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The Impacts of Trade Barriers and Market Interventions on Maize Price Predictability: Evidence from Eastern and Southern Africa

by

Antony Chapoto and T.S. Jayne

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THE IMPACT OF TRADE BARRIERS AND MARKET INTERVENTIONS ON MAIZE PRICE UNPREDICTABILITY: EVIDENCE FROM EASTERN AND SOUTHERN AFRICA

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EXECUTIVE SUMMARY

There is continuing debate in east and southern Africa about the effects of food market reform on the welfare of small-scale farmers and low-income consumers. At the center of this debate is the perception that food prices have become more unstable in countries that have liberalized their staple food markets, thereby exacerbating the plight of poor consumers and farmers. This perception has led many governments in the region to shun an open maize borders policy and pursue a variety of food marketing and trade policy tools to stabilize food prices. Unfortunately, there remains a dearth of empirical evidence on the effects of alternative food marketing and trade policies, including that of liberalization, on price stability and predictability. Assessments of this issue are complicated by the fact that *market reform programs* are not monolithic in their design or implementation – impacts of reform on price instability may depend on variations in implementation. It would be particularly important to compare the magnitude of food price instability in countries that have embraced relatively comprehensive staple food market reform policies over time versus those in which the state continues to influence and stabilize food prices through the operations of marketing boards and controls on trade.

This study examines the amplitude of price instability and unpredictability between countries using trade barriers and marketing board operations to stabilize prices versus countries with relatively open trade policies. *Instability* is defined as the unconditional variance in food prices over time, whereas *unpredictability* is defined as the unanticipated component of price instability, i.e., the conditional variance from a price forecast model.

Two groupings of countries are defined according to their maize marketing and trade policies. The first group of countries *(Category A)* is comprised of those having adopted staple food market liberalization in a relatively comprehensive and sustained manner, with the role of government being limited mostly to regulating the playing field, investing in physical infrastructure, encouraging diversification of food consumption patterns, improving rural financial markets to improve traders' capacity to absorb surplus production, and relying primarily on private trade to stabilize maize prices. The second group of countries *(Category B)* includes those having implemented a more partial liberalization process, in which the private sector is encouraged to operate but where governments also continue to operate extensively in food markets, mainly through marketing board activities and discretionary trade policy tools such as export bans, changes in import tariff rates, and direct government importation and stock release. Mozambique and Uganda best fit the first category (A), whilst Zambia, Malawi, Ethiopia, and Tanzania fit the second category (B). Kenya is a borderline case, operating as a *Category B* country until January 2005, when it harmonized its import tariff rates with neighboring east African countries (from as high as 50% down to 2.75%). This rate has not fluctuated from that time until late 2008 and over this 45-month period Kenya essentially embraced an open borders policy with respect to regional trade. The study is intended to provide empirical insights that may guide policy debates regarding the appropriate roles for state involvement in food marketing and trade in the region.

These contrasting approaches to food price stabilization in the two groups of countries can provide useful information for policy makers and development planners to improve the performance of staple food markets. Our focus is on the class of discretionary and, therefore, not easily anticipated trade policy interventions as commonly implemented in many countries of eastern and southern Africa. Our premise is that these discretionary trade policies impede regional trade incentives and lead to more tentative behavior by private traders, which may contribute to price instability. We hypothesize that an unpredictable trade and marketing

policy environment will also depress trader activity that could otherwise stabilize prices through spatial and temporal arbitrage.

The selection of countries included in this study is mainly based on the availability of country time series data for carrying out the analysis. Because there is great heterogeneity within both country categories that could influence price instability apart from differences in marketing policy environment, our analysis controls to the extent possible for other exogenous influences.

The study uses market price data collected by national market information systems in Zambia, Kenya, Malawi, Tanzania, Ethiopia, Mozambique, and Uganda. We conduct the analysis in inflation-adjusted local currency terms, with the consumer price index from each country used as the deflator. However, to allow for cross-country comparisons, maize prices are sometimes reported in nominal US$ per metric ton. We use a combination of descriptive and econometric analyses to compare and characterize the two groups of countries. In particular, we (1) track maize grain production and price trends for a number of markets by country to identify any striking patterns; (2) derive and compare the unconditional and conditional coefficient of variation for various regional markets; and (3) characterize the seasonal patterns of maize prices by country and market.

