can influence markets rapidly, and weekly data help to evaluate how that works through the marketing system.

7.4.2 Retail prices as a proxy for producer prices

As previously noted, producer prices for locally produced white maize are not available for the period under study. However, retail prices in the markets in producing areas have been collected on a weekly basis since December 1992. In July 1995, a new producer price collection system was designed by PSA-MSU researchers taking into account the different marketing options that may be available to producers. In the center region part of the country, the region near Manica City (about 50 kilometers west of Chimoio) was



Source: MAP/MSU SIMA database.

Figure 7.6 White maize grain prices at retail, itinerant trader, and producer market levels in Manica, July 1, 1995 - February 2, 1996

chosen as the data collection point. As Figure 7.6 shows, retail market prices provide a good proxy for producer prices based on either the producer marketplace or the itinerant trader. For the July 1995 - February 1996, retail prices are an average 10 percent higher than the producer market prices, and for the July - December 1995 period, an average 13 percent higher than the itinerant trader level. The cross-price correlation coefficients are 0.99, while the correlation coefficients for the first differences are 0.70 between retail and informal levels, 0.77 between informal and producer market levels, and 0.87 between producer market and retail levels, all highly significant. Thus, retail market prices are reasonable proxies for the prices faced by farmers in these production regions.

7.4.3 Grain as the selected commodity

In the current research, the focus will be on white maize grain, the locally produced, unprocessed product. Since there are no industrial mills based near Chimoio, white maize destined for other markets leaves in an unprocessed form. The proliferation of small hammer mills in urban areas and the continued practice of home processing means that white maize grain can be found readily in the consumption area markets, other than during drought and economic crisis.

7.4.4 Prices and costs of trade

The analysis of Chapter 6 shows that white maize prices in Maputo are affected by both food aid supply shocks and yellow maize price shocks from the demand side. In modeling the relationships between the markets, transport and transaction costs must also be considered. Ravallion (1986) shows that levels of price data (rather than logs) should be used if transport data can be considered as a cost per unit rather than an ad valorem fee. In Mozambique, transport costs are per unit volume or weight (90 kg sack, for example), not by value of commodity, thus price levels will be used in the analysis.

Following the analysis in Chapter 6, April 3, 1993 was chosen as the starting date for the analysis. This date marks the beginning of the first harvest in the post-war, post-drought period. Figure 7.2 shows the two data series over the April 3, 1993 - November 25, 1995 period of analysis, along with the Beira prices. The analysis in Chapter 6 used data through April 1995. The addition of the May through November 1995 data for the market integration work allows the analysis to incorporate an additional marketing season.

However, the additional months have important consequences for the modeling the entire series. Both the Maputo and Chimoio price series indicate the possible presence of stochastic trends in the later part of the period, when markets are thought to be more integrated. This will be discussed in greater detail below.

7.4.5 Seasonality

Seasonality may be one underlying reason for this finding of nonstationarity. With the harvest season each year the price declines and then gradually increases over time through February and possibly March. These data end in November as the price in on the increase, seemingly to some new level, yet when harvest occurs the prices will once again come down. As domestic white maize production increases and becomes the dominant maize in the markets, this typical seasonal pattern for a storable commodity develops with the prices. As will be seen in the univariate testing, the inclusion of simple seasonal indicator variables did not result in stationarity. The time series is too short to adequately identify the seasonal components, so more detailed seasonality modeling will have to await a longer data series.

7.4.6 Stochastic trends in the data

The question remains: could there be stochastic trends in real maize prices in Chimoio and Maputo? What would be the source(s) for such trends? If the economy is now making adjustments after the war, and with the dismantling of the command-based economic system, there may be adjustments that compensate for misalignment in prices during those periods. Nonstationarity would be indicated, as shocks would have long term effects, permanently shifting price levels. Over the long run, these would be captured as single exogenous shifts rather than stochastic trends. Regardless of the cause of the nonstationarity results, researchers need to evaluate whether or not traditional hypothesis tests and parameter estimates based on asymptotic distribution theory are valid in the presence of such nonstationarity (Sims, et al. 1990).

7.4.7 Structural break in the prices

The Peace Accord was signed in late 1992, but the roads did not become easily transited for months, because both demining and rehabilitation of the main routes and feeder roads was needed. The Chimoio white maize price graph clearly shows a change in mid-1994. Prior to that period, there is no evidence of significant maize trade between Maputo and Chimoio. In the Chimoio market, demand was apparently thin while supply was high relative to demand, so that the price remained basically at a floor price over long periods. With the marketing season of 1994, the activities of the itinerant traders increased in the center production zones. ICM began a major purchasing effort in the Chimoio zone in early August 1994, when funds become available. The demand for maize in the Chimoio markets increased, consequently so did the price. Chimoio went from relatively inactive maize markets to very active markets during this period.

7.4.8 Margins and trade development

It unclear whether the increase in informal maize trade was due to increased gross margins between prices, increased transport availability, lowered transport and other transaction costs, increased information about maize supplies and arbitrage opportunities, or some other factor. Figure 7.7 shows the gross margin (in real meticais/kg) between Maputo and Chimoio retail real prices for white maize during the period of study.[3] The margin for white maize grain during 1993 was between 100 and 150 meticais/kg and increased in early 1994 reaching 200 meticais/kg. The margin fell in April 1994 to about 100 meticais/kg and the margin rose again in August and September 1994. The increase in informal trade may have been sparked by the increased gross margins in January and February or August and September of 1994, when white maize prices in Maputo rose. These periods of increased gross margins also coincide with reduced market supplies of yellow maize in Maputo. For the informal sector, these periods of high margins may have motivated the initial search for maize in more distant markets. Once these informal traders had learned about the markets, continued travel and trade was conducted with lower costs and known risks. Thus, in the August 1994 to November 1995 period, these traders became more active in the markets in the center. For that reason, the data are divided into two periods for analysis, the war/drought period and the post-war/drought period.

As shown in Figure 7.7, the Beira-Chimoio margin approached zero and then fell below it, while the Maputo-Chimoio margin narrowed in late 1995 to between zero and 50 meticais/kg. As demand for the white maize increased in Beira and Maputo, prices rose, but prices also increased in Chimoio. During the post-war/drought period, the Maputo prices basically hit a ceiling as white maize grain prices approached the prices for rice and

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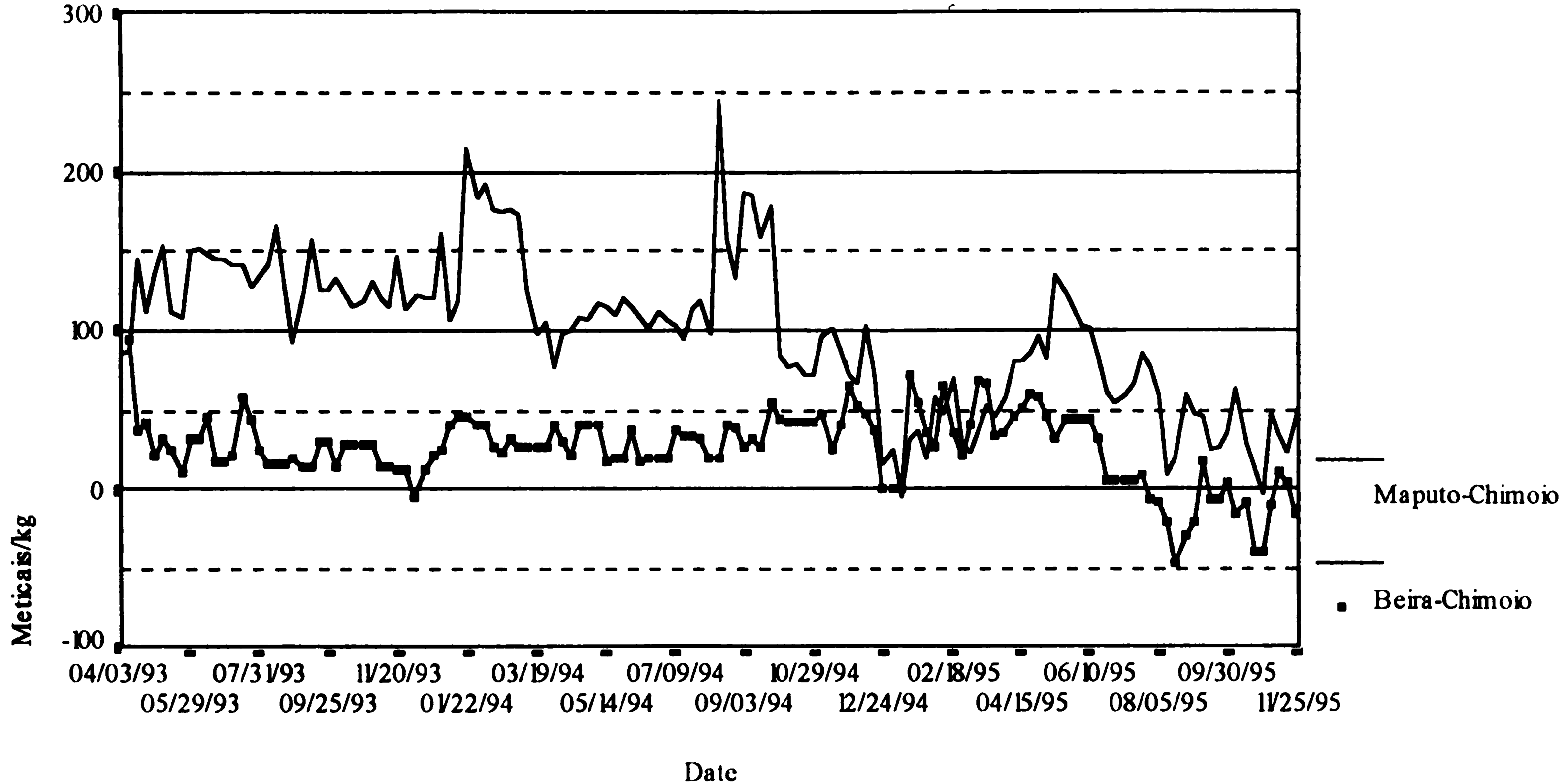
[3] Rather than gross margin as a percentage of price, the simple gross margin in meticais/kg is a useful indicator of potential arbitrage opportunities because most of the transport and other transaction costs are based upon weight or volume rather than value. We do not have sufficient information to estimate average net margins over time.



Note: Margins are in real meticias/kg, based on CPI
with December 1989=100.

Figure 7.7 Gross margin between real white maize grain retail prices in Maputo and Chimoio, April 3, 1993 - November 25, 1995 (in meticais/kg) finely processed imported white maize flour, preferred substitutes to the domestic white grain for many households. Thus, white maize grain prices could not continue to increase as the households shifted into substitutes. The margins in late 1995 were likely to be insufficient to motivate trade in either direction (to or from Chimoio), and yellow maize did not reappear until late October 1995.

7.5 Analysis of the war/drought period

7.5.1 Univariate Analysis of the war/drought period: Maputo and Chimoio prices

The Maputo white maize price data in the April 1993 to August 1994 period are similar in characteristics to the April 1993 - April 1995 series evaluated in Chapter 6 for the food aid analysis.[4] The coefficient of variation for white maize prices is 0.15 for this period (Table 7.2). The figure of first differences, Figure 7.3, also portrays the volatility. The partial autocorrelation plot indicates that only the first lag is significant. There is also a significant trend in this series. All of the unit root tests provide evidence that Maputo prices were trend stationary in this period, as can be seen in the Phillips and Perron tests reported in Table 7.3, and the KPSS test results in Table 7.4.

The mean of the white maize price in Chimoio for this period is only 71 meticais/kg, much lower than the mean in Maputo of 199 meticais/kg. The plot of the first differences (Figure 7.3) indicates the lack of volatility of Chimoio price series in the war/drought period. With a coefficient of variation of 0.13, variability is relatively low. Both the low

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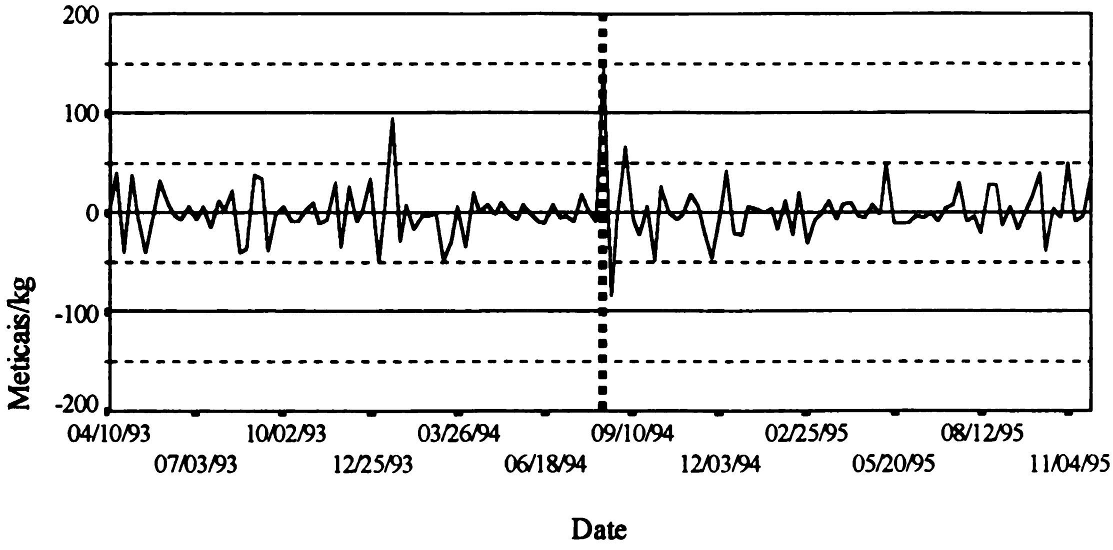
[4] The August 1994 breaking point was selected based upon a shift in the Chimoio price data, not the Maputo data.

Table 7.2 Descriptive statistics of real price data for war/drought period

Statistics	April 3, 1993 - August 6, 1994	
	Maputo	Chimoio
Mean (meticias/kg)	198.94	70.96
Standard deviation (meticias/kg)	29.56	8.95
Coefficient of variation	0.15	0.13
Median (meticias/kg)	194.64	71.14
Maximum (meticias/kg)	283.76	100.44
Minimum (meticias/kg)	139.19	57.61
Skewness	0.54***	0.91***
Kurtosis	-0.11**	1.5**

Note: ** indicates significant at the 0.05 level.
*** indicates significant at the 0.01 level.

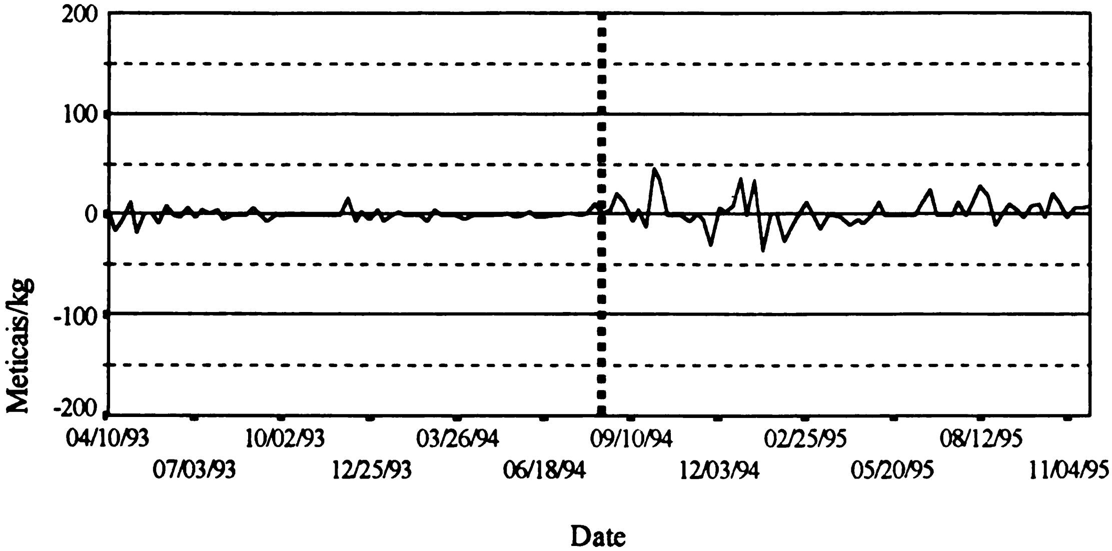
Source: MAP/MSU database.



Note: Dashed vertical line indicates August 6, 1994.

Source: MAP/MSU SIMA database.

Figure 7.8 First differences in white maize grain prices in Maputo



Note: Vertical dashed line indicates August 6, 1995.

Source: MAP/MSU SIMA dataset.

Figure 7.9 First differences in white maize grain prices in Chimoio

Table 7.3 Phillips Perron test results for the real white maize prices: Maputo and Chimoio in war/drought period

Test statistic	Maputo	Chimoio
Z(phi_2)	5.53***	4.15*
Z(phi_3)	8.29***	6.23**
Z(t_ alpha~)	-12.42***	-2.45
Z(phi_1)	5.16**	5.38**
Z(t alpha*)	-2.71*	-3.19**
Z(t alpha^)	-0.32	-0.35
NW lags	4	4

Note: Significance level determined according to A. Banerjee, et al., **Co-integration, Error Correction, and the Econometric Analysis of Non-stationary Data,** Oxford University Press, Oxford, England, 1993.

* indicates significance level of 10%
** indicates significance level of 5%
*** indicates significance level of 1%

mean and low variability reinforce the perception that, during this period, the Chimoio market had abundant supply relative to demand, maintaining prices at a floor level. As with the Maputo series in this period, trend stationarity of the series was supported in the various tests conducted, as shown in Tables 7.3 and 7.4. The abundant supply in Chimoio with low, relatively stable prices is in contrast with the variability in Maputo prices, suggesting that the markets in this war/drought period were only weakly integrated, a hypothesis which will be tested below.

7.5.2 Simple correlation coefficients

Table 7.5 shows the simple cross-price correlation coefficients for the real prices in the war/drought period. The levels of the real prices are significantly correlated, whereas the first differences are not. In a static context, then, there is not a strong relationship between changes in Maputo and changes in Chimoio. It is the dynamic context with lags that may be more important here.