The study highlights several findings as follows:

First, with the exception of Malawi, none of the other *Category B* countries pursuing food price stabilization policies and food security objectives through direct state operations over the past decade has been able to match production growth for Sub-Saharan Africa as a whole. By contrast, Mozambique and Uganda, countries that have maintained relatively stable maize marketing and trade policies have experienced more than a 100% increase in maize production over the past two decades. A caveat to these conclusions is that official production statistics on which these findings are based are in some cases frequently questioned.

Second, Malawi and Zambia have the highest degree of price volatility and price uncertainty compared to all the other countries. The measures of price uncertainty control for other factors affecting prices such as rainfall, seasonal effects, and exchange rate movements. This finding suggests that the highly discretionary trade and marketing policies in these two countries have had a destabilizing effect on prices and market predictability, although the counterfactual of little or no government intervention in food markets is not known because there is no period of time when these countries pursued such policies.

Third, Mozambique, a country that has pursued a relatively open trade and marketing policy in southern Africa, has the lowest price variability in the capital city of Maputo, but the other markets for which data was available, Nampula and Beira, have price volatility and market uncertainty closer to that of Malawi. This is likely because markets in the northern part of Mozambique are somewhat integrated with markets in Malawi; hence policy instability in Malawi is likely to be transmitted into these markets.

Fourth, historical unconditional and conditional Coefficient of Variations (CVs) have declined greatly in Kenya since Kenya's entry into the East African Commission trading agreement in January 2005. At this time, Kenya eliminated the variable maize import tariffs from Uganda and Tanzania (except for a 2.75% inspection fee). The more stable trade policy environment between 2005 and 2008 appears to have contributed to the decline of both price volatility and market uncertainty.

Fifth, there is no apparent difference between coastal and landlocked countries in terms of the magnitude of price instability and unpredictability measures.

Sixth, in well functioning markets, there is a regular seasonal price pattern in which prices are lowest directly after the harvest, and rise gradually over the season reflecting the costs of storage until they reach their peak in the months prior to the next harvest. This pattern is seen most clearly in Randfontein, South Africa. In other countries, deviations from the normal seasonal pattern of maize prices are particularly pronounced in years of discretionary government involvement in trade and stock releases.

These findings indicate that many governments' well-meaning attempts to stabilize prices may actually destabilize them. Future food prices appear to be more difficult to predict in an environment in which the extent and composition of marketing board operations are frequently changing and where cross-border trade policies also change in ways that are difficult to anticipate. There is increasing evidence that private trade and investment develops more slowly and more tentatively in countries where government policy is particularly unpredictable. While private trading systems will always result in price variation – potentially very wide price swings in landlocked countries with poor transport infrastructure – they tend not to cause the frequent food crises due to policy mistakes and inaction that are commonly seen in the region. However, these findings do not suggest that governments have no role to play in maize markets. The findings rather indicate that the price instability and unpredictability could be mitigated more effectively by limiting the state's role to adopting a rules-based and transparent approach to state operations in markets so that the private sector understands the specific market conditions that will trigger government interventions. Other positive roles of government to reduce price instability includes: regulating the playing field, investing in physical infrastructure, encouraging diversification of food consumption patterns, improving rural financial markets to improve traders' capacity to absorb surplus production, and encouraging the development of regional maize trade and market-based risk management instruments to stabilize maize prices.

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ACRONYMS

ADF	Augmented Dickey Fuller
ADMARC	Agricultural Development and Marketing Corporation
AMIC	Zambia Ministry of Agriculture and Cooperatives
ARCH	Autoregressive Conditional Heteroskedastic
ASIP	Agricultural Sector Investment Program
CIF	Cost, Insurance, and Freight
CMA	Crop Marketing Authority
COMESA	Common Market of Eastern and Southern Africa
CPI	Consumer Price Index
CSRP	Cereal Sector Reform Program
CUSA	Credit Union and Savings Association of Zambia
CVs	Coefficient of Variation
EAC	East African Community
FAOSTATS	Food and Agricultural Organization Online Statistical Database
FRA	Food Reserve Agency
FSRP	Food Security Research Project
GDP	Gross Domestic Product
GMO	Genetically Modified Organism
GRZ	Government Republic of Zambia
GTAZ	Grain Traders Association of Zambia
IMF	International Monetary Fund
INE	National Statistics Institute of Mozambique
KPSS	Kwiatkowski, Phillips, Schmidt, and Shin tests
MACO	Ministry of Agriculture and Cooperatives
MATEP	Market Access, Trade Enabling Policies
MAZ	Millers Association of Zambia
MFNP	Ministry of Finance and National Planning
MoU	Memorandum of Understanding
NAMBOARD	National Agricultural Marketing Board
NCPB	National Cereals and Produce Board
NCZ	Nitrogen Chemicals Zambia
NFRA	National Food Security Reserve Agency
NMC	National Milling Company
NSO	National Statistical Office
OLS	Ordinary Least Squares
PP	Phillip-Perron Test
RATIN	Regional Agricultural Trade Intelligence Network
SAFEX	South Africa Futures Exchange
SAGIS	South Africa Grain Information System
SGR	National Strategic Reserve
SIDA	Swedish International Development Agency
SIMA	*O Sistema de Informação de Mercados Agrícolas* (Agricultural Market Information Centre)
SSA	Sub-Saharan Africa
US$	United States Dollar
USAID	United States Agency of International Development
VAT	Value Added Tax
ZCF	Zambia Cooperative Federation
ZNFU	Zambia National Farmers Union

1. INTRODUCTION

The effects of food market reform and economic liberalization in general continue to be hotly contested in much of Sub-Saharan Africa. At the center of this debate is the perception that food market reform has exposed farmers and consumers to wide price swings, creating disincentives for farmers to adopt productivity-enhancing technologies and exacerbating food insecurity for low-income consumers during production shortfalls. Maize is a strategic food staple that accounts for a major share of income and expenditure of poor people; hence, unregulated grain marketing could expose them to unacceptable price spikes and collapses. This perception has led some countries in the region to attempt to manage market prices through marketing board operations as well as trade policy instruments such as export bans, changes to import tariff rates, and direct government importation and sale to domestic buyers at subsidized prices (Jayne, Zulu, and Nijhoff 2006; Dorosh, Dradri, and Haggblade 2009).

Food market reform has therefore taken several distinct forms in the region. Some countries have abolished their marketing boards, left prices to be determined mainly by market forces, and have imposed virtually no controls on private cross-border trade. On the other extreme, countries such as Malawi and Ethiopia have occasionally regulated the prices at which private traders can buy and/or sell, restricted the issuance of licenses to enable legal export or import of grain, and maintained a prominent state or quasi-state presence in food markets through direct purchase, sale, and stock releases to stabilize prices. These various state operations have affected the scope of private traders' operations.

On net, it is not clear how these state marketing and trade policies have affected food price stability. On the one hand, many of these direct state operations are explicitly designed to stabilize prices. If these state operations are achieving their objectives, then food prices should be more stable in countries where price stabilization operations are in effect, holding other factors constant. On the other hand, if state operations within an otherwise liberalized system are implemented in an *ad hoc* or unpredictable way that affects the behavior of private traders, then it is not clear that government operations should in practice contribute to price stability. Pan-territorial pricing by the marketing board could make it uneconomical for private traders to purchase grain in remote areas facing high transportation costs. State stock releases at below-market prices make it risky for traders to store grain for release later in the year. Sudden announcements that the state intends to import maize for subsidized sale later in the season makes it uneconomical for traders to attempt to import maize for sale at commercial prices. Hence, market prices could become more unstable if state operations led to an under-provision of key marketing functions on account of strategic interactions and lack of coordination between the public and private sectors.