7.5.3 VAR order selection and exogeneity testing

Lag length testing of the bivariate VAR system indicates that between three and seven lags are needed in the models (Table 7.6). Both the likelihood ratio tests and the AIC suggest 7 lags be included. Given the delays in transport between the regions and the potential bias of omitted variables, the estimations will be conducted with seven lags.

Table 7.4 KPSS test results for the real white maize prices: Maputo and Chimoio in war/drought period, with trend

Lags	Maputo	Chimoio
0	0.37***	0.14*
1	0.23***	0.01
2	0.18**	0.08
3	0.15**	0.07
4	0.13*	0.06
5	0.12	0.06
6	0.11	0.06
7	0.11	0.06
8	0.1	0.06

Note: Significance level determined according to D. Kwiatkowski, et al., "Testing the null hypothesis of stationarity against the alternative of a unit root," **Journal of Econometrics** 54: 159-178, 1992.

* indicates significance level of 10%
** indicates significance level of 5%
*** indicates significance level of 1%

Table 7.5 Cross-price correlation coefficients for real white maize grain prices: levels and first differences in the war/drought period

Market	Maputo	Chimoio
Real prices in levels		
Maputo		0.41***
Chimoio	0.41***	
First differences of real prices		
Maputo		0.08
Chimoio	0.08	

Note: *** indicates significant at the 0.01 level.

Source: MAP/MSU SIMA database.

Table 7.6 Lag length testing for war/drought period: Maputo and Chimoio prices with trend variable in VAR

Number of Lags	Test			
	Akaike Information Criterion	Schwarz Criterion	Likelihood Ratio χ^2	Likelihood Ratio p-value
1	**1.54**	**1.82**	225.06	0.00
2	8.85	9.40	5.78	0.21
3	8.39	**9.21**	6.78	0.15
4	8.34	9.45	6.54	0.16
5	8.29	9.67	1.67	0.80
6	8.03	9.69	7.47	0.11
7	**7.94**	9.88	**8.57**	0.07
8	8.93	10.14	1.85	0.76
9	8.90	10.38	2.01	0.73
10	8.79	10.55	6.06	0.19

Note: * indicates significant at the 0.10 level
** indicates significant at the 0.05 level
*** indicates significant at the 0.01 level

Table 7.7 Exogeneity testing of Maputo and Chimoio prices, with seven lags and trend in the war/drought period

Null hypothesis	χ^2	p-value
Maputo helps to predict Chimoio	4.99	0.66
Chimoio helps to predict Maputo	8.89	0.26

Using seven lags and a trend in the estimations, exogeneity testing of the this period supports the characterization of this period as one of weak integration, at least between Maputo and Chimoio. Neither series "Granger-causes" the other to a significant degree, as can be seen in Table 7.7.[5] Thus in forecasting, knowledge of the lagged price of the other market would not contribute information beyond what own prices already have.

7.5.4 Identification considerations

With only two variables in the VAR, there are fewer alternative identification schemes. Should Maputo price shocks be allowed to affect Chimoio prices contemporaneously or should Chimoio price shocks be allowed to affect Maputo prices contemporaneously? Given the transportation and communication difficulties during the war/drought period, lags in responses to shocks from spatially separate markets might be expected. The recursive identification of Maputo first, then Chimoio, such that Maputo prices unaffected contemporaneously by Chimoio prices, will be used, however, alternative specifications

[5] See Chapter 6 for a definition and greater details on Granger-causality.

will include the Chimoio-Maputo ordering to assess the sensitivity of the results to the choice of identification, as reported in Appendix B.

7.5.5 VAR results for the war/drought period

The VAR results, based on estimates using a trend and seven lags, provide further evidence that the Chimoio prices remain relatively unaffected by Maputo price fluctuations during the this period. Figure 7.10 presents the impulse responses for this model in meticais/kg. The top plot in Figure 7.10 shows the response paths of Maputo prices to own shocks (solid line) and to shocks from Chimoio (dotted line). Maputo prices oscillate between 0 and 5 meticais/kg in response to a Chimoio price shock, returning to near steady state values by the fifth week. In the bottom plot, it can be seen that Chimoio prices fluctuate between 0.5 and 1 meticais/kg in response to a shock from Maputo.[6] This effect of Maputo price shocks wears off quickly in Chimoio, with a return to near-previous levels by the fifth period. That Maputo price shocks have little effect on Chimoio in this period is not surprising, but the effect of Chimoio price shocks on Maputo is larger than would be anticipated given the transportation difficulties in this period.

The results were qualitatively similar using the alternative recursive ordering of Chimoio, then Maputo, as reported in Appendix B.

[6] The impulse responses in this chapter can be shown in meticais/kg., rather than proportions of standard deviations as in Chapter 6, because both variables have the same units. The meticais/kg are in constant December 1989 values. To determine approximate values in January 1996 terms, multiply by ten.

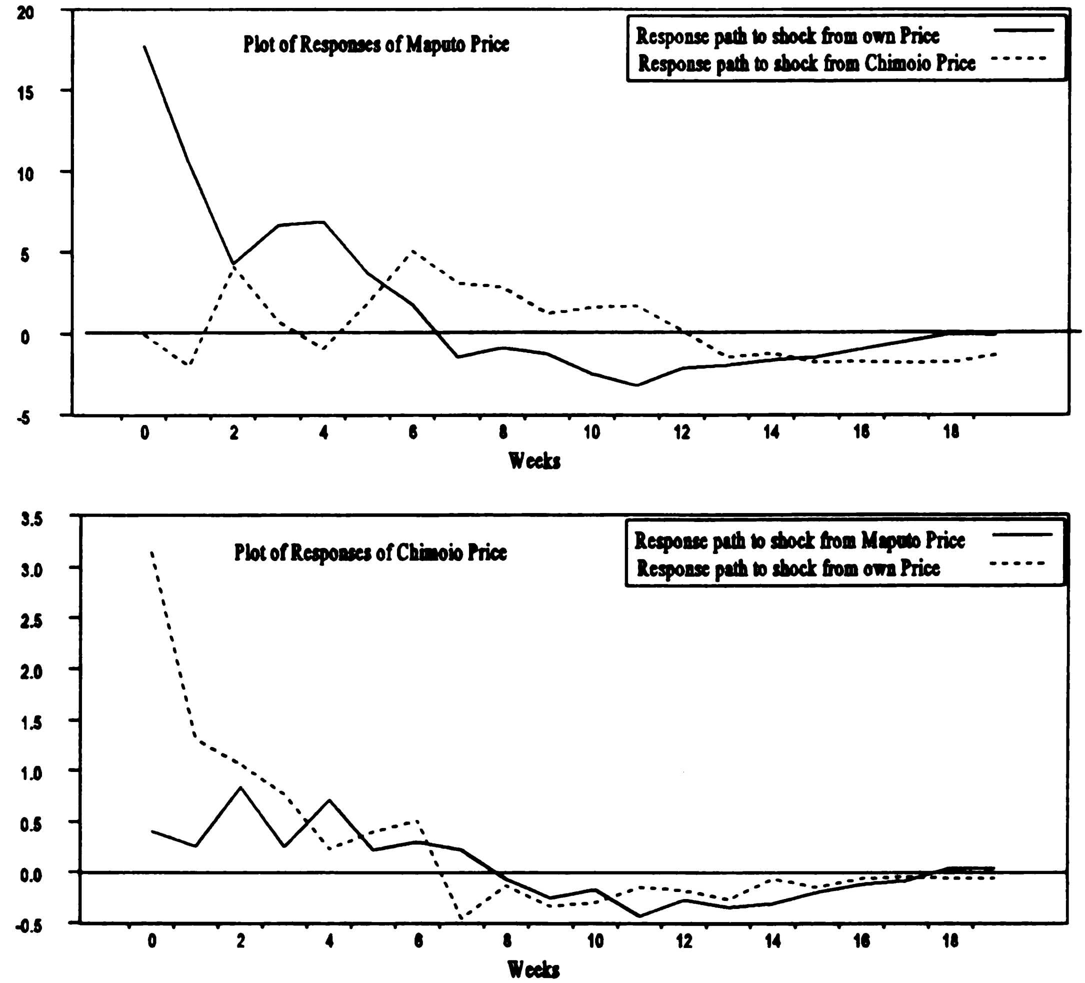


Figure 7.10 Impulse responses of each price series to shocks, recursive, seven lags, war/drought period, (in real meticais/kg)

7.6 Analyses for post-war/drought period

7.6.1 Univariate analysis of the post-war/drought period: Maputo and Chimoio prices

In Maputo, the white maize prices increased in mean during the post-war/drought period by 18 percent, going from 199 to 235 meticais/kg (Table 7.8). Similarly, the Chimoio prices saw a major climb in prices, averaging 163 meticais/kg, 79 percent higher than the previous mean of 91 meticais/kg. There was little change in the coefficient of variation of Maputo prices and the plot of first differences (Figure 7.8) reconfirms the continued variability. Chimoio prices, however, showed increased variability, with the coefficient of variation doubling, apparent in an inspection of the plot of first differences (Figure 7.9).

Results for testing stationarity suggest that there may be a stochastic trend in both of these series. The ADF tests and the PP tests for Maputo and Chimoio prices fail to reject a unit root, regardless of whether or not a trend and a constant are included, and through inclusion of eight lags (Table 7.9). The KPSS of stationarity tests are rejected through six lags for Maputo prices, with and without the inclusion of a trend, and for up to eight lags for the Chimoio prices (Table 7.10). The Perron models were used, with possible shifts in trend and in mean in July 1994, and still there was evidence to support nonstationarity.

Table 7.8 Descriptive statistics of Maputo and Chimoio prices during post-war/drought period

Statistics	August 13, 1994 - November 25, 1995	
	Maputo	Chimoio
Mean	234.64	163.04
Standard deviation	37.44	51.97
Coefficient of variation	0.16	0.32
Median	230.22	152.18
Maximum	337.44	287.04
Minimum	173.45	70.01
Skewness	0.62**	0.61**
Kurtosis	-0.12	-0.29

Note: ** indicates significant at the 0.05 level.
*** indicates significant at the 0.01 level.

Source: MAP/MSU database.

Table 7.9 Phillips Perron test results for the real white maize prices: Maputo and Chimoio

Test statistic	Maputo	Chimoio
Z(phi_2)	2.64	1.78
Z(phi_3)	3.25	0.95
Z(t_ alpha~)	-1.86	-1.31
Z(phi_1)	3.07	1.82
Z(t alpha*)	-1.63	-0.67
Z(t alpha^)	0.85	1.37
NW lags	4	4

(Significance level determined according to Banerjee, et al. 1993)

* indicates significance level of 10%
** indicates significance level of 5%
*** indicates significance level of 1%

Table 7.10 KPSS test results for the real white maize prices: Maputo and Chimoio in post-war/drought period, with and without trend

Lags	Maputo		Chimoio	
	Without trend	With trend	Without trend	With trend
0	1.63***	1.21***	2.87***	1.07***
1	0.92***	0.69***	1.51***	0.56***
2	0.67**	0.50***	1.05***	0.39***
3	0.53**	0.40***	0.82***	0.3***
4	0.45*	0.34***	0.68***	0.25***
5	0.39*	0.29***	0.59**	0.22***
6	0.35*	0.26***	0.53**	0.19**
7	0.31	0.24***	0.48**	0.18**
8	0.29	0.22***	0.45*	0.16**

Note: Significance level determined according to D. Kwiatkowski, P.C.B. Phillips, P. Schmidt, and Y. Shin, "Testing the null hypothesis of stationarity against the alternative of a unit root," **Journal of Econometrics** 54(1992): 159-178.

* indicates significance level of 10%
** indicates significance level of 5%
*** indicates significance level of 1%

Table 7.11 Cross-price correlation coefficients for real white maize grain prices: levels and first differences in the post-war/drought period

Market	Maputo	Chimoio
Real prices in levels		
Maputo		0.46***
Chimoio	0.46***	
First differences of real prices		
Maputo		-0.03
Chimoio	-0.03	

Note: ** indicates significant at the 0.05 level.
*** indicates significant at the 0.01 level.

Source: MAP/MSU SIMA database.

7.6.2 Static measures of relationship between Maputo and Chimoio

As shown in Table 7.11, the bivariate cross-price correlation between Maputo and Chimoio real prices was significant, with a value of 0.46, however the cross-price correlation coefficient between the first differences of prices was not significant for Maputo and Chimoio.[7]

7.6.3 VAR order selection and exogeneity testing in the post-war/drought period

Lag length testing of the bivariate VAR system indicates that a minimum of 3 lags is needed, with the possibility that seven lags contribute useful information (Table 7.12). For

[7] For comparison, the cross-price correlations coefficients for real prices and first differences of real prices between Chimoio and Beira are significant, with values of 0.84 and 0.24, respectively, in this period.

Table 7.12 Lag length testing for post-war/drought period: Maputo and Chimoio prices with trend variable in VAR

	Test			
Number of Lags	Akaike Information Criterion	Schwarz Criterion	Likelihood Ratio	
			χ^2	p-value
1	17.22	17.50	8184.78	0.00
2	14.84	15.40	11.04	0.02
3	10.66	**11.50**	8.88	0.06
4	10.54	11.66	9.02	0.06
5	10.38	11.78	**8.10**	0.09
6	10.29	11.97	0.73	0.95
7	**10.23**	12.19	6.38	0.17
8	11.20	12.44	3.59	0.46
9	11.17	12.69	1.89	0.76
10	11.11	12.91	15.84	0.73

Table 7.13 Exogeneity testing of Maputo and Chimoio prices, with 7 lags and trend in the post-war/drought period

Null hypothesis	χ^2	p-value
Maputo helps to predict Chimoio	19.28	0.01
Chimoio helps to predict Maputo	10.29	0.17

the VARs, seven lags will be used, based upon the war/drought period's estimations and the desire to avoid bias.

Exogeneity testing results, with the seven lags included as well as a trend, support the division of the data into periods of weak versus improved integration. Given the large size of the Maputo market relative to the Chimoio market and the verified existence of direct trade between the two markets, Maputo prices would be expected to help predict Chimoio prices. As reported in Table 7.13, testing results accord with that hypothesis. The Chimoio prices were not useful in helping to predict Maputo prices, as would be expected given Maputo's diversified sources of maize supply.

7.6.4 VAR identification in the post-war/drought period

Once again, identification options in this period are limited, with the bivariate VAR, using just contemporaneous restrictions. The Maputo - Chimoio ordering was chosen, due to the relative size of the Chimoio and Maputo markets, but the alternative specification will also be estimated and reported in Appendix B.

7.6.4 VAR results for the post-war/drought period

The seven lag model of the recursive VAR, with a time trend added, is used in the initial estimations (Figure 7.11). A one standard deviation shock in the Maputo price series is 15 meticais/kg, slightly lower than the value in the autarky period. In Chimoio, however, the greater sample variance in this period translates to greater value for the standard deviations of its innovation than in the previous period, with 12 meticais/kg the value of a single shock compared to about 4 meticais /kg in the previous period. The estimated effect of a Maputo price shock on the Chimoio prices is much greater than in the war/drought period, with a 15 meticais/kg shock of Maputo prices resulting in a Chimoio price increase of about 8 meticais/kg, and that shock has long term effects, to be discussed later. The Chimoio price begins to climb by the second period in response to the shock in Maputo prices, as would be expected given the lags due to transport.

7.6.5 Long run dynamics

The apparent nonstationarity of the data series leaves open the possibility of a common stochastic trend between the two prices series in the post-war/drought period. There was no evidence of nonstationarity in the war/drought period, so we are concerned only with the post-war/drought period .

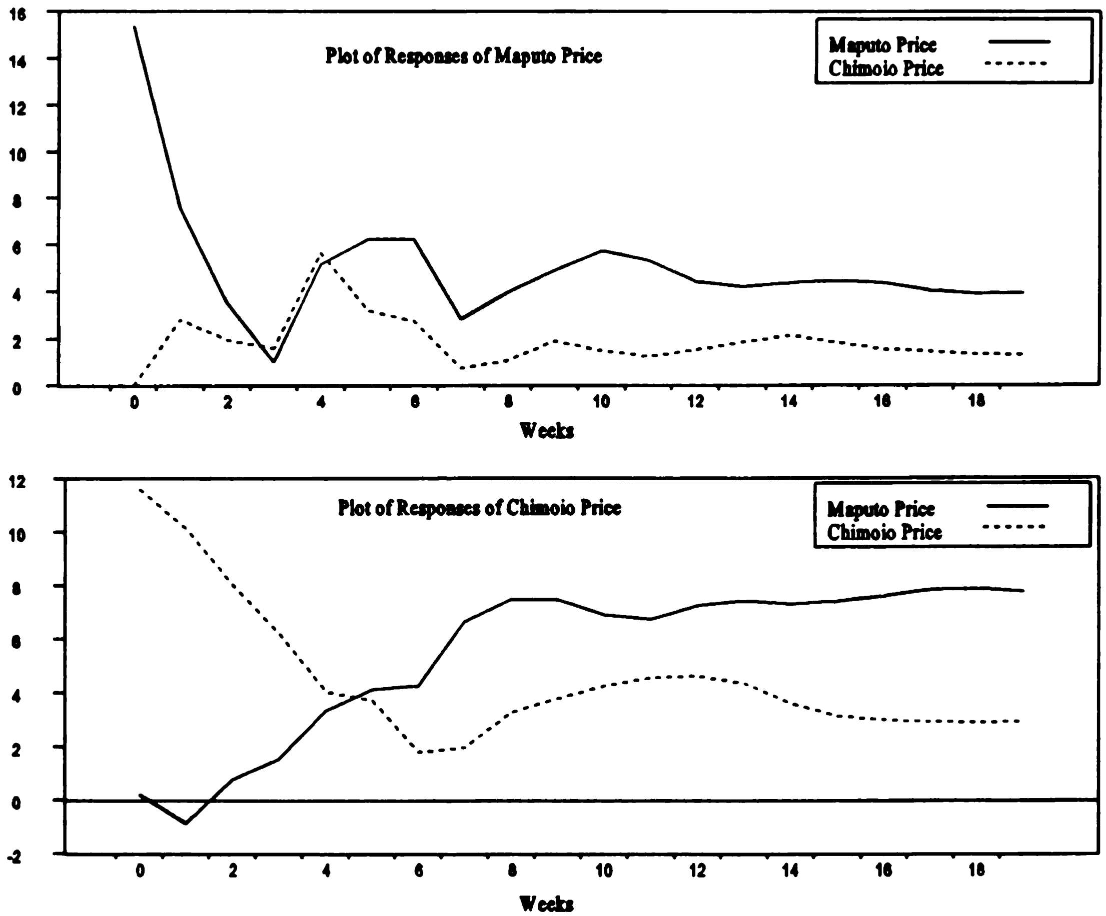


Figure 7.11 Impulse responses from various shocks, based on recursive model, post-war/drought period, with seven lags (in real meticias/kg)

The work of Sims, Stock, and Watson (1990) shows that the use of a VAR in cases in which one or more unit roots may be present does not necessitate the use of the two-step procedures involved in cointegration analysis. They write that "the OLS estimator is consistent whether or not the VAR contains integrated components, as long as the innovations in the VAR have enough moments and a zero mean, conditional on past values of Y_t" (1990, pp.113-114). The critical issue is "whether the coefficients and test statistics of interest have distribution unaffected by the nonstationarity, in which case the hypotheses can be tested without first transforming to stationary regressors" (Sims, Stock, and Watson 1990, p.136). Testing does show that the Maputo and Chimoio prices are first difference stationary, indicating that both are I(1) series. Differencing the data and then estimating the VAR on the stationary first differences would not be appropriate if the series actually are cointegrated, that is, have a common stationary trend (Hamilton 1994).