There is no question that unstable prices for food staples such as maize can have severe economic, social, and political consequences (Newberry and Stiglitz 1981; Byerlee, Jayne, and Myers 2006; Williams and Wright 1991; Timmer 2000; and Dehn, Gilbert, and Varangis 2005). World market volatility in 2007 and 2008 has rekindled efforts to deal with food price instability and its potential effects on the poor in low income countries. Governments may make concerted efforts to shield producers and consumers from such instability and may not regard the policy tools they employ at short notice as *ad hoc*. If such interventions were based on transparent and relatively systematic criteria for triggering policy actions, they certainly would not be *ad hoc*, but from the standpoint of market actors, such policies can be very difficult to predict and may therefore alter market behavior in unexpected ways. There is a large literature on the relative merits of discretionary vs. rules-based approaches to economic policy management, starting with the macroeconomic policy literature (Kydland

and Prescott 1977; Barro and Gordon 1983; Taylor 1993). However, an empirical study of the effects of highly discretionary food marketing and trade policies on price instability in Sub-Saharan Africa has to our knowledge not been conducted. Such information could be valuable to policy makers and is the motivation for this study.

This report examines the amplitude of price instability and unpredictability between countries using trade barriers and marketing boards to stabilize prices versus countries having implemented relatively consistent food market liberalization and regional trade policies. *Instability* is defined as the unconditional variance in food prices over time; whereas *unpredictability* is defined as the unanticipated component of price variations, i.e., the conditional variance from a price forecast model. An understanding of the effectiveness of contrasting approaches to food price stabilization in the two groups of countries can help policy makers and development planners meet national food security objectives.

The remainder of this paper is organized as follows: Section 2 briefly describes the maize marketing policies in the countries analyzed. Section 3 presents methods and data used in this study. Sections 4 and 5 present the findings and a summary of the implications of these findings for maize grain trade and food security respectively.

2. MAIZE MARKETING AND TRADE POLICIES IN EASTERN AND SOUTHERN AFRICA

In this study, we group countries into two categories according to their maize marketing and trade policies. The first group of countries *(Category A)* is those having liberalized domestic and external maize trade and where government operations in markets have been relatively modest. The second group *(Category B)* is comprised of countries retaining a major direct government role in food marketing and external trade. In most of these cases, the parastatal marketing board remains the single largest player in the maize market. While the private sector is encouraged to invest and participate in markets, the scope for private trade is sometimes restricted by the manner of state intervention. *Category B* countries are also characterized by the use of discretionary trade policy tools, including export bans, changes to import tariff rates, and stock release operations undertaken with no explicit criteria or guidelines about the circumstances that would lead to such actions.

Mozambique, Uganda, and South Africa fit the first group, *Category A*. There are no state marketing boards in these countries, and trade policy is relatively open and stable. To our knowledge, there has never been a maize export ban in these countries over the sample period, January 1994 to December 2008. In contrast, Zambia, Malawi, Ethiopia, and Tanzania fit the second group of countries, *Category B*. A defining feature of the marketing environment in the *Category B* countries has been the tremendous unpredictability and frequent change of direction in governments' role in the market. These countries have all implemented market reform processes in the 1980s and 1990s, but the scope for private investment and trade has been restricted by frequent direct state or quasi-state operations in domestic markets. This includes the mandating of floor and ceiling prices, government purchase and sales of grain at subsidized prices that commercial traders cannot compete against, providing contracts for selected traders to engage in certain activities that are not available to other traders, the frequent banning of external trade, and unpredictable changes in import tariff rates.

Kenya is an intermediate case, characterized by *Category B* behavior until January 2005, when it harmonized its import tariff rates with neighboring east African countries (from as high as 50% down to 2.75%). This rate has not fluctuated since that time and no other trade policy tools have been used until late 2008. Kenya has complied with regional initiatives under the Common Market for Eastern and Southern Africa (COMESA) and the East African Community (EAC) to eliminate cross-border tariffs within the region and harmonize regional and international trade policies.

Since the early 2000s, food policies in Zambia and Malawi have been characterized by a re-emergence of direct parastatal operations in the maize market, state restrictions on the private export of maize, and unpredictable changes in trade tariff rates. The Food Reserve Agency (FRA) in Zambia, the Agricultural Development and Marketing Corporation (ADMARC), and the National Food Security Reserve Agency (NFRA) in Malawi, and the National Milling Company (NMC) in Tanzania have become major actors in these countries' maize markets.

Ostensibly, these state activities have been in response to perceived failings of the private trade to provide reliable markets and stable prices for smallholder farmers' surplus maize production. For example, during the drought of 2001 and 2005, the government of Zambia announced its intention to import maize grain to supply selected milling firms in order to protect poor consumers from rising prices. Unfortunately, these imports were arranged too late to avoid price surges well above import parity. During these periods, the private sector refrained from importing commercial supplies, based on the knowledge that subsidized

supplies were coming into the country under the Government import program and that private imports would be uncompetitive in this situation (Nijhoff et al. 2003; Mwanaumo et al. 2005). Also, Zambia has often used export bans to restrict maize outflows to ensure food security. Maize export restrictions/bans are common and date back to the 60s and 70s. In Zambia, import and export bans are implemented through a system of quantitative restrictions regulated under the Control of Goods Act. Both imports and exports require government permits stipulating the allowable quantities traded. In recent years, the Food Reserve Agency has received the bulk of the trading permits for both the import and export of maize. Export restrictions are commonly invoked when the country experiences a maize production deficit, although these sometimes occur during good production seasons as well to provide FRA with a monopoly on exports.

The story is similar in Malawi, for example, in 2003 the government, facing a good harvest and the prospect of storing maize for more than a year, decided to sell some of its accumulated stocks in a good production year, depressing market prices to very low levels. This decision undermined incentives to farmers. Also, in 2006 and 2007, exports were banned despite the above average harvests of 2005/06 and 2006/07 worsening the maize price situation for net maize sellers.

In response to the reported surplus for the 2007/08 marketing season, the government of Malawi issued tenders to private traders to supply 450,000 tons for export to other countries in the region. However, the private sector reported difficulties in sourcing this quantity of maize, and by late 2007 Malawi had only exported 283,000 tons. The government then suspended further exports due to a rapid escalation in domestic market prices. Within several months after the harvest, maize prices reached near record highs, exceeded only in the major crisis year of 2001/02 and the drought year of 2005/06. Most recently, only 2-3 months after reporting a good harvest in 2008, the government of Malawi had to ban private trade because the maize prices had reached historic highs. Many in Malawi felt that private traders orchestrated these price rises. Since August 2008 and to the time of this writing, the Malawi government mandated that private traders were not to buy and sell outside the range of 45 and 52 kwacha per kg (roughly between US$320 to US$370 per ton) under penalty of prosecution even though market prices were frequently well outside that range since that time (Jayne et al. 2009).

In Tanzania, the Food Security Act of 1991 led to the consolidation of the Strategic Grain Reserve management under the Food Security Department under the Ministry of Agriculture and Cooperatives with expanded responsibilities. In addition to directly competing with private sector when buying maize grain, the department was also empowered to determine the country's import and export needs. Since the passing of the Food Security Act of 1991, we have seen the Tanzanian maize marketing policy reverting to the pre-reform period with the exception that the government parastatal would directly compete with private sector. With the mandate to determine the import and export requirements of the country, the Food Security Department in Tanzania has for a number of times imposed maize export bans especially when the country experiences a production deficit. Similar, to what has been happening in Malawi and Zambia, these bans sometimes occur during good production seasons resulting in price crashes and disruption of maize trade in the region.

In summary, the role of the government in fostering maize market and trade development in Zambia, Malawi, and Tanzania has characterized by frequent policy reversals motivated largely by the understandable need to ensure national food security. However, it is possible that such policies have had unintended consequences, a premise that we examine empirically below.

3. DATA AND METHODS

3.1. Methods

This study uses a combination of descriptive and econometric analyses to compare and characterize countries that have adopted open border maize policies (*Category A*) versus countries that still have active government participation in the maize market (*Category B*). We carry out three different types of analysis as follows: (1) As a start, we compute and graph the annual maize production index and the average annual maize production growth rates between the two groups of countries to examine whether there are any striking patterns that exist within each country and between the two groups of countries; (2) we look at maize grain price volatility/variability and price uncertainty by comparing the unconditional and conditional coefficient of variation by market and country respectively; and (3) we present tables that show the seasonal characteristics of maize prices by country and market. The discussion below gives more details about the procedures followed in estimating maize price instability and uncertainty in this study.

3.1.1. Price Predictability versus Price Variability

Price instability can be defined as the unconditional variance of prices, often measured as a standard deviation or coefficient of variation. However, some part of price instability is predictable, and indeed necessary for the functioning of markets. For example, seasonal price variation is observed for staple foods in most countries that have one production season. Seasonal price variation is required to induce storage to smooth out consumption across the year. Therefore, the unconditional CV (the standard deviation of price observations divided by the mean), while being a meaningful measure of price variability/volatility, does not account for the component of volatility that is, in fact, predictable.