Looking at the results, long term effects are shown in all of the impulse responses for this period. As was discussed earlier regarding the sources of stochastic trends in these series, the market adjustments of the ERP may cause permanent changes in these series, as they correct for previous policy distortions and the effects of the war. Over a longer period of analysis, such changes would be considered as one time shifts in mean or trend or both. The relatively short period of time included here does not allow us to incorporate or model these shifts.

An additional source of difficulties is the possibility of increasing seasonality in the Mozambican time series data. As domestic and regional production increases, farmers are not afraid to store on-farm, marketing activities expand, and the potential for profits with interseasonal storage improve, the usual seasonal trends expected in prices for storable commodities may be established. As yet however, those seasonal trends may be masked somewhat by food aid arrivals which come in cycles counter-cyclical to the regional white maize production and harvest cycles.

7.7 Summary of market integration results and conclusions

The above analysis has demonstrated that the relationships between the Maputo and Chimoio markets for white maize have changed over time, as the peace became effective and investments in transport and communications enabled product and information flows. If food aid arrivals affect the prices in Maputo, Chimoio markets will also feel the effects.

This analysis cannot look separately at demand and supply shocks, to see if there is a difference in response due to the specific source of shock. During recent history in Mozambique, the significant price changes in the post-war, post-drought period can be associated with supply side shocks, specifically food aid arrivals and then recovering white maize production and trade. Thus, the preceding analysis is relevant for the question at hand, that is the response of prices in maize production areas to prices changes due to food aid arrivals in the consumption areas. Further research on the Maputo-Chimoio-Beira trade patterns would be valuable to gain more information concerning price formation in the production zones.

What the analysis shows unambiguously is that maize markets have changed in Mozambique. During the war/drought period with weak integration, Chimoio prices were flat, presumably due to high supply relative to demand, so producers faced weak markets for their maize production. The presence of large stocks of yellow maize in Maputo may have contributed to the lack of white maize market activity in the production regions, because the margins between Maputo white maize prices and Chimoio white maize prices were too narrow to spark trader action. Transport constraints and high transportation costs exacerbated the inactivity in these markets.

By 1994, transport became more available, larger quantities of maize were produced in the center region in hopes of a better marketing season, and yellow maize food aid diminished in the markets. With these developments, more informal traders began to arrive in Chimoio from Maputo and Beira, and the markets experienced greater integration. In that environment of integrated markets, a shock in the Maputo markets is found to have a significant effect over time in the Chimoio markets. In this analysis, a 15 meticais/kg positive shock in the Maputo market price was transmitted to the producing region, resulting in an 8 meticais/kg upward shift in prices that was maintained over time. It took only two weeks for the Maputo shocks to begin to affect the Chimoio prices, about the amount of time it takes informal traders to arrive in the Chimoio markets and buy enough maize to push prices up. In the other direction, Chimoio price shocks are also transmitted to Maputo, resulting in Maputo price jumps of up to 6 meticais/kg within four weeks of an 11 meticais/kg price shock in Chimoio prices.

That both markets respond fairly rapidly to shocks in the other market indicates that the scarcities in one market will generate a response in the other market. When scarcities hit the market in Maputo, Chimoio producers will face higher prices, increasing their price incentives to produce maize and to sell from on-farm stocks. This is the result that is predicted with market integration, that producers will see higher prices as the demand for their product increases, while consumers will face lower prices than they otherwise would as the supplies available increase. With lowered transportation and transaction costs, trade is facilitated, as the margin can be narrowed between producer prices and consumer prices.

But this also means that a localized glut of yellow maize in Maputo that shocks white maize prices downward in Maputo will also have a negative effect on Chimoio prices for white maize in less than one month. If the shock from yellow maize is large and white maize prices in Maputo fall enough, white maize prices in Chimoio may reach a floor price, below which farmers are unwilling to sell. At that point, with low Maputo prices, the margin left between Maputo and Chimoio white maize prices may be insufficient to cover transport and transaction costs and there will be no trade between the two markets.

Market integration is a key for economic development in Mozambique. If the markets are integrated, farm producers have greater options for selling their products in a competitive environment. Consumers demand for goods is communicated to producers through the prices. Competition keeps the margins between producer prices and consumer prices to a minimum. Mozambican maize markets are improving and expanding, with more traders, particularly informal traders, active in more regions. While improved market integration means that food aid shocks in Maputo will result in lower prices in the production regions, it also means that Maputo markets can signal a maize scarcity with high prices and the markets will respond, bringing in more maize to lower the price spikes.

Chapter 8

Conclusions and Implications

8.1 Introduction

For some ten years, yellow maize commercial food aid has been a major policy instrument for meeting food security needs in Mozambique, particularly among the urban poor. Three major events provided the impetus for large quantities of food aid. First, over a decade of civil war, ending with the Peace Accords in late 1992, had destroyed many of the productive assets of the country and left much of the physical infrastructure unusable. Second, socialist policies put into place at the time of Mozambican Independence in 1975 proved unable to generate strong economic activity, leading to an Economic Rehabilitation Program (ERP) which was initiated in 1987. Third, agricultural production and food availability were limited by a severe drought throughout the Southern Africa region during the 1991/92 crop year. The research reported here is designed to determine the effects of this yellow maize food aid on prices for domestic white maize in different locations, under these and likely future conditions.

8.2 Research objectives

This research was directed toward five key research questions. First, what are the key characteristics of the structure and conduct of the maize markets in Mozambique that would influence the effects of food aid deliveries and price shocks? Second, how do the quantities of yellow maize commercial food aid deliveries affect prices for white maize in the Maputo markets? Third, how do Maputo price shocks for white maize affect the prices for white maize in the maize producing area of Chimoio? An important fourth question is whether there are differences in the effects of yellow maize food arrivals between the war/drought period in 1992 and 1993 and the post-war recovery period in 1994 through late 1995. Finally, in thinking about the future, a fifth question arises. What are the lessons learned from this research about commercial food aid and its effects? That is, what can this research tell us about the likely effects of various policy options for ensuring food security in Mozambique, especially for the low income rural and urban consumers.

8.3 Research methods

Well-formulated price analysis begins with a solid knowledge of the structure of the markets, the behavior of the agents involved, and the marketing channels being used. From that base, time series price analysis can be used to answer questions surrounding the relationships between commodity prices in spatially distinct markets, or between prices for different commodities in the same markets.

Thus, there were two interrelated methods used in this study: 1) a market structure study consisting of a rapid appraisal of trader behavior in key white maize markets; and 2) econometric analyses of yellow and white maize prices and commercial food aid delivery quantities.

In 1992, the MAP/MSU Food Security project began market surveys on the behavior of informal markets and traders in Maputo. For the present study, a white maize market rapid appraisal was designed to complement the previous studies. During July to September 1994, the author worked with Mozambican analysts to conduct structured surveys of traders in markets in six provinces of Mozambique, along with informal interviews of key personnel in the public and private sectors at both local and national levels. In each site, informal and formal traders were systematically asked questions concerning their business activities, marketing costs, and pricing behavior.

Dynamic analysis using time series methods is used to examine weekly price and food aid delivery data that were collected over the April 1990 through November 1995 period. Initial analysis, including descriptive statistics and stationarity testing, assisted in determining the characteristics of the data, including the structural break identified in early 1993. Vector autoregressions (VARs) on maize prices and food aid deliveries are then used to investigate the effects of unpredictable fluctuations in prices and quantities delivered. VARs are used to examine the price effects of Maputo commercial food aid deliveries (question 2), and the relationship between white maize price shocks in Maputo and Chimoio (questions 3). In each case, the data were divided into two periods, based upon differences in variability which can be traced back to structural changes in the economy, to determine changes over time (question 4). High frequency (weekly) data were used to capture the rapid responses of prices, in contrast with previous analyses using monthly or annual data which can only reflect the net effects of food aid on prices over time.

Evaluating the effects of food aid in this way is not merely an exercise to determine whether or not there were (or are) price and market effects. The research was designed to help evaluate how the effects may be working through the markets in this developing market economy and suggest options that may help governments in the future in using commercial food aid constructively to support food security and market development. In addition, the analysis provides a quantitative assessment of the effects, demonstrating the relative importance of the effects in overall price movements, which is crucial to effective policy choice.

8.4 Findings from the market structure study

Rapid appraisal surveys in 1994 found that informal trade was prevalent in white maize in the center and south regions, including extensive interregional maize trade. Informal maize trade in the north was limited at the time of the rapid appraisal, but has become more active over time. In contrast, the formal sector traders took part in white maize trade on only a limited basis, when an implicit or explicit contract guaranteed immediate resale of the commodity at known prices. Interseasonal storage was primarily undertaken at the farm level, with little evidence of large-scale commercial storage of domestic white maize. Private yellow maize trade was primarily in the port cities where the yellow maize was delivered, and in the nearby deficit areas of the south, with small quantities of yellow maize appearing in the markets in rural areas under emergency distributions.

The following key market characteristics were found to influence how quantities of food aid maize affect the prices of white and yellow maize:

- participation of large numbers of small informal traders and maize millers who got started in their trade because of yellow maize food aid availability, increasing market competition;
- the informal private sector much more active than the formal sector in white maize markets, buying from rural producers and selling to urban consumers;
- lack of marketing infrastructure significantly increases transaction costs and limits trade development;
- government regulations deny legal status to the informal sector, while the formal sector relies on public sector guarantees (contracts);
- risks due to price volatility and unpredictable shifts in yellow and white maize supply and prices;
- policy caught in a conflict between ensuring food security and promoting domestic production and marketing.

8.5 Findings on commercial food aid effects on Maputo maize prices

Weekly retail prices (in constant December 1989 meticais) of white and yellow maize in Xipamanine and Mucoriama markets in Maputo were combined with weekly food aid yellow maize delivery data to analyze the effects of food aid deliveries on prices (Figure 8.1). Two periods were evaluated: 1) the war/drought period, April 1990 - February 1993; and 2) the post-war/drought period, April 1993 - April 1995.

8.5.1 Effects during war/drought period

During the war/drought period, there was high volatility in both white and yellow maize prices caused by extreme domestic and regional scarcity of white maize combined with limited market development. In this period, the commercial yellow maize food aid program was designed to dampen the high white maize price spikes which jeopardized food security for the majority of consumers in Maputo and other urban areas, as well as provide an alternative, lower cost consumption staple to urban consumers. Impulse responses from the VARs show the responses of white and yellow maize prices to a typical food aid arrival shock. Based on a positive shock of one standard deviation of food aid's own innovation (about 2,600 metric tons in one week), and assuming no further food aid shocks, prices for yellow maize decline immediately by a value of about 14 meticais/kg, and return gradually to near pre-shock values after eight weeks.[1] The impulse responses for white maize prices to the same food aid delivery shock show an immediate decline of 12 meticais/kg and return rapidly (within 4 weeks) to the pre-shock price level.

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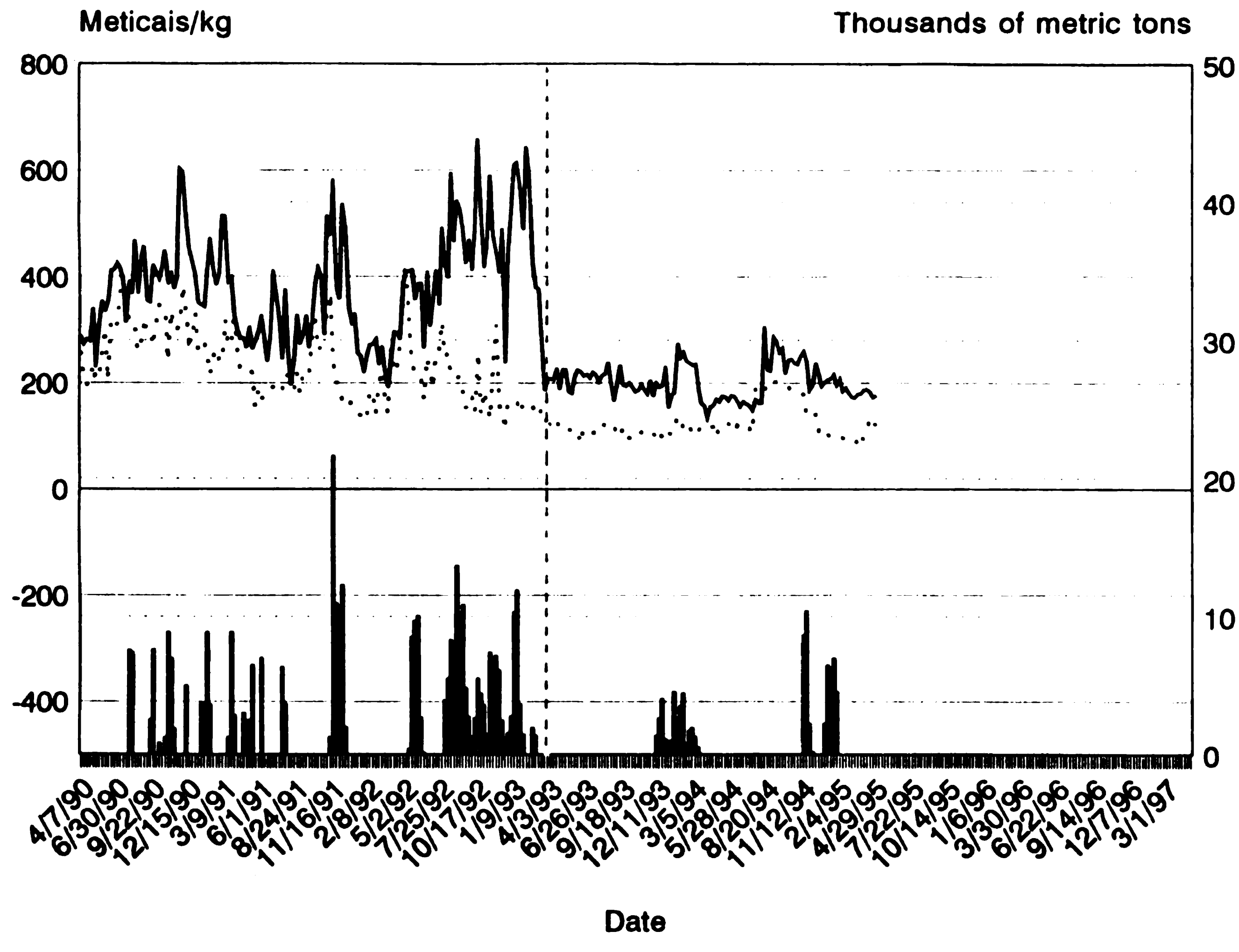
[1] All prices are stated in constant December 1989 meticais throughout this chapter. These prices can be approximately converted to January 1996 prices by multiplying by a factor of ten. Thus a 14 meticais/kg real price in constant 1989 values corresponds to about 140 meticais/kg using a base of January 1996.



Source: MAP/MSU SIMA dataset. Deflated with CPI: December 1989 = 100.
Dotted vertical line indicates April 3, 1993.

Figure 8.1 Weekly real retail prices for white and yellow maize grain in Maputo and weekly monetized yellow maize food aid deliveries in Maputo, April 1990 - December 1995

The VAR results were also used to conduct historical simulations of the effects of removing food aid shipments during this period. Results indicate yellow maize prices may have been two to three times higher in real terms without the food aid (only commercial imports would have been available). The simulations suggest that white maize prices would have been only 10 percent higher because prices were already very high, approaching the price of rice, a preferred substitute. The food security implications for Maputo households are clear. During the war/drought period, although food aid had only a minor impact on white maize prices in Maputo, yellow maize commercial food aid played a fundamental role in ensuring food supplies at accessible price for poor urban households at a time when white maize scarcities meant extremely high prices without any other dampening mechanism.

The minimal effects of food aid on white maize prices during this period appear to be a result of white maize scarcity and heterogeneous consumption preferences which result in imperfect substitutability between white and yellow maize products. No matter how high white maize prices go, there are some consumers who indicated in a MAP/MSU preference survey that they would not switch to yellow maize, and so some demand is sustained even at very high white maize prices. For that reason, positive shocks from food aid do not have strong effects on white maize prices during the war/drought period. However, for those consumers willing to substitute yellow maize for white maize, or for consumers forced to switch to yellow maize to maintain consumption, the commercial food aid provided an alternative staple.

8.5.2 Effects during the post-war/drought period

With the peace accords and gradual recovery of the markets, an increase in domestic production has meant that domestic prices have become more sensitive to food aid shocks during the post-war/drought period. While the direct effect of food aid shocks on white maize prices is small in absolute amount, as shown in the impulse responses, with a decline in white prices of 2-3 meticais/kg with a single food aid shock of 1,500 metric tons. However, comparing the forecast error variance decompositions (FEVD) of this period with the earlier period, a greater proportion of white maize error variance is explained by food aid shocks and yellow maize price shocks. In the war/drought period, only 2 percent of FEVD was attributed to food aid shocks and 11 percent to yellow maize price shocks. In the post-war/drought period, 11 percent is attributed to food aid shocks and 22 percent to yellow maize prices.

Yellow maize food aid shocks affect yellow maize prices, with a food aid shock of 1,250 metric tons corresponding to a decline in real yellow maize prices of 5 meticais/kg over nine weeks. The forecast error variance decompositions for this period indicate that food aid shocks account for 27 percent of FEVDs for yellow maize prices the 20 periods evaluated, while white maize price shocks account for 20 percent.

Historical simulations of real white and yellow maize prices were conducted by excluding the December 1994 - January 1995 commercial yellow maize food aid deliveries of 47,500 metric tons. Comparing the simulated white maize price with the actual price, the results suggest that white maize prices were held lower during January - March 1994 by the food aid deliveries. Going into the harvest and marketing season of 1995, the observed white maize prices were ten to fifteen percent lower than what the historical simulations indicate they would have been without the food aid deliveries. For consumers, this is a benefit, but for white maize producers and traders, depending upon transmission of prices across markets, the lower prices may affect incentive for future production and trade.

8.6 Findings on market integration and price transmission

The market integration analysis extended the earlier analysis of Maputo markets to the Chimoio market, in the central maize production area of Manica Province. Maputo was included in the study because it is the major consumption market, with high population and poor agricultural production nearby contributing to a strong demand pull. Large amounts of commercial food aid enter the Maputo market directly, along with South African imports when they are available. Chimoio was selected because it is an important market in the center maize production region, connected by roads to Maputo, and with a market structure well-known to the researchers.

As in the Maputo analysis, there was an obvious structural break in the data after the signing of the Peace Accords and the ERP. Based upon the Chimoio prices, the recovery of the markets was delayed in the rural areas outside Maputo, and so the structural break for Chimoio was in August 1994. So, for this market integration analysis, the war/drought period extends from April 3, 1993 - August 6, 1994; the post-war/drought period is August 13, 1994 - November 1995.[2]

A key finding in the analysis is that yellow maize was not available in Chimoio for long periods of time and yet the prices for white maize in Chimoio were low with little variability, indicating high supply relative to demand. If the Chimoio white maize prices were affected by yellow maize commercial food aid deliveries, it must be through the reduction in demand for white maize products in Maputo due to supplies of yellow maize food aid. Given the strong connection between Chimoio and Beira, yellow maize commercial food aid arrivals in Beira could also depress Chimoio prices, but once again only through reduced demand for white maize.

8.6.1 Effects during war/drought period

During the period from April 3, 1993 through August 6, 1994, identified as the period of weak market integration, price shocks in Maputo had basically no effect in Chimoio and *vice versa*. There are two main explanations: 1) abundant yellow maize supplies in Maputo depressed white maize prices in Maputo, thus depressing white maize demand in Chimoio; and 2) transport and other transaction costs remained too high relative to the gross margin during this period to motivate any active trade. These are not mutually exclusive explanations for the apparent lack of white maize trade between Maputo and Chimoio in this period.

[2] The April 3, 1993 starting date and the November 25, 1995 ending date differ from the earlier analysis due to data availability. See Chapter 7 for a discussion.

8.6.2 Effects during the post-war/drought period

During the post-war/drought period, identified as the improved integration period, white maize price shocks were transmitted in both directions. Maputo price shocks (15 meticais/kg) have little effect on Chimoio prices in the first two weeks after a shock, but by the fourth week, the Chimoio prices increase substantially and continue to climb to about ½ of the value of the shock, or about 7 meticais/kg higher than before the shock.

Own price shocks in Chimoio may have come from demand or supply shifts in Beira or from more local sources, but they also affect Maputo prices over time. The initial effects of Chimoio price shocks are felt in Maputo prices after one week, but the strongest effect is four weeks after the shock. Overall, the effects of Chimoio prices on Maputo are not strong, with Maputo prices rising only about 2 meticais/kg for a 12 meticais/kg shock from Chimoio prices. Since Maputo has other supply sources, this was expected. The strength of the Maputo price shocks on Chimoio reflects the importance of the Maputo market for Chimoio maize producers during the later improved integration period. Finding that there are effects from Maputo price shocks on the Chimoio market prices (and *vice versa*) is not surprising; the interesting part is the magnitude of the effects, how they work through the markets, and how the effects have changed over time.

In summary, white maize prices in the post-war/drought period are no longer driven primarily by great scarcity of white maize in urban areas. Instead, white and yellow maize products compete in the market as substitutes in consumption. The forecast error decompositions and the impulse response analyses show increased responsiveness between the prices. Preference surveys bring this relationship clearly into focus, as poorer consumers indicate a willingness to substitute yellow maize for white maize with relatively moderate price differences.

8.7 Lessons learned to inform future policy options

The government of Mozambique and the donor agencies have been and will continue to diminish the amount of commercial yellow maize food aid available in the country, as long as the economy continues to recover from the war and drought, and there no new events that create extreme shortages of basic consumption staples. In fact, USAID announced in January 1996 that commercial yellow maize food aid would no longer be brought into Mozambique. Other donors have started to rely on local purchases of white maize (40,000 metric tons in 1994), in order to obtain relief supplies for demobilized soldiers and other targeted vulnerable groups. They continued this approach in 1995 and have announced additional purchases for 1996. What lessons does the present research provide regarding the policy options available for meeting food security needs and promoting domestic production and market development under these evolving conditions of reduced yellow maize and increased domestic production of white maize?

8.7.1 Effects of yellow maize and monetization

In 1992 and 1993, as the informal sector in Maputo was growing, the arrival of large quantities of yellow maize commercial food aid spurred informal trading and small-scale milling sectors of yellow maize by providing a commodity that allowed business activity to expand when white maize was scarce in Maputo. This food aid provided a low-cost, self-targeting commodity which lowered food prices in urban areas during a period of white maize scarcity. Unlike other food aid commodities (for example, wheat and rice), yellow maize is a less-preferred substitute for locally produced domestic white maize. Choosing yellow maize rather than wheat as the main commodity avoided potential future problems with demand for an expensive, imported commodity. This experience also shows that Mozambique has increased food security options in the long run, for world white maize markets are thin and prices are relatively unstable compared to the world yellow maize prices.

Eliminating commercial yellow maize food aid does three things. Removal of yellow maize commercial food aid disengages the policy dialogue that has developed between USAID and the Government of Mozambique. Second, unless commercial traders begin to import yellow maize from South Africa or the world markets, depending upon exchange rates and prices, urban consumers will no longer have a less-expensive consumption alternative to domestic white maize. As the price graphs show, there is a persistent 10 - 25 percent margin between white and yellow maize prices when both yellow and white maize are relatively abundant. Third, in the post-war/drought period, white maize price increases are dampened by the food aid deliveries, such that removal of the deliveries means higher white maize prices. Estimation of precise welfare effects requires new Maputo consumption studies, but for low income consumers, the yellow maize food aid can be an important contribution to food security.

Should another severe drought strike the region and large quantities of yellow maize food aid be needed again, there are several additional lessons that have been learned. Yellow maize food aid shocks will not have much effect on prices for the domestic white maize commodities in times of extreme scarcity, as happened in Mozambique in 1992. Yet the price of yellow maize will be lower than that of white, and lower income consumers will take advantage of this price differential. Of course, some consumers will not substitute out of white maize to yellow, and so the price of domestic white maize may rise as high as the next preferred good (rice or finely milled imported white maize flour). During these periods, the arrivals of the inferior yellow maize did relatively little to lower white maize prices, but consumers benefitted from access to the alternative, cheaper commodity, yellow maize.

However, at higher levels of domestic production and under improved market integration, care should be taken to avoid large unpredictable quantities of food aid, for such shocks do act to lower prices for the domestic white maize. Both producers and traders will be affected by the lower prices. In order to avoid such food aid shocks, the government and donors need to plan carefully the quantities that are delivered to consignees during any given week. Since shipments tend to be large (10,000 to 15,000 metric tons), it may be necessary for the GOM to make an effort to constrain the quantities available to the market, limiting weekly deliveries to consignees, and possibly storing maize for later release. If large quantities do arrive, the consignee prices charged may form a floor price and can be used to hold maize prices up, as long as emergency program leakages are kept down. Thus, distribution policies can be designed to avoid the large quantities arriving on the market in any given week or over an entire hungry season. This should help to reduce potential negative price effects.

When food aid yellow maize makes up 25 - 50 percent of total marketed supplies, as it did in 1994 and 1995, that yellow maize will have significant effects on consumer prices. For planning the overall quantities of food aid to arrive and the timing of those arrivals, policy makers need greater knowledge of the domestic production, marketed surplus, and consumption demand in both urban and rural areas.

8.7.2 Effects of market integration

The general lack of yellow maize in the Chimoio markets indicates that the food aid commodity need not be present in production areas to have an effect upon the markets in those regions. By lowering the prices in the consumption regions, the food aid commodity competes with the domestic commodity, lowering its price and jeopardizing production and trade incentives. Yet, this only happens when the markets are more strongly integrated.

One clear result of the rapid appraisal and the market integration analysis is that the markets in Mozambique are increasingly connected. In 1993, prices in Chimoio were relatively unaffected by Maputo price shocks. By 1995, Maputo price shocks rapidly and significantly affected prices in Chimoio. Government and donor participation in markets will have more than localized effects in the presence of such integrated markets. Further research will help to evaluate the extent of market integration between other regions of the country. It is logical to expect that with new investments in major roads connecting the north and south of Mozambique, markets will continue to become more integrated.

8.7.3 Effects of domestic purchases to acquire emergency food aid supplies

Given continued emergency food aid needs for targeted groups, and the increase in domestic production of white maize, some donors began in 1994 to purchase locally produced white maize to supply their emergency distribution programs. As was shown above, the rapid price increases Maputo and Chimoio in August 1994[3] for white maize can be attributed to these purchases, as white maize was bought by ICM and others for delivery to WFP and other donors. The market integration work shows that price shocks in Chimoio do affect the Maputo prices, and *vice versa*. White maize local purchases represent a drain on available marketed quantities, as the supplies are targeted to those people without effective demand. Essentially, every 10,000 metric tons purchased locally is 10,000 metric tons less available on the market, logically resulting in higher prices than would occur otherwise.

Whether local purchases drive up consumer prices depends upon the quantity, the location, and the procedures used for making these purchases. During the rapid appraisal, white maize prices went up for consumers in Maputo because formal traders began buying maize for ICM in the main producing areas. These are the same regions (near Chimoio, for example) in which informal traders were buying for Maputo consumers, so the local

[3] The price increase in Maputo was earlier, in July at the time of World Food Programme and ICM's announcement of the intention to purchase. In Chimoio, it began in August with the actual initiation of purchases.

purchases meant increased competition for white maize. If local purchases were conducted in zones in which traders were absent, for example, in some of the northern zones of Mozambique, white maize quantities purchased might otherwise have remained unsold in farmers' storage sheds. The local purchases may provide additional production incentives in otherwise economically depressed areas. Thus, local purchases may assist in longer term development efforts if they are focused in areas that have future trading potential.

This increased trade, however, may be only transitory, as long as local purchases are made, if traders are absent because the transportation and transaction costs are too high to justify the activity. The local purchases may provide incentives for maize production in zones that are not financially viable for future trading without infrastructure investments. In this way, local purchases are similar to pan-territorial pricing mechanisms in which the more distant production zones receive prices that do not reflect market supply and demand conditions.

The rapid appraisal and market integration work indicate that informal traders in particular respond to changing environments, and prices can become responsive between markets as infrastructure improves. Yet, considerable and careful analysis is needed to determine whether and how much local purchases will influence white maize prices for all of the consumers dependent upon the market for their supplies of white maize. More research is needed to understand the effects on rural households and their maize sales and purchases, for many rural households are net buyers of maize.

Special care is needed to study the potential positive and negative effects of local purchases in 1996. If indeed donors do not bring in quantities of commercial yellow maize food aid, lower income consumers in Maputo and other urban areas in southern Mozambique will not have the option to purchase yellow maize. Domestic white maize prices will be at least 10-15 percent higher than they would be when commercial yellow maize food aid is present in the market. If the local purchases are a relatively large compared to total marketed surplus available (as was the case in 1994), then market prices could again be quite high in the hungry season months of 1996/97, as indeed happened in 1995/96 (Figure 8.1).

One source of optimism with the elimination of the commercial yellow maize food aid shipments is that there will no longer be the unpredictable downward pressures on white maize prices that came from delivery shocks. White maize prices are already beginning to have the seasonal price movements of falling prices at harvest and gradual increases through the hungry season which will help to generate interseasonal storage and trade.

However, this also means that increases in white maize prices will no longer be dampened by the commercial food aid yellow maize supplies and consumers in large urban areas may face substantially higher prices in the hungry season. Prices for white maize may rise until they reach an equilibrium based on higher-priced, substitute commodities, such as rice and imported finely processed white maize flour, at least until marketed supplies of white maize are sufficient to meet demand with lower prices.

Therefore, in future years, in order to fulfill its food security objectives, the government may need to encourage some import of yellow maize from South Africa or from the world markets when white maize prices are high. Formal traders do not have experience with private imports of yellow maize. Special import licenses or exemptions from duties may encourage the private sector to experiment with imported yellow maize, thus making the lower priced yellow maize available as a consumption substitute for the poor. In addition, the yellow maize imports would continue to stimulate the small scale milling sector, as the food aid supplies did on the past. Yellow maize is more frequently milled than yellow maize in urban areas.

Mozambique is an economy in transition and growth. When the drought hit the Southern Africa region, Mozambique was already having great economic problems. The yellow maize food aid did not just temporarily affect the opportunities of existing private traders and their marketing channels. Instead, Mozambican consumers, farm producers, and private traders were learning and adapting in a new economic environment. Yellow maize food aid brought new opportunities, supporting the private sector commercial activities. In the long run, consumer, producer, and trader interests will be served by encouraging continued competition in private markets. As this research shows, there may still be an important role for commercial yellow maize imports by the public or private sector, as well as for additional domestic purchases of emergency food aid supplies. But, these efforts must be managed with care to avoid the negative price effects on all market participants. Combining knowledge of the markets with better production and consumption information will help policy makers make informed decisions for food security policy.

APPENDIX A

APPENDIX A

Data for analysis of food aid quantity effects on maize prices in Maputo

YEAR	MONTH	DAY	Nominal White Price	Nominal Yellow Price	Food Aid Deliveries	Real White Price	Real Yellow Price	CPI (Dec 1989 = 100)
90	4	7	400.00	357.14	0.00	288.60	257.68	138.60
90	4	14	375.00	285.71	0.00	272.93	207.94	137.40
90	4	21	384.62	266.67	0.00	282.39	195.79	136.20
90	4	28	375.00	266.67	0.00	277.78	197.53	135.00
90	5	5	454.55	312.50	0.00	339.72	233.56	133.80
90	5	12	304.88	273.97	0.00	229.06	205.84	133.10
90	5	19	410.96	273.97	0.00	310.39	206.93	132.40
90	5	26	466.67	334.35	0.00	354.34	253.88	131.70
90	6	2	437.50	394.74	0.00	333.97	301.33	131.00
90	6	9	466.67	266.67	0.00	357.71	204.40	130.46
90	6	16	533.33	416.67	0.00	410.51	320.71	129.92
90	6	23	533.33	400.00	0.00	412.22	309.17	129.38
90	6	30	547.95	400.00	0.00	425.29	310.46	128.84
90	7	7	533.33	479.45	0.00	415.69	373.70	128.30
90	7	14	500.00	479.45	0.00	390.55	374.50	128.03
90	7	21	400.00	466.67	0.00	313.11	365.30	127.75
90	7	28	500.00	400.00	7590.00	392.23	313.79	127.48
90	8	4	466.67	400.00	7410.00	366.88	314.47	127.20
90	8	11	600.00	384.62	0.00	468.38	300.25	128.10
90	8	18	473.68	333.33	0.00	367.20	258.40	129.00
90	8	25	562.50	357.14	0.00	433.03	274.94	129.90
90	9	1	597.00	400.00	0.00	456.42	305.81	130.80
90	9	8	466.67	400.00	0.00	354.56	303.91	131.62
90	9	15	466.67	400.00	2530.00	352.36	302.02	132.44
90	9	22	562.50	357.14	7620.00	422.11	268.00	133.26
90	9	29	547.92	411.90	0.00	408.65	307.21	134.08
90	10	6	533.33	466.67	850.00	395.35	345.94	134.90
90	10	13	571.43	466.67	0.00	419.94	342.95	136.08
90	10	20	615.38	466.67	1265.00	448.37	340.01	137.25
90	10	27	533.33	333.33	8855.00	385.29	240.80	138.43
90	11	3	571.43	466.67	6985.00	409.33	334.29	139.60
90	11	10	533.33	428.57	1895.00	376.98	302.93	141.48
90	11	17	571.43	428.57	0.00	398.62	298.97	143.35
90	11	24	875.00	466.67	0.00	602.51	321.34	145.23