To derive a measure of unpredictability, we start from the fact that economic agents take into account available information at time *t,* such as such as prices, past production, weather, exchange rates, interest rates, and government behavior to predict future prices. A measure of unpredictability for the price in month *t+1* could be represented by the forecast error between predicted and actual price.

$$P_{t+1} - E_t(P_{t+1}) = e_{t+1} \qquad (1)$$

where $E_t(P_{t+1})$ is the expected price in month *t+1* given available information at time *t.* The squared forecast error, or conditional variance, is thus a measure of the unpredictable component of price variation. It is reasonable to expect that these time-varying conditional variances may affect the plans made by economic agents in situations where resources are committed in advance of prices being revealed.[1]

Using multivariate ARCH (1,1), we estimate and compute the forecast error for each of the countries *c* and market *i*,

[1] See Dehn, Gilbert, and Varangis (2005) for an elaboration of the differences between price instability and unpredictability.

$$P_{cit} = \alpha_{ci} + \sum_{s=1}^{n} \alpha_s P_{cit-s} + \varphi T_{ci} + \beta_i X_{cit-1} + \sum_{m=1}^{11} \gamma_{cm} D_{cmt} + \varepsilon_{cit} \qquad \varepsilon_{it} \sim N(0, h_{it}) \qquad (2)$$

$$h_{it} = \gamma_0 + \sum_{j=1}^{p} \gamma \varepsilon_{it-j}^2 + v_{it} \qquad v_{it} \sim i.i.d(0,1) \qquad (3)$$

where equation 2 describes the conditional mean of the price process over time and equation 3 describes the evolution of the conditional variance. P_{it} is the real commodity price in market i at time t, the right hand side terms in the mean equation include an autoregressive process of order q AR(q), X_{t-1} represents a vector of already known information at time t-1, T is a time trend, ε_{it} is the disturbance term and α, β, φ are parameters to be estimated. The AR(q) process captures movement in the conditional expected innovation in prices and the condition variance is specified following an ARCH (q,p) process (see Engle 1982; Engle and Bollerslev 1986).

In equation 3, h_{it} denotes the variance of e_t conditional upon information up to period t. The fitted value of h_{it} is the conditional variance, i.e., the squared difference between expected and actual prices. This term represents the unpredicted portion of the price variance after accounting for available information.

In our case, the vector 'X' is limited only to the most recent maize production level, real exchange rate, gross domestic product per capita as a proxy for purchasing power, international grain prices, and monthly seasonal dummies.[2] In principle, marketing actors might also attempt to take into account anticipated government operations in markets when forming one-month ahead price expectations. However, there are few if any indicators that marketing agents could use to predict future government actions especially given the discretionary nature of government operations in most of the markets. Information on future marketing board purchases, sales, stock levels, and trade policy decisions is rarely announced in advance or even published *ex post*, and hence we do not include any government policy variables in the model. In fact, unanticipated government actions are likely to be a major source of the one-month ahead price forecast errors as measured in equations 2 and 3.

3.1.2. Seasonal Pattern

We present tables showing the seasonal nominal price movements for all the capital city markets. All other factors constant, one would expect maize prices to show a regular seasonal pattern, with low price months occurring immediately after the main harvest month and high price months occurring during the lean season before the next harvest. For example, in Zambia we expect maize grain prices to be lowest during the months of May through August and rising between September and April. With relatively stable seasonal price rises, storage agents might be able make a return by buying in the low price months and selling in the high price months.

[2] In the absence of complete rainfall information, we decided to use local maize production. Shively 1996, has a detailed explanation of why maize production can be used in mean price models.

3.2. Data

This study uses market price data collected by national market information systems in Zambia, Kenya, Malawi, Tanzania, South Africa, Mozambique, Ethiopia, and Uganda. In order to allow cross-country comparisons, maize market price are reported in both nominal US$ per metric ton and inflation adjusted US$ per metric ton. The consumer price index from each country is used as the deflator.

The monthly maize price information and consumer price index (CPI) information were acquired from the national statistical agencies in charge of collecting food price data. In Mozambique, Ethiopia, Kenya, and Malawi, the maize prices are specified as retail market prices, while in Zambia, Uganda, Tanzania, and South Africa, maize prices are considered to be wholesale prices. In addition to maize grain market prices, we also obtain data on exchange rates, gross domestic product (GDP), population estimates, local and regional maize production. Exchange rates and population figures are obtained from the country's central bank and statistical offices respectively, GDP figures for all the countries were obtained from the International Monetary Fund Financial (IMF), local maize production figures were obtained from the Food and Agricultural Organization Online Statistical Database (FAOSTATS) and Gulf International yellow maize prices were obtained from the International Grains Council**.** The data sources are summarized by country below.

- Zambia: Agricultural Market Information Centre, Ministry of Agriculture and Cooperatives (AMIC), Central Statistical Office, Republic of Zambia and Bank of Zambia.
- Mozambique: Ministry of Agriculture Agricultural Market Information Center (SIMA), National Statistics Institute (INE) of Mozambique, IMF database on exchange rates augmented by data from Bank of Mozambique.
- Kenya: Market Information Bureau, Ministry of Agriculture and Livestock, Government of Kenya, Central Bureau of Statistics, IMF database on exchange rates augmented by data from Bank of Kenya.
- Malawi: Ministry of Agriculture price monitoring system; National Statistical Office (NSO), IMF database augmented by data from Bank of Malawi.
- South Africa: South Africa Grain Information System (SAGIS), Statistical Agency of South Africa.
- Tanzania: Tanzania Ministry of Agriculture complemented by Regional Agricultural Trade Intelligence Network (RATIN), Tanzania Bureau of Statistics, Bank of Tanzania.
- Uganda: Uganda Ministry of Agriculture complemented by RATIN, Uganda Bureau of Statistics, IMF database augmented by data from Bank of Uganda.
- Ethiopia: Central Statistical Agency, National Bank of Ethiopia.

3.3. Diagnostic Tests

Before estimating the models to estimate the level of price uncertainty, a series of diagnostic test were conducted. First, we test for the presence of unit roots which could potentially lead to problems of I(1) cointegration by using both Phillip-Perron test (PP), the Augmented Dickey Fuller (ADF) test and the KPSS test.[3] If we fail to reject the null hypothesis of unit root, we first-difference the price series. Using the ADF and PP test, we find limited evidence of the presence of a unit root in Nairobi central and Randfontein, South Africa, the majority of the markets rejected the null hypothesis of no unit root at 10% level of significance,

[3] For each market, the PP test is conducted using the estimated regression $Pt=\alpha+\phi Pt\text{-}1+\delta t+\mu t$, under the null hypothesis that the price process is a random walk with or without drift.

indicating stationarity. However, using the KPSS test that directly tests the null hypothesis that the price series is trend stationary, we find that all the price data were all trend stationary. Based on the weight of the evidence from these three tests, we conclude that the data are stationary when deflated and hence no special treatment of the data is required before model estimations (Table 5A in the appendix).

Second, we verify the suitability of the heteroskedastic conditional variance model as well as the order of the AR process of the dependent variable. LM test is used to test the presence of Arch effect (Engle 1982)[4]. The lag structure is determined using partial autocorrelations. An inspection of the partial autocorrelations indicated that a first-order autoregression process for all markets would be appropriate for the conditional mean equation. Based on diagnostic tests of residual autocorrelations, the conditional variance equation is also estimated as a first order autoregressive process. The ARCH effects test results are presented in table A6 in the appendix.

[4] This test is performed by estimating a regression of the squared residuals on a constant and lagged residuals up to the order q. If we reject the null of no ARCH then Ordinary Least Squares (OLS) model is estimated.

4. RESULTS AND DISCUSSION

4.1. Trends in Maize Production

As a prelude to the econometric analysis, we present a comparison of trends in maize grain production between the countries that have continued to pursue direct price support and stabilization objectives (Figure 1.1a for Malawi, Zambia, Tanzania, and Ethiopia) and those countries that have adopted a comparatively non-interventionist approach to grain markets (Figure 1.1b for Mozambique, Uganda, and South Africa). As mentioned earlier, Kenya is categorized in the first group until January 2005, and then in the second category from 2005 to 2008.