YEAR	MONTH	DAY	Nominal White Price	Nominal Yellow Price	Food Aid Deliveries	Real White Price	Real Yellow Price	CPI (Dec 1989 = 100)
90	12	1	875.00	562.50	0.00	594.83	382.39	147.10
90	12	8	775.34	487.13	5000.00	523.38	328.83	148.14
90	12	15	675.68	411.76	0.00	452.93	276.02	149.18
90	12	22	642.86	428.57	0.00	427.94	285.30	150.22
90	12	29	615.38	500.00	0.00	406.84	330.56	151.26
91	1	5	533.33	400.00	0.00	350.19	262.64	152.30
91	1	12	533.33	400.00	3795.00	346.49	259.87	153.93
91	1	19	533.33	428.57	1646.00	342.87	275.52	155.55
91	1	26	642.86	400.00	8855.00	409.01	254.49	157.18
91	2	2	750.00	342.47	3630.00	472.29	215.66	158.80
91	2	9	666.67	400.00	0.00	414.59	248.76	160.80
91	2	16	625.00	428.57	0.00	383.91	263.25	162.80
91	2	23	666.67	400.00	0.00	404.53	242.72	164.80
91	3	2	857.14	400.00	0.00	513.87	239.81	166.80
91	3	9	866.67	538.46	0.00	513.49	319.03	168.78
91	3	16	666.67	466.67	1265.00	390.41	273.29	170.76
91	3	23	687.50	466.67	8855.00	398.00	270.16	172.74
91	3	30	571.43	583.33	2880.00	327.05	333.87	174.72
91	4	6	533.33	466.67	0.00	301.83	264.10	176.70
91	4	13	500.00	400.00	0.00	283.73	226.98	176.23
91	4	20	500.00	400.00	3000.00	284.50	227.60	175.75
91	4	27	466.67	400.00	0.00	266.25	228.21	175.28
91	5	4	533.33	400.00	2530.00	305.11	228.83	174.80
91	5	11	466.67	384.62	6470.00	263.69	217.33	176.98
91	5	18	500.00	277.78	0.00	279.10	155.05	179.15
91	5	25	533.33	333.33	0.00	294.13	183.83	181.33
91	6	1	600.00	300.00	7000.00	326.98	163.49	183.50
91	6	8	514.29	333.33	0.00	284.10	184.14	181.02
91	6	15	428.57	333.33	0.00	240.04	186.70	178.54
91	6	22	500.00	333.33	0.00	283.99	189.33	176.06
91	6	29	714.29	333.33	0.00	411.50	192.03	173.58
91	7	6	625.00	312.50	0.00	365.28	182.64	171.10
91	7	13	562.50	333.33	0.00	324.82	192.48	173.18
91	7	20	428.57	333.33	6325.00	244.55	190.20	175.25
91	7	27	666.67	333.33	3675.00	375.96	187.98	177.33
91	8	3	467.00	400.00	0.00	260.31	222.97	179.40
91	8	10	353.00	400.00	0.00	195.59	221.63	180.48
91	8	17	438.00	333.00	0.00	241.24	183.41	181.56
91	8	24	600.00	400.00	0.00	328.52	219.01	182.64
91	8	31	500.00	333.00	0.00	272.15	181.25	183.72

YEAR	MONTH	DAY	Nominal White Price	Nominal Yellow Price	Food Aid Deliveries	Real White Price	Real Yellow Price	CPI (Dec 1989 = 100)
91	9	7	533.00	400.00	0.00	288.42	216.45	184.80
91	9	14	610.00	400.00	0.00	327.25	214.59	186.40
91	9	21	500.00	400.00	0.00	265.96	212.77	188.00
91	9	28	600.00	533.00	0.00	316.46	281.12	189.60
91	10	5	737.50	633.00	0.00	385.72	331.07	191.20
91	10	12	800.00	500.00	0.00	416.83	260.52	191.93
91	10	19	775.00	516.50	0.00	402.28	268.10	192.65
91	10	26	563.00	533.00	0.00	291.14	275.63	193.38
91	11	2	1000.00	667.00	0.00	515.20	343.64	194.10
91	11	9	928.50	690.50	1265.00	476.01	353.99	195.06
91	11	16	1143.00	467.00	21660.00	583.10	238.24	196.02
91	11	23	750.00	400.00	10960.00	380.75	203.07	196.98
91	11	30	708.50	366.50	10060.00	357.94	185.16	197.94
91	12	7	1067.00	333.00	12305.00	536.45	167.42	198.90
91	12	14	1000.00	357.00	1990.00	492.31	175.75	203.13
91	12	21	714.00	357.00	0.00	344.35	172.17	207.35
91	12	28	667.00	333.00	0.00	315.25	157.39	211.58
92	1	4	714.00	333.00	0.00	330.86	154.31	215.80
92	1	11	563.00	313.00	0.00	255.76	142.19	220.13
92	1	18	563.00	313.00	0.00	250.84	139.45	224.45
92	1	25	500.00	333.00	0.00	218.56	145.56	228.78
92	2	1	588.00	313.00	0.00	252.25	134.28	233.10
92	2	8	635.00	429.00	0.00	271.07	183.13	234.26
92	2	15	643.00	429.00	0.00	273.13	182.23	235.42
92	2	22	667.00	333.00	0.00	281.93	140.76	236.58
92	2	29	556.00	471.00	0.00	233.87	198.12	237.74
92	3	7	643.00	533.00	0.00	269.15	223.11	238.90
92	3	14	529.00	412.00	0.00	218.03	169.81	242.63
92	3	21	471.00	353.00	0.00	191.19	143.29	246.35
92	3	28	625.00	660.00	0.00	249.93	263.92	250.08
92	4	4	750.00	556.00	0.00	295.51	219.07	253.80
92	4	11	750.00	586.00	0.00	293.97	229.69	255.13
92	4	18	722.00	706.00	0.00	281.54	275.30	256.45
92	4	25	1000.00	1067.00	0.00	387.94	413.93	257.78
92	5	2	1059.00	1059.00	0.00	408.72	408.72	259.10
92	5	9	1063.00	832.50	440.00	410.46	321.45	258.98
92	5	16	1067.00	606.00	8554.25	412.19	234.10	258.86
92	5	23	923.00	571.00	9723.90	356.73	220.68	258.74
92	5	30	1000.00	571.00	10057.65	386.67	220.79	258.62
92	6	6	1000.00	533.00	2709.50	386.85	206.19	258.50

YEAR	MONTH	DAY	Nominal White Price	Nominal Yellow Price	Food Aid Deliveries	Real White Price	Real Yellow Price	CPI (Dec 1989 = 100)
92	6	13	688.00	438.00	133.45	265.38	168.95	259.25
92	6	20	1067.00	643.00	0.00	410.38	247.31	260.00
92	6	27	800.00	571.00	0.00	306.81	218.98	260.75
92	7	4	941.00	500.00	0.00	359.85	191.20	261.50
92	7	11	1067.00	667.00	0.00	412.17	257.65	258.88
92	7	18	889.00	667.00	0.00	346.93	260.29	256.25
92	7	25	1250.00	800.00	0.00	492.85	315.43	253.63
92	8	1	1059.00	625.00	3947.37	421.91	249.00	251.00
92	8	8	1000.00	643.00	5526.32	397.58	255.65	251.52
92	8	15	1500.00	533.33	8308.57	595.14	211.61	252.04
92	8	22	1176.47	533.33	4378.25	465.82	211.17	252.56
92	8	29	1375.00	533.33	13701.75	543.31	210.74	253.08
92	9	5	1333.33	533.33	9381.90	525.76	210.30	253.60
92	9	12	1263.16	466.67	10859.60	490.36	181.16	257.60
92	9	19	1111.11	400.00	4866.30	424.74	152.91	261.60
92	9	26	1250.00	466.67	2778.15	470.63	175.70	265.60
92	10	3	1111.11	466.67	1317.55	412.13	173.10	269.60
92	10	10	1333.33	400.00	2663.65	486.69	146.01	273.96
92	10	17	1833.33	714.29	5519.90	658.71	256.64	278.32
92	10	24	1466.67	400.00	4424.70	518.84	141.50	282.68
92	10	31	1195.22	531.21	3648.45	416.39	185.06	287.04
92	11	7	1333.33	463.58	1423.10	457.56	159.09	291.40
92	11	14	1744.19	392.16	7402.40	590.50	132.77	295.38
92	11	21	1428.57	714.29	4107.40	477.22	238.61	299.35
92	11	28	1357.14	937.50	7164.40	447.42	309.07	303.33
92	12	5	1250.00	500.00	6155.80	406.77	162.71	307.30
92	12	12	1529.41	400.00	2489.05	490.59	128.31	311.75
92	12	19	750.00	400.00	1071.15	237.19	126.50	316.20
92	12	26	1411.76	533.33	1568.30	440.28	166.33	320.65
93	1	2	1699.01	534.76	2803.00	522.61	164.49	325.10
93	1	9	1986.25	534.76	10340.51	609.54	164.11	325.86
93	1	16	2005.35	529.67	11894.65	613.97	162.17	326.62
93	1	23	1871.66	467.91	3665.08	571.71	142.93	327.38
93	1	30	1604.28	534.76	1480.71	488.90	162.97	328.14
93	2	6	2118.67	534.76	0.00	644.17	162.59	328.90
93	2	13	1986.25	534.76	0.00	597.37	160.83	332.50
93	2	20	1426.03	529.67	1939.58	424.29	157.59	336.10
93	2	27	1292.34	472.64	1385.42	380.43	139.13	339.70
93	3	6	1292.34	472.64	0.00	376.44	137.68	343.30
93	3	13	968.01	524.86	0.00	280.87	152.29	344.65

YEAR	MONTH	DAY	Nominal White Price	Nominal Yellow Price	Food Aid Deliveries	Real White Price	Real Yellow Price	CPI (Dec 1989 = 100)
93	3	20	643.69	514.67	0.00	186.04	148.75	346.00
93	3	27	722.92	386.22	0.00	208.12	111.19	347.35
93	4	3	722.92	441.92	0.00	207.32	126.73	348.70
93	4	10	722.92	467.91	0.00	206.06	133.38	350.83
93	4	17	802.14	472.64	0.00	227.27	133.91	352.95
93	4	24	668.45	397.25	0.00	188.26	111.88	355.08
93	5	1	802.14	401.07	0.00	224.56	112.28	357.20
93	5	8	802.14	401.07	0.00	224.76	112.38	356.88
93	5	15	655.72	401.07	0.00	183.90	112.48	356.56
93	5	22	643.34	397.25	0.00	180.59	111.51	356.24
93	5	29	757.58	399.16	0.00	212.85	112.15	355.92
93	6	5	794.50	401.07	0.00	223.43	112.79	355.60
93	6	12	786.86	305.58	0.00	220.41	85.60	357.00
93	6	19	764.79	405.12	0.00	213.39	113.04	358.40
93	6	26	776.84	384.69	0.00	215.91	106.92	359.80
93	7	3	755.27	392.16	0.00	209.10	108.57	361.20
93	7	10	792.24	384.69	0.00	219.53	106.60	360.88
93	7	17	776.84	384.69	0.00	215.45	106.69	360.56
93	7	24	727.05	392.16	0.00	201.82	108.86	360.24
93	7	31	769.37	384.89	0.00	213.76	106.94	359.92
93	8	7	776.84	457.52	0.00	216.03	127.23	359.60
93	8	14	872.43	440.57	0.00	238.48	120.43	365.83
93	8	21	740.74	440.33	0.00	199.10	118.35	372.05
93	8	28	629.39	440.33	0.00	166.38	116.40	378.28
93	9	4	769.79	415.05	0.00	200.21	107.95	384.50
93	9	11	898.09	377.43	0.00	232.60	97.75	386.10
93	9	18	755.27	453.16	0.00	194.81	116.88	387.70
93	9	25	755.27	415.29	0.00	194.01	106.68	389.30
93	10	2	784.31	377.43	0.00	200.64	96.55	390.90
93	10	9	755.27	380.95	0.00	191.89	96.79	393.60
93	10	16	726.22	384.69	0.00	183.25	97.07	396.30
93	10	23	740.74	377.63	0.00	185.65	94.64	399.00
93	10	30	790.12	432.10	0.00	196.69	107.57	401.70
93	11	6	754.85	448.80	0.00	186.66	110.98	404.40
93	11	13	740.74	448.80	0.00	179.07	108.50	413.65
93	11	20	864.20	432.10	0.00	204.35	102.18	422.90
93	11	27	755.27	453.16	0.00	174.77	104.86	432.15
93	12	4	881.14	436.21	1379.50	199.62	98.83	441.40
93	12	11	864.20	503.23	2626.80	191.34	111.42	451.65
93	12	18	898.09	452.67	4028.05	194.43	98.00	461.90

YEAR	MONTH	DAY	Nominal White Price	Nominal Yellow Price	Food Aid Deliveries	Real White Price	Real Yellow Price	CPI (Dec 1989 = 100)
93	12	25	1091.62	533.77	1112.70	231.20	113.05	472.15
94	1	1	740.74	517.90	1005.10	153.55	107.36	482.40
94	1	8	864.20	503.51	1023.10	176.81	103.01	488.78
94	1	15	897.60	556.77	4560.25	181.28	112.44	495.16
94	1	22	1374.86	694.44	2324.20	274.13	138.46	501.54
94	1	29	1258.08	647.74	3541.95	247.69	127.53	507.92
94	2	5	1320.39	601.04	4430.30	256.74	116.87	514.30
94	2	12	1258.78	595.62	807.25	241.09	114.08	522.13
94	2	19	1258.78	653.59	1710.25	237.53	123.33	529.95
94	2	26	1258.08	560.22	1927.30	233.94	104.17	537.78
94	3	5	1282.98	623.16	1313.00	235.15	114.22	545.60
94	3	12	1035.79	606.45	545.50	189.24	110.80	547.35
94	3	19	888.89	641.49	57.50	161.88	116.83	549.10
94	3	26	864.20	641.49	0.00	156.88	116.45	550.85
94	4	2	747.80	617.28	0.00	135.32	111.71	552.60
94	4	9	856.41	647.37	0.00	154.79	117.01	553.26
94	4	16	871.46	653.59	0.00	157.33	117.99	553.92
94	4	23	941.18	549.94	0.00	169.71	99.16	554.58
94	4	30	915.03	653.59	0.00	164.80	117.71	555.24
94	5	7	972.22	694.44	0.00	174.89	124.92	555.90
94	5	14	972.22	694.44	0.00	173.96	124.26	558.88
94	5	21	936.82	694.44	0.00	166.74	123.60	561.85
94	5	28	995.37	694.44	0.00	176.23	122.95	564.83
94	6	4	995.37	617.28	0.00	175.30	108.72	567.80
94	6	11	953.16	694.44	0.00	165.88	120.85	574.63
94	6	18	906.32	663.50	0.00	155.87	114.11	581.45
94	6	25	972.22	694.44	0.00	165.27	118.05	588.28
94	7	2	953.16	694.44	0.00	160.17	116.69	595.10
94	7	9	953.16	694.44	0.00	157.82	114.99	603.94
94	7	16	915.03	653.59	0.00	149.32	106.66	612.78
94	7	23	1045.75	1176.47	0.00	168.23	189.26	621.62
94	7	30	1045.75	1013.07	0.00	165.87	160.69	630.46
94	8	6	1045.75	1045.75	0.00	163.58	163.58	639.30
94	8	13	1960.78	1176.47	0.00	306.70	184.02	639.33
94	8	20	1437.91	1307.19	0.00	224.90	204.46	639.35
94	8	27	1424.21	1307.19	0.00	222.75	204.45	639.38
94	9	3	1830.07	1288.52	0.00	286.22	201.52	639.40
94	9	10	1795.21	1307.19	0.00	278.81	203.02	643.88
94	9	17	1666.98	1307.19	0.00	257.11	201.62	648.35
94	9	24	1725.49	1307.19	0.00	264.31	200.24	652.83

YEAR	MONTH	DAY	Nominal White Price	Nominal Yellow Price	Food Aid Deliveries	Real White Price	Real Yellow Price	CPI (Dec 1989 = 100)
94	10	1	1424.21	1307.19	0.00	216.68	198.87	657.30
94	10	8	1608.47	1270.88	0.00	243.20	192.16	661.38
94	10	15	1624.30	1234.57	0.00	244.09	185.52	665.46
94	10	22	1583.15	1246.33	0.00	236.45	186.15	669.54
94	10	29	1580.73	1244.08	0.00	234.66	184.69	673.62
94	11	5	1692.19	1244.08	0.00	249.70	183.57	677.70
94	11	12	1803.64	1241.83	8653.95	258.86	178.23	696.78
94	11	19	1721.13	965.87	10414.35	240.43	134.93	715.85
94	11	26	1373.19	1015.87	2235.30	186.85	138.23	734.93
94	12	3	1483.71	1045.75	172.70	196.78	138.69	754.00
94	12	10	1805.86	1069.96	0.00	237.11	140.49	761.60
94	12	17	1667.88	849.04	0.00	216.83	110.38	769.20
94	12	24	1510.53	820.42	0.00	194.46	105.62	776.80
94	12	31	1583.15	890.19	2232.70	201.83	113.49	784.40
95	1	7	1635.51	816.37	6453.70	206.50	103.08	792.00
95	1	14	1636.41	766.73	5884.50	206.94	96.96	790.78
95	1	21	1699.35	755.27	6993.55	215.23	95.66	789.55
95	1	28	1539.58	775.22	4556.90	195.30	98.34	788.33
95	2	4	1629.37	769.37	0.00	207.01	97.75	787.10
95	2	11	1463.33	769.79	0.00	184.26	96.93	794.17
95	2	18	1525.05	727.39	0.00	190.34	90.78	801.24
95	2	25	1454.85	747.80	0.00	179.99	92.51	808.30
95	3	4	1414.34	776.84	0.00	173.46	95.27	815.37
95	3	11	1414.88	769.79	0.00	171.98	93.57	822.69
95	3	18	1481.48	708.08	0.00	178.49	85.31	830.01
95	3	25	1497.18	658.44	0.00	178.80	78.63	837.34
95	4	1	1576.02	872.43	0.00	186.59	103.29	844.66
95	4	8	1636.41	976.48	0.00	187.02	111.60	875.00
95	4	15	1651.69	1235.20	0.00	182.22	136.27	906.42
95	4	22	1620.22	1164.02	0.00	172.55	123.97	938.98
95	4	29	1709.03	1174.05	0.00	175.70	120.70	972.71

Appendix B

Appendix B

Alternative models for the Food Aid Effects Analysis

B.1 Simultaneous model for the war/drought period

Although the results of the recursive ordering WP, FA, YP were in correspondence with economic expectations and allowed for FA_t to be contemporaneously affected by WP_t, it restricts the coefficient on YP_t to be zero in the WP_t equation. As an alternative, a nonrecursive identification scheme was tested, as indicated by the following A_0 matrix with the same ordering of WP, FA, and YP:

$$A_0 = \begin{bmatrix} \alpha_{11} & 0 & \alpha_{13} \\ \alpha_{21} & \alpha_{22} & 0 \\ 0 & \alpha_{32} & \alpha_{33} \end{bmatrix} \qquad \textbf{(B.1)}$$

This is based on the following logic: white maize price shocks affect food aid arrivals contemporaneously since they are the signals of market scarcity of maize products, shown in the first row. Yellow maize prices are affected contemporaneously by the food aid arrivals (as was observed), but not by the white maize price shocks. Food aid shocks do not contemporaneously affect white maize prices, however yellow maize price shocks do. The corresponds to the interpretation that the yellow maize price shocks are demand shocks. Since white and yellow maize products are substitutes in consumption, white price would be affected by yellow maize demand shocks and only indirectly by yellow maize supply shocks.

The results are in accordance with economic logic. Figure B.1 presents the impulse responses for a one standard deviation shock, holding all other shocks to zero. A food aid arrival shock has negative effects on white and yellow maize prices. High supply is followed in 4 weeks by a reduction in FA arrivals, in compensation for the oversupply and the reduction in prices with series returning to near steady state by the twelfth week. Yellow maize price shocks result in a positive response of all three series with each series returning to near steady state by the eleventh week .

The difference in identification schemes allows contemporaneous effects across the series, such that yellow maize prices, while not affected directly by a white maize price shock in the initial period, are affected by the change in food aid arrivals that the shock generates. Food aid arrivals show an increase with the white maize price shock, as would be expected since the price spike in white signals scarcity. That increase of yellow maize supplies has a negative influence on the yellow maize prices, resulting in a net negative effect on yellow maize prices.

The FEVDs for the VAR with this nonrecursive identification can be seen in Table B.1. With the nonrecursive structure, white maize price shocks account for almost 17 percent of the forecast error variance in food aid after one period, and after 20 periods, still account for almost 16 percent. By the ninth period, yellow maize price shocks account for 11.4 percent, and maintain a level close to 12 percent of the food aid error variance throughout the remaining periods. Thus, food aid own shocks account for about 72 percent of the error variance, with 28 percent from other shocks. Looking at the yellow maize price, own shocks account for a high percentage of the error variance, yet by the 4th period, 30 percent of the error variance can be accounted for by the shocks from food aid. Finally, the white maize prices follow a pattern similar to the yellow maize prices, initially 80 percent for own shocks, declining to 60 percent, with over 30 percent accounted for by the yellow maize price shocks, with surprisingly little attributable to the food aid shocks. This suggests that the food aid delivery shocks affect the yellow maize prices; through the demand in the markets, yellow prices in turn affect white maize prices.

The simulation was run with this simultaneous identification scheme as well. Figure B.2 appears almost identical to Figure 6.2, the simulation results with the recursive model, although careful observation shows a moderate increase in the simulated yellow maize price with the simultaneous identification scheme.

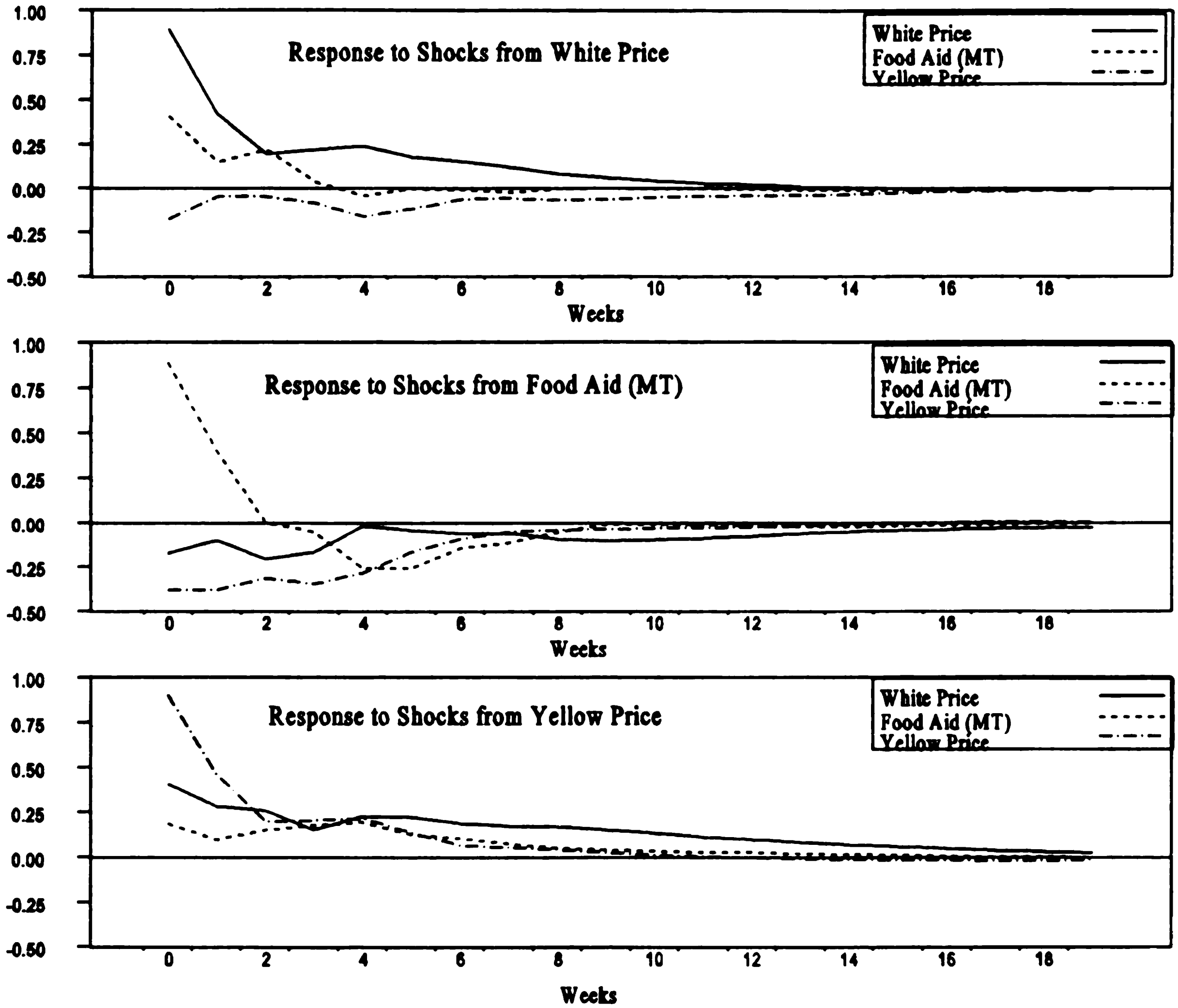


Figure B.1 Impulse responses to shocks, based on the simultaneous model, war/drought period

Table B.1 Forecast error variance decompositions for simultaneous model, war/drought period

Step	Variance Decomposition (% of total variance due to each shock)								
	White maize price			Food aid			Yellow maize price		
	Own shock	FA shock	YP shock	WP shock	Own shock	YP shock	WP shock	FA shock	Own shock
1	80.2	2.9	16.9	17.0	79.5	3.6	3.1	14.4	82.5
2	77.2	3.1	19.7	16.1	80.1	3.9	2.4	21.0	76.5
3	71.8	5.7	22.5	19.0	75.4	5.5	2.3	25.5	72.1
4	70.3	7.2	22.5	18.6	73.5	7.9	2.5	30.0	67.5
5	69.1	6.7	24.2	17.3	72.6	10.1	3.7	31.9	64.4
6	67.5	6.5	26.0	16.3	73.0	10.6	4.3	32.3	63.4
7	66.4	6.5	27.1	16.0	72.8	11.2	4.5	32.5	63.1
8	65.4	6.5	28.1	15.8	72.7	11.5	4.6	32.4	63.0
9	64.2	6.7	29.0	15.8	72.6	11.6	4.8	32.4	62.8
10	63.1	7.1	29.7	15.7	72.5	11.7	5.0	32.3	62.6
11	62.3	7.5	30.2	15.7	72.5	11.8	5.1	32.3	62.5
12	61.7	7.8	30.6	15.7	72.4	11.9	5.3	32.3	62.4
13	61.1	8.0	30.9	15.7	72.4	11.9	5.3	32.3	62.4
14	60.8	8.2	31.0	15.7	72.7	11.9	5.4	32.3	62.3
15	60.5	8.3	31.2	15.7	72.4	11.9	5.5	32.3	62.3
16	60.4	8.3	31.3	15.7	72.4	11.9	5.5	32.3	62.2
17	60.3	8.4	31.3	15.7	72.4	11.9	5.5	32.2	62.2
18	60.2	8.4	31.4	15.7	72.4	11.9	5.5	32.2	62.2
19	60.1	8.5	31.4	15.7	72.4	11.9	5.5	32.2	62.2
20	60.1	8.5	31.4	15.7	72.4	11.9	5.6	32.2	62.2

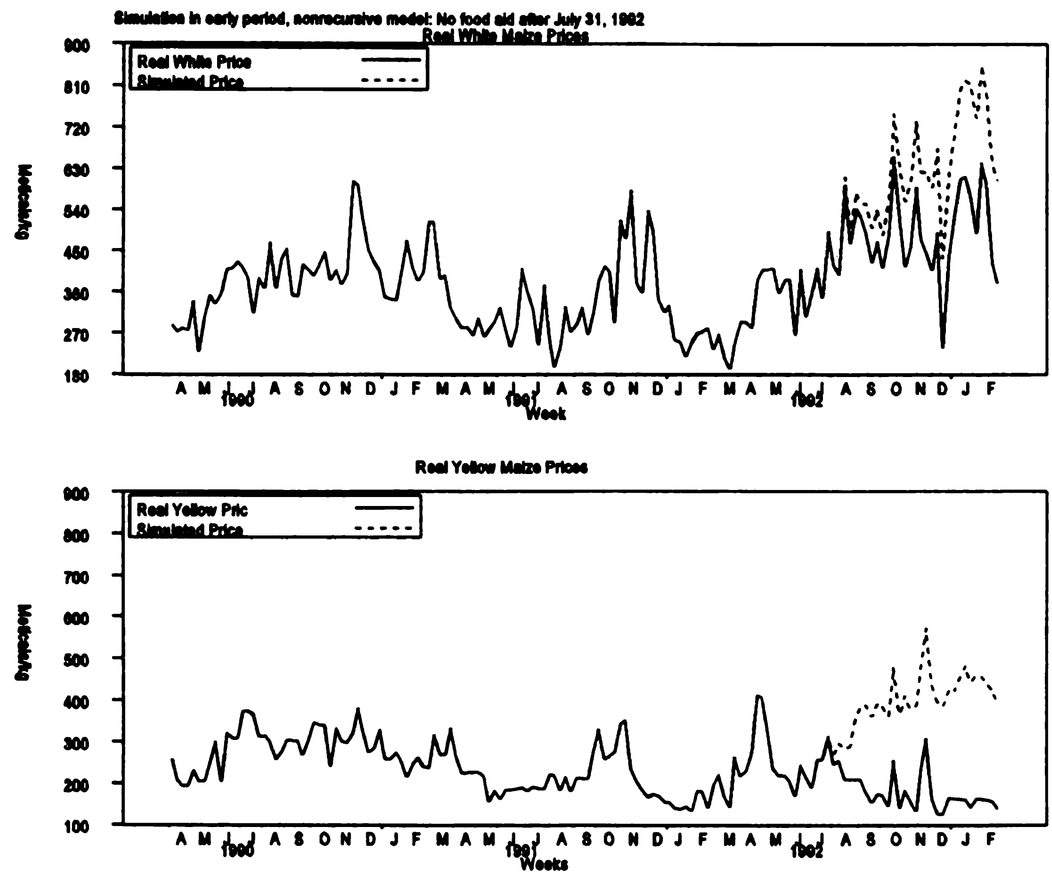


Figure B.2 Simulation in war/drought périod, simultaneous model with no food aid after July 31, 1992

B.2 Recursive ordering: FA, YP, WP in the war/drought period

Initial analysis was conducted with identification based upon the recursive model, ordering the variables FA, YP, and WP. The first row of A_0 gives the coefficients for the contemporaneous effects of each variable on FA_t ; the second row, similarly for YP_t ; and the third row for WP_t . Thus, α_{21} is the coefficient of FA_t in the YP_t equation. This A_0 implies that the FA_t equation would not contain YP_t or WP_t as explanatory variables, although the lagged values of those variables are still in the equation (see equation 5.2). For YP_t , the current FA, FA_t , would be included but not WP_t . Finally, current values of YP and FA would be included in the equation for WP.

The results of this recursive model (with FA, YP, WP ordering) were not good in terms of reflecting what economic theory and market structure would predict. For example, the response of white maize prices to a food aid arrival shock (approximately 2600 metric tons) was to increase, rather than to decrease. The lack of correspondence led the researcher to re-examine the premises of the identification and the market structure. The first aspect evaluated was whether or not food aid arrivals were exogenous, in the time series sense, to the white and yellow maize prices, as was assumed. This led to the recursive model selected in Chapter 6 for the war/drought period.

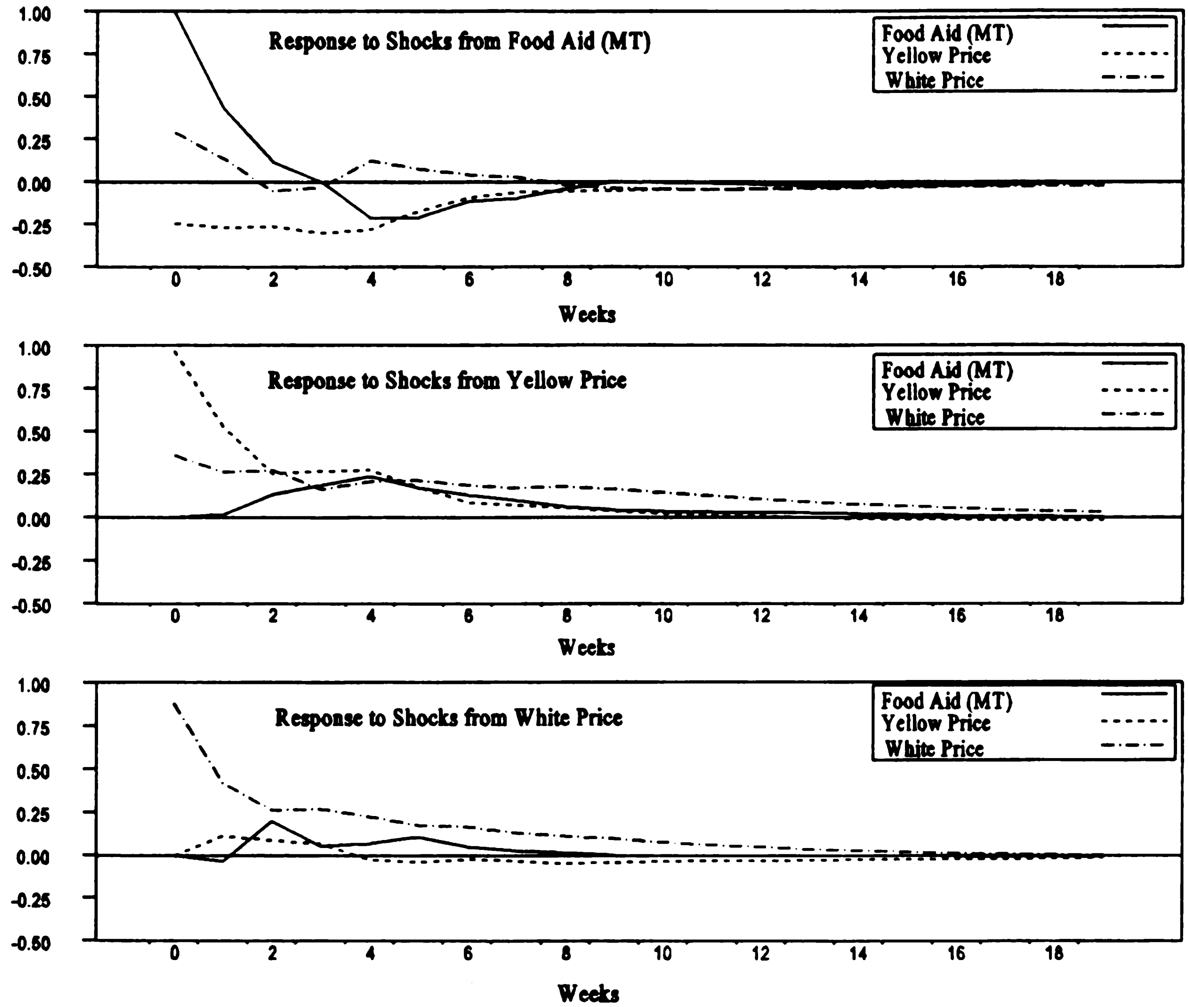


Figure B.3 Impulse responses to shocks, based on the recursive model FA,YP, WP, in war/drought period

B.3 Simultaneous identification in post-war/drought period

Exogeneity testing suggests that it would be valuable to estimate a model in which at least one of the maize prices is allowed to have a non-zero contemporaneous coefficient in the food aid equation. In order to evaluate this, a simultaneous identification was tested, in which white maize price shocks were allowed to affect food aid deliveries contemporaneously, as in the earlier period. Also white maize prices would be affected contemporaneously only by yellow maize price shocks and not by the food aid delivery shocks. This is the same simultaneous identification scheme used in the war/drought period, but the parameters estimates and shock paths will differ.

Using the ordering WP, FA, YP, the following A_0 matrix was proposed:

$$A_0 = \begin{bmatrix} 1 & 0 & \alpha_{13} \\ \alpha_{21} & 1 & 0 \\ 0 & \alpha_{32} & 1 \end{bmatrix} \qquad \textbf{(B.2)}$$

The impulse responses for this model are presented in Figure B.3. Comparing Figure B.3 with Figure 6.3 which presents the recursive model impulse responses, the results are almost identical, except in the first period. For a single delivery shock of 1250 metric tons, yellow maize prices decline about 4 meticais/kg, an effect lasting for 12-14 weeks. White maize price shocks increase the food aid, resulting in a decrease in yellow maize prices. With the simultaneous identification scheme, the contemporaneous effect of white maize prices on yellow maize prices allows yellow maize prices to increase initially, and then, as food aid increases, the yellow maize prices decrease. White maize prices come down quickly after a shock, due to the combination of increased food aid and lowered yellow maize prices.

The similarity between the two estimates indicates that the relationships between food aid shocks and yellow maize prices and between yellow maize demand shocks and white maize prices are robust.

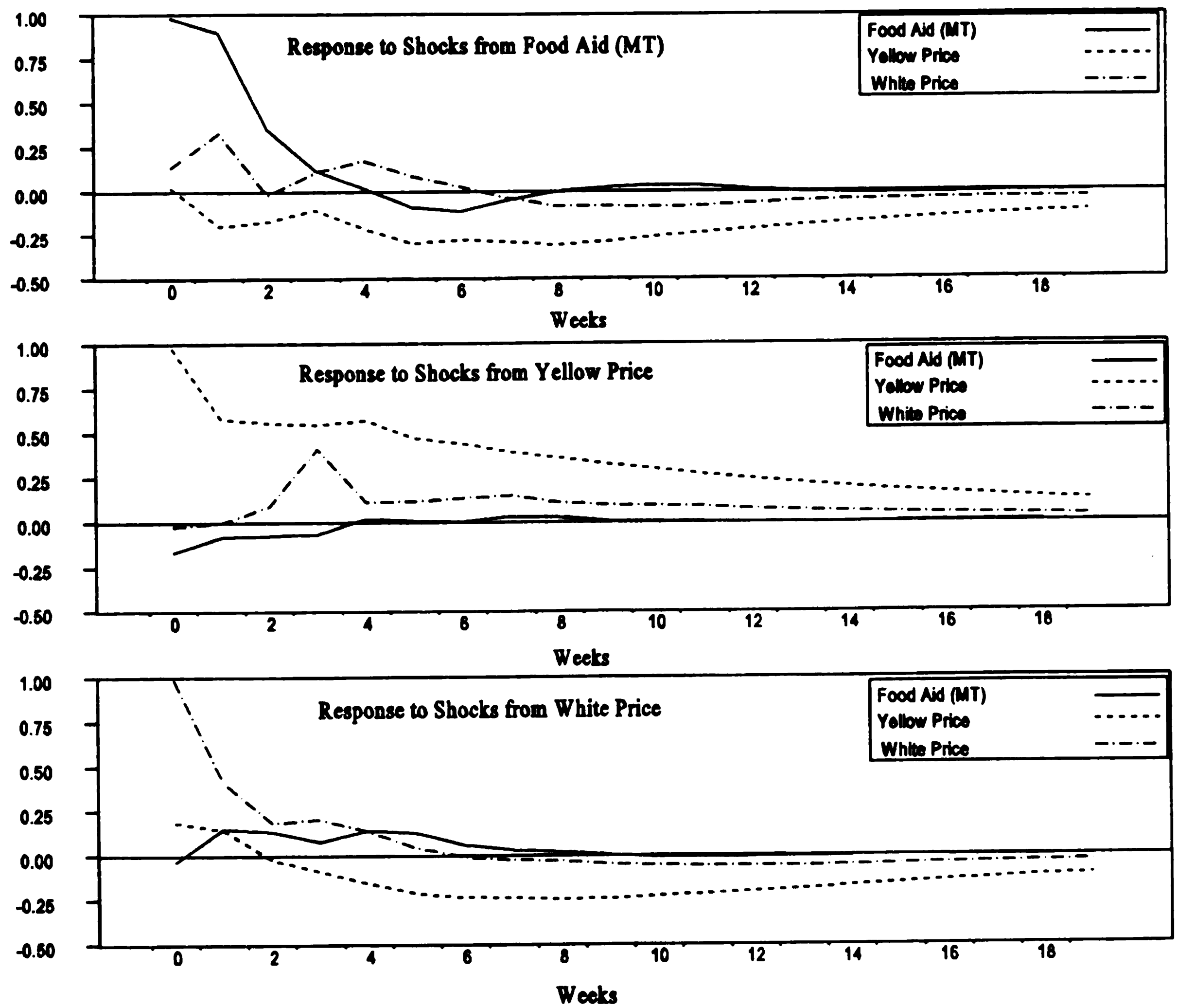


Figure B.4 Impulse responses to shocks, based on the simultaneous model with trend and mean shift, in the post-war/drought period

Table B.2 Forecast error variance decompositions, based on nonrecursive ordering, late period

Step	Variance Decomposition (% of total variance due to each shock)								
	Food Aid			Yellow maize price			White maize price		
	Own shock	YP shock	WP shock	FA shock	Own shock	WP shock	FA shock	YP shock	Own shock
1	92.2	2.7	0.1	0.1	96.2	3.7	1.8	0.0	98.1
2	96.8	1.8	1.4	2.8	93.0	4.2	9.9	0.0	90.0
3	95.8	1.9	2.2	3.9	92.7	3.4	9.6	0.6	89.7
4	95.4	2.1	2.5	3.8	93.0	3.2	9.0	11.6	79.4
5	94.4	2.1	3.5	5.0	91.3	3.6	10.6	11.9	77.5
6	93.7	2.1	4.3	7.5	87.8	4.7	10.9	12.6	76.5
7	93.5	2.1	4.4	9.2	84.9	5.9	10.9	13.5	75.6
8	93.4	2.1	4.4	10.8	82.2	7.0	10.8	14.6	74.6
9	93.4	2.1	4.5	12.5	79.5	8.0	11.1	15.2	73.7
10	93.4	2.1	4.5	13.9	77.2	9.0	11.4	15.5	73.0
11	93.4	2.1	4.5	14.8	75.5	9.7	11.7	15.9	72.4
12	93.4	2.1	4.5	15.5	74.1	10.4	12.0	16.1	71.9
13	93.4	2.1	4.5	16.1	73.0	10.9	12.2	16.3	71.5
14	93.4	2.1	4.5	16.5	72.2	11.4	12.3	16.5	71.2
15	93.4	2.1	4.5	16.8	71.5	11.7	12.4	16.6	71.0
16	93.4	2.1	4.5	17.1	70.9	12.0	12.4	16.7	70.9
17	93.4	2.1	4.5	17.3	70.5	12.2	12.5	16.7	70.8
18	93.4	2.1	4.5	17.5	70.1	12.4	12.5	16.8	70.7
19	93.4	2.1	4.5	17.6	69.8	12.6	12.6	16.9	70.6
20	93.4	2.1	4.5	17.7	69.6	12.7	12.6	16.9	70.5

B.4 Recursive model WP, FA, YP for the post-war/drought period

In the war/drought period, the recursive model estimated was based on the ordering white maize price, food aid deliveries, yellow maize price. Figure B.5 shows the results from that same ordering for the post-war/drought model. Comparing Figure B.5 with Figure 6.3 shows that the change in ordering makes little difference in the impulse responses.

B.5 Recursive model FA, YP, WP for the post-war/drought period with seven lags

Figure B.6 shows the impulse responses for the model selected in the post-war/drought period but includes additional lags, a total of seven compared to the four lags in the model in Chapter 6, to test the model for sensitivity to the choice of lags. As with the other alternative specifications, the responses of white and yellow maize prices to shocks from food aid deliveries are quite similar between the four lag and seven lag models, shown by examining Figure B.6 and Figure 6.3.

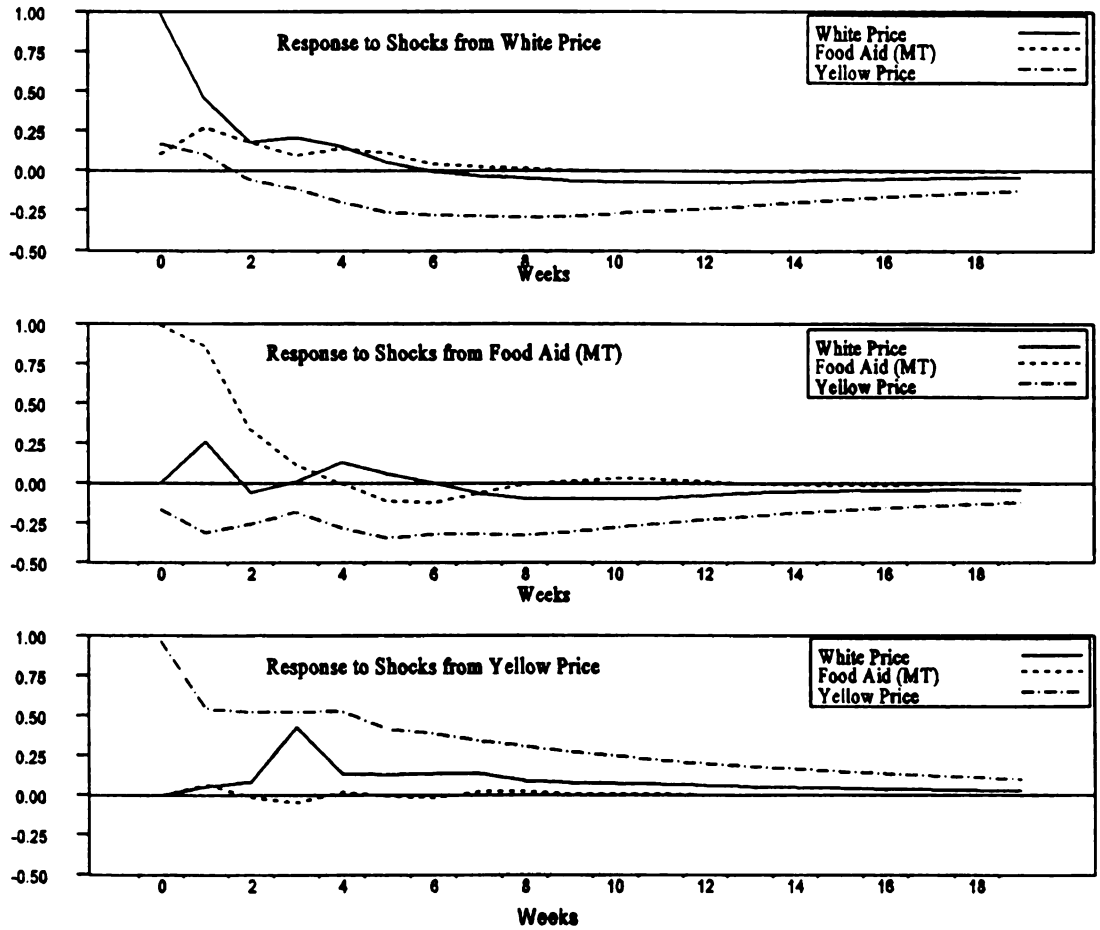


Figure B.5 Impulse responses to shocks, based on the recursive model WP, FA, YP, with a trend and mean shift, four lags, in the post-war/drought period

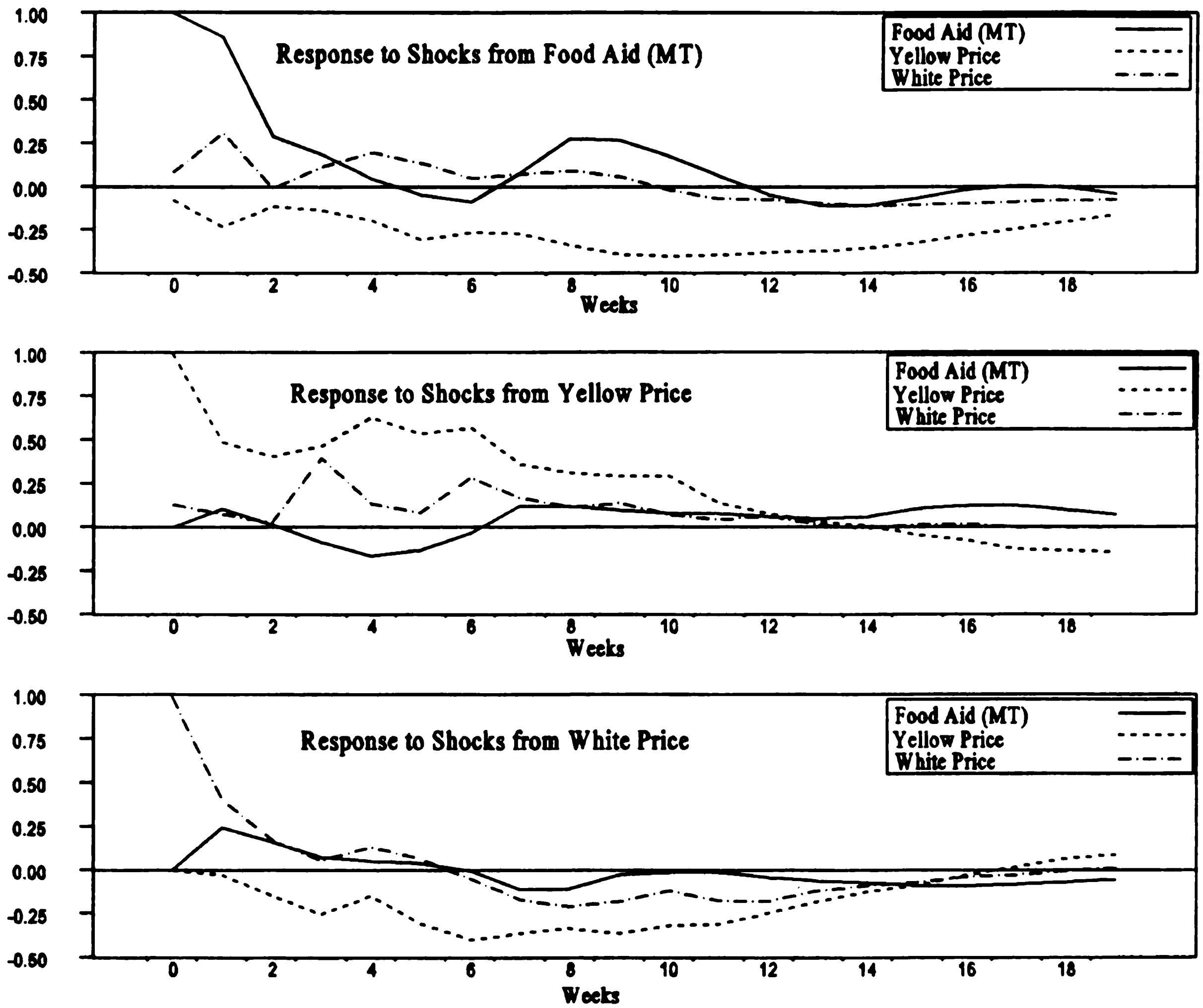


Figure B.6 Impulse responses to shocks, based on recursive model FA, YP, WP, with a trend and mean shift, seven lags, in the post-war/drought period

APPENDIX C

APPENDIX C

Data for the Market Integration Analysis

Year	Month	Day	CPI (Dec. 1989=100)	Maputo Nominal White Price	Chimoio Nominal White Price	Beira Nominal White Price	Maputo Real White Price	Chimoio Real White Price	Beira Real White Price
93	4	3	348.70	640.97	342.86		183.82	98.32	
93	4	10	350.83	659.46	352.38	685.71	187.98	100.44	195.46
93	4	17	352.95	806.72	295.24	428.57	228.57	83.65	121.43
93	4	24	355.08	672.27	276.19	428.57	189.33	77.78	120.70
93	5	1	357.20	814.87	323.81	400.00	228.13	90.65	111.98
93	5	8	356.88	806.72	257.14	371.43	226.05	72.05	104.08
93	5	15	356.56	659.46	257.14	342.86	184.95	72.12	96.16
93	5	22	356.24	647.01	257.14	295.24	181.62	72.18	82.88
93	5	29	355.92	761.90	228.57	342.86	214.07	64.22	96.33
93	6	5	355.60	799.04	257.14	371.43	224.70	72.31	104.45
93	6	12	357.00	791.36	257.14	419.05	221.67	72.03	117.38
93	6	19	358.40	769.16	247.62	314.29	214.61	69.09	87.69
93	6	26	359.80	799.04	276.19	342.86	222.08	76.76	95.29
93	7	3	361.20	776.84	266.67	342.86	215.07	73.83	94.92
93	7	17	360.80	799.04	285.71	495.24	221.46	79.19	137.26
93	7	24	360.40	747.82	285.71	444.44	207.50	79.28	123.32
93	7	31	360.00	791.36	304.76	393.65	219.82	84.66	109.35
93	8	7	359.60	799.04	285.71	342.86	222.20	79.45	95.34
93	8	14	365.83	897.35	285.71	342.86	245.30	78.10	93.72
93	8	21	372.05	761.90	285.71	342.86	204.79	76.79	92.15
93	8	28	378.28	634.92	285.71	357.14	167.85	75.53	94.41
93	9	4	384.50	791.78	314.29	371.43	205.93	81.74	96.60
93	9	11	386.10	923.75	314.29	371.43	239.25	81.40	96.20
93	9	18	387.70	776.84	285.71	400.00	200.37	73.69	103.17
93	9	25	389.30	776.84	285.71	400.00	199.55	73.39	102.75
93	10	2	390.90	806.72	285.71	342.86	206.38	73.09	87.71
93	10	9	393.60	776.84	285.71	400.00	197.37	72.59	101.63
93	10	16	396.30	746.97	285.71	400.00	188.48	72.10	100.93
93	10	23	399.00	761.90	285.71	400.00	190.95	71.61	100.25
93	10	30	401.70	812.70	285.71	400.00	202.31	71.13	99.58
93	11	6	404.40	776.42	285.71	342.86	191.99	70.65	84.78
93	11	13	413.65	761.90	285.71	342.86	184.19	69.07	82.89
93	11	20	422.90	906.32	285.71	342.86	214.31	67.56	81.07

Year	Month	Day	CPI (Dec. 1989=100)	Maputo Nominal White Price	Chimoio Nominal White Price	Beira Nominal White Price	Maputo Real White Price	Chimoio Real White Price	Beira Real White Price
93	11	27	432.15	776.84	285.71	342.86	179.76	66.11	79.34
93	12	4	441.40	906.32	361.90	342.86	205.33	81.99	77.67
93	12	11	451.65	888.89	342.86	400.00	196.81	75.91	88.56
93	12	18	461.90	923.75	361.90	457.14	199.99	78.35	98.97
93	12	25	472.15	1102.76	342.86	457.14	233.56	72.62	96.82
94	1	8	482.40	888.89	371.43	571.43	184.26	77.00	118.46
94	1	15	490.38	923.25	342.86	571.43	188.27	69.92	116.53
94	1	22	498.35	1414.14	342.86	571.43	283.76	68.80	114.66
94	1	29	506.33	1294.03	361.90	571.43	255.57	71.48	112.86
94	2	5	514.30	1358.12	366.67	571.43	264.07	71.29	111.11
94	2	12	522.13	1294.74	371.43	514.29	247.98	71.14	98.50
94	2	19	529.95	1294.74	371.43	495.24	244.31	70.09	93.45
94	2	26	537.78	1294.03	342.86	514.29	240.63	63.75	95.63
94	3	5	545.60	1319.64	371.43	514.29	241.87	68.08	94.26
94	3	12	547.35	1065.39	371.43	514.29	194.64	67.86	93.96
94	3	19	549.10	914.29	371.43	514.29	166.51	67.64	93.66
94	3	26	550.85	955.72	371.43	514.29	173.50	67.43	93.36
94	4	2	552.60	769.16	342.86	571.43	139.19	62.04	103.41
94	4	9	553.26	888.89	342.86	514.29	160.66	61.97	92.96
94	4	16	553.92	896.36	342.86	457.14	161.82	61.90	82.53
94	4	23	554.58	941.18	342.86	571.43	169.71	61.82	103.04
94	4	30	555.24	941.18	342.86	571.43	169.51	61.75	102.92
94	5	7	555.90	1000.00	342.86	571.43	179.89	61.68	102.79
94	5	14	558.88	1000.00	352.38	457.14	178.93	63.05	81.80
94	5	21	561.85	963.59	342.86	457.14	171.50	61.02	81.36
94	5	28	564.83	1023.81	342.86	457.14	181.26	60.70	80.94
94	6	4	567.80	1023.81	361.90	571.43	180.31	63.74	100.64
94	6	11	574.63	980.39	352.38	457.14	170.61	61.32	79.56
94	6	18	581.45	932.21	342.86	457.14	160.33	58.97	78.62
94	6	25	588.28	1000.00	342.86	457.14	169.99	58.28	77.71
94	7	2	595.10	980.39	342.86	457.14	164.74	57.61	76.82
94	7	9	603.94	980.39	352.38	571.43	162.33	58.35	94.62
94	7	16	612.78	941.18	361.90	571.43	153.59	59.06	93.25
94	7	23	621.62	1075.63	361.90	571.43	173.04	58.22	91.93
94	7	30	630.46	1120.45	371.43	571.43	177.72	58.91	90.64
94	8	6	639.30	1075.63	447.62	571.43	168.25	70.02	89.38
94	8	13	639.33	2016.81	447.62	571.43	315.46	70.01	89.38
94	8	20	639.35	1478.99	476.19	733.33	231.33	74.48	114.70
94	8	27	639.38	1464.91	609.52	857.14	229.12	95.33	134.06
94	9	3	639.40	1882.35	685.71	857.14	294.39	107.24	134.05

Year	Month	Day	CPI (Dec. 1989=100)	Maputo Nominal White Price	Chimoio Nominal White Price	Beira Nominal White Price	Maputo Real White Price	Chimoio Real White Price	Beira Real White Price
94	9	10	643.88	1846.50	647.62	857.14	286.78	100.58	133.12
94	9	17	648.35	1714.61	685.71	857.14	264.46	105.76	132.20
94	9	24	652.83	1774.79	609.52	971.43	271.86	93.37	148.80
94	10	1	657.30	1464.91	914.29	1200.00	222.87	139.10	182.57
94	10	8	661.38	1654.42	1142.86	1428.57	250.15	172.80	216.00
94	10	15	665.46	1670.71	1142.86	1428.57	251.06	171.74	214.67
94	10	22	669.54	1628.38	1142.86	1428.57	243.21	170.69	213.37
94	10	29	673.62	1625.89	1142.86	1428.57	241.37	169.66	212.07
94	11	5	677.70	1758.14	1104.76	1428.57	259.43	163.02	210.80
94	11	12	696.78	1855.18	1142.86	1314.29	266.25	164.02	188.62
94	11	19	715.85	1770.31	1142.86	1428.57	247.30	159.65	199.56
94	11	26	734.93	1483.71	952.38	1428.57	201.89	129.59	194.38
94	12	3	754.00	1526.10	1028.57	1428.57	202.40	136.42	189.47
94	12	10	761.60	1857.45	1066.67	1428.57	243.89	140.06	187.58
94	12	17	769.20	1715.53	1142.86	1428.57	223.03	148.58	185.72
94	12	24	776.80	1553.69	1428.57	1428.57	200.01	183.90	183.90
94	12	31	784.40	1628.38	1428.57	1428.57	207.60	182.12	182.12
95	1	7	792.00	1682.24	1714.29	1714.29	212.40	216.45	216.45
95	1	14	790.78	1683.16	1428.57	2000.00	212.85	180.65	252.92
95	1	21	789.55	1715.53	1428.57	1857.14	217.28	180.93	235.22
95	1	28	788.33	1583.57	1428.57	1714.29	200.88	181.22	217.46
95	2	4	787.10	1675.92	1219.05	1428.57	212.92	154.88	181.50
95	2	11	798.25	1525.87	1142.86	1657.14	191.15	143.17	207.60
95	2	18	809.40	1718.02	1142.86	1428.57	212.26	141.20	176.50
95	2	25	820.55	1496.42	1257.14	1428.57	182.37	153.21	174.10
95	3	4	831.70	1454.75	1257.14	1600.00	174.91	151.15	192.38
95	3	11	839.05	1455.30	1142.86	1714.29	173.45	136.21	204.31
95	3	18	846.40	1583.57	1142.86	1714.29	187.09	135.03	202.54
95	3	25	853.75	1539.96	1142.86	1428.57	180.38	133.86	167.33
95	4	1	861.10	1621.05	1123.81	1428.57	188.25	130.51	165.90
95	4	8	864.50	1725.49	1028.57	1428.57	199.59	118.98	165.25
95	4	15	867.90	1698.88	990.48	1428.57	195.75	114.12	164.60
95	4	22	871.30	1666.52	914.29	1428.57	191.27	104.93	163.96
95	4	29	874.70	1757.86	914.29	1428.57	200.97	104.53	163.32
95	5	6	878.10	1760.35	1028.57	1428.57	200.47	117.14	162.69
95	5	13	886.68	2221.74	1028.57	1314.29	250.57	116.00	148.23
95	5	20	895.25	2146.92	1028.57	1428.57	239.81	114.89	159.57
95	5	27	903.83	2063.19	1028.57	1428.57	228.27	113.80	158.06
95	6	3	912.40	1979.46	1028.57	1428.57	216.95	112.73	156.57
95	6	10	916.18	1962.30	1028.57	1428.57	214.18	112.27	155.93

Year	Month	Day	CPI (Dec. 1989=100)	Maputo Nominal White Price	Chimoio Nominal White Price	Beira Nominal White Price	Maputo Real White Price	Chimoio Real White Price	Beira Real White Price
95	6	17	919.95	1922.90	1142.86	1428.57	209.02	124.23	155.29
95	6	24	923.73	1942.11	1371.43	1428.57	210.25	148.47	154.65
95	7	1	927.50	1871.35	1371.43	1428.57	201.76	147.86	154.02
95	7	8	927.88	1922.90	1371.43	1428.57	207.24	147.80	153.96
95	7	15	928.26	1997.60	1371.43	1428.57	215.20	147.74	153.90
95	7	22	928.64	2285.71	1485.71	1571.43	246.14	159.99	169.22
95	7	29	929.02	2201.06	1485.71	1428.57	236.92	159.92	153.77
95	8	5	929.40	2171.43	1619.05	1542.86	233.64	174.20	166.01
95	8	12	936.73	1997.60	1904.76	1714.29	213.25	203.34	183.01
95	8	19	944.05	2285.71	2095.24	1647.62	242.12	221.94	174.53
95	8	26	951.38	2570.13	2000.00	1714.29	270.15	210.22	180.19
95	9	2	958.70	2460.01	2000.00	1809.52	256.60	208.62	188.75
95	9	9	966.04	2550.78	2114.29	2285.71	264.05	218.86	236.61
95	9	16	973.38	2412.70	2171.43	2114.29	247.87	223.08	217.21
95	9	23	980.72	2412.70	2152.38	2095.24	246.01	219.47	213.64
95	9	30	988.06	2589.48	2247.62	2285.71	262.08	227.48	231.33
95	10	7	995.40	3005.29	2380.95	2228.57	301.92	239.20	223.89
95	10	14	999.58	2639.28	2361.90	2285.71	264.04	236.29	228.67
95	10	21	1003.75	2695.63	2571.43	2171.43	268.56	256.18	216.33
95	10	28	1007.93	2663.47	2685.71	2285.71	264.25	266.46	226.77
95	11	4	1012.10	3174.60	2666.67	2571.43	313.67	263.48	254.07
95	11	11	1011.00	3077.85	2742.86	2857.14	304.44	271.30	282.61
95	11	18	1016.47	3062.07	2819.05	2857.14	301.25	277.34	281.08
95	11	25	1021.94	3448.49	2933.33	2780.95	337.44	287.04	272.12

Appendix D

Appendix D

Alternative Models for the Market Integration Analysis

D.1 Recursive model with Chimoio-Maputo ordering in war/drought period

To evaluate the robustness of the VAR results to the identification scheme chosen for the war/drought period, the VARs were estimated using the reverse ordering. In this case, Chimoio price shocks are allowed to affect Maputo prices contemporaneously, whereas Maputo price shocks only have effects with a lag.

The impulse response results of Chimoio-Maputo ordering with seven lags and a time trend included are reported in Figure D.1. Visual inspection of this figure in comparison with Figure 7.10 indicates that the results are robust to the identification scheme for the two sets of figures show similar trends.

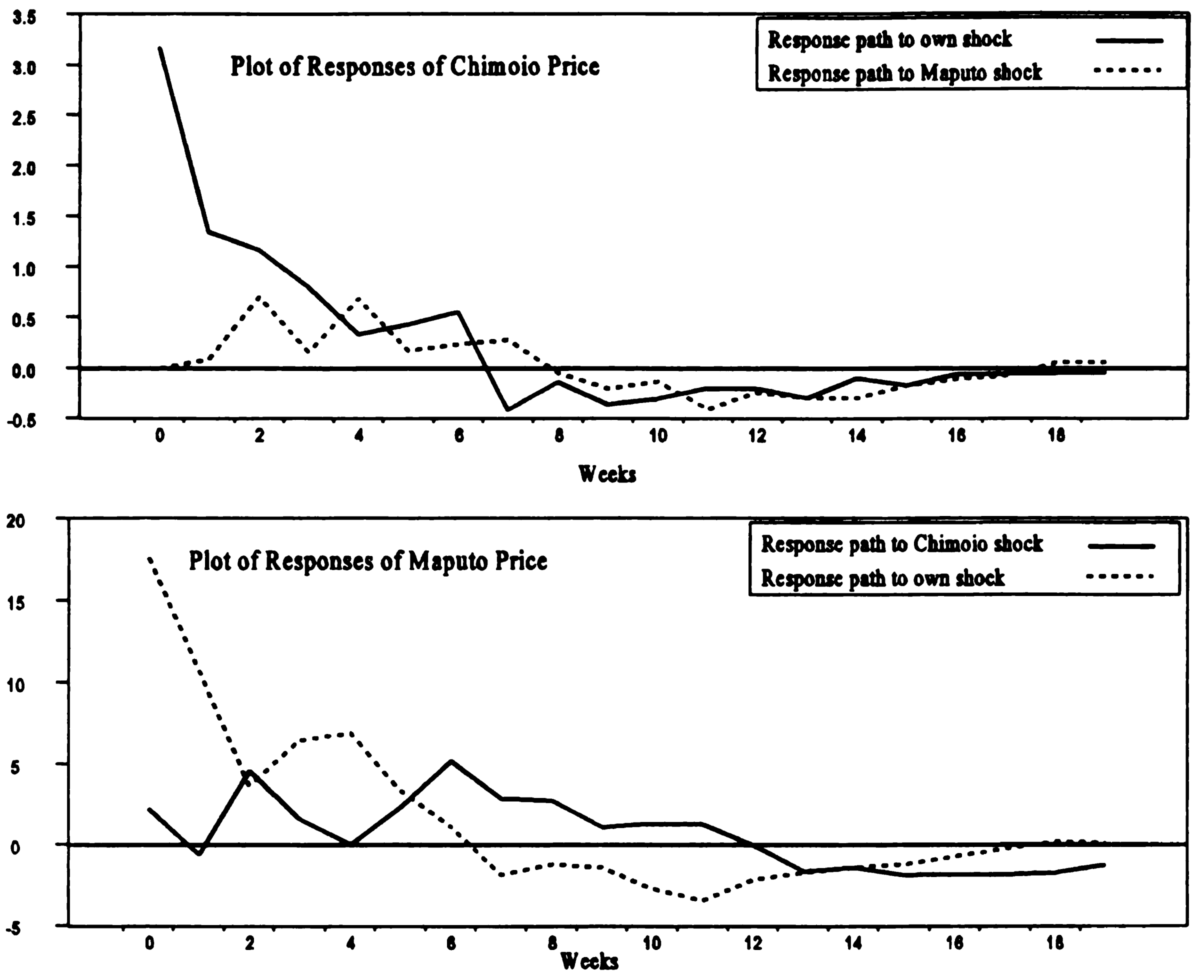


Figure D.1 Impulse responseof each price series to shocks, recursive model, Chimoio-Maputo ordering in the war/drought period, with seven lags

D.2 Recursive model with Chimoio-Maputo ordering in post-war/drought period

As in the war/drought period above, to evauate the robustness of the results to the identification scheme chosen, VARs were estimated using the reverse ordering. Chimoio price shocks are allowed to affect Maputo prices contemporaneously, whereas Maputo price shocks only have effects with a lag. The hungry season variable was included along with the time trend and seven lags.

For this post-war/drought period, the impulse response results of Chimoio-Maputo ordering with are reported in Figure D.2. Visual inspection of this figure in comparison with Figure 7. 10 indicates that the results are robust to the identification scheme for the two sets of figures show similar trends.

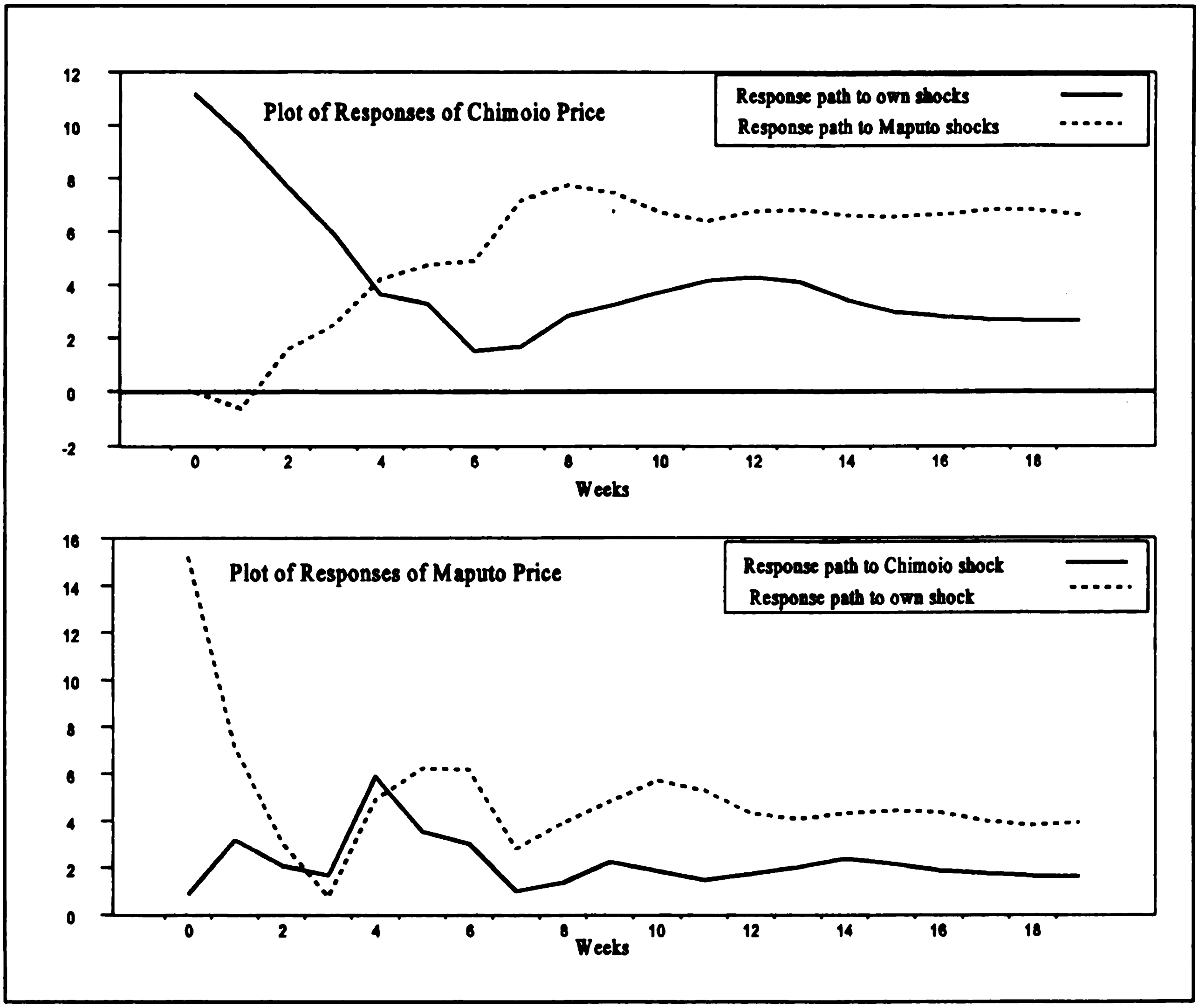


Figure D.2 Impulse response of each price series to shocks, recursive with Chimoio-Maputo ordering, with trend, seven lags, and hungry season in post-war/drought period (in real meticais/kg)

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