Many factors influence national agricultural performance, and one obviously cannot attribute cross-country differences simply to the manner of government participation in food markets. Moreover, it is possible that shifts among crops, and between crop and animal activities, may mask major differences in cereal production growth vs. agricultural production growth. For these reasons, attribution of differences to food marketing policies is not inferred, nevertheless it is interesting to compare cereal production growth rates between the two categories of countries.

Figures 1.1a and 1.1b indicate that, with the exception of Malawi, the set of countries pursuing state food price stabilization policies through direct state operations over the past decade have not kept up with cereal production growth for Sub-Saharan Africa as a whole. While cereal production in the Sub-Saharan Africa region as a whole has increased by roughly 47.5% over the past 25 years, three of the four countries in which the state continues to intervene heavily in food markets are barely achieving maize production levels that they obtained in the 1980s. Ironically, these are the countries where the greatest advances in cereal seed technology have been made, and where fledgling green revolutions were initiated in the 1970s and 1980s. By contrast, Mozambique and Uganda have both experienced more than 100% gains in maize production over the past two decades, despite having benefited much less from the technological contribution of improved seeds (Figure 1.2.).

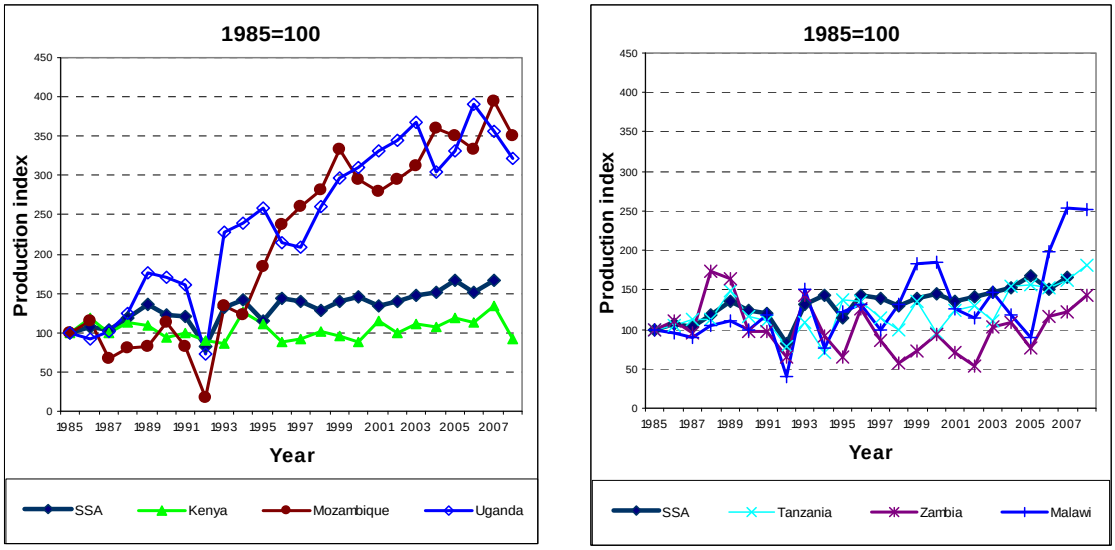
As an exception among the countries that have continued to pursue direct price support and stabilization objectives, Figure 1.2 shows that Malawi maize production has grown by 77% over the 24-year period, 30% above the Sub-Saharan Africa (SSA) production growth. However, a closer look at the trends in the production index, Figure 1.1b shows that maize production grew by a large percentage in the last few years starting 2005. This coincides with the huge increase in the quantity of subsidized fertilizer distributed to smallholder farmers by the government of Malawi. Malawi has recently received critical acclaim for its success in turning the country into a food-surplus maize exporter (New York Times 2007). The government issued an official maize production estimates over the past three seasons that all exceed the prior peak production year by more than 25%.

4.2. Comparison of Price Volatility and Predictability

As described in Section 3, we measured price volatility based on price movements by computing the unconditional coefficient of variation (CV), while price uncertainty was measure by computing the conditional variance based on the difference between actual prices and predicted prices derived from a simple forecasting model. It is important to keep this distinction clear as we discuss the results of price volatility and price uncertainty.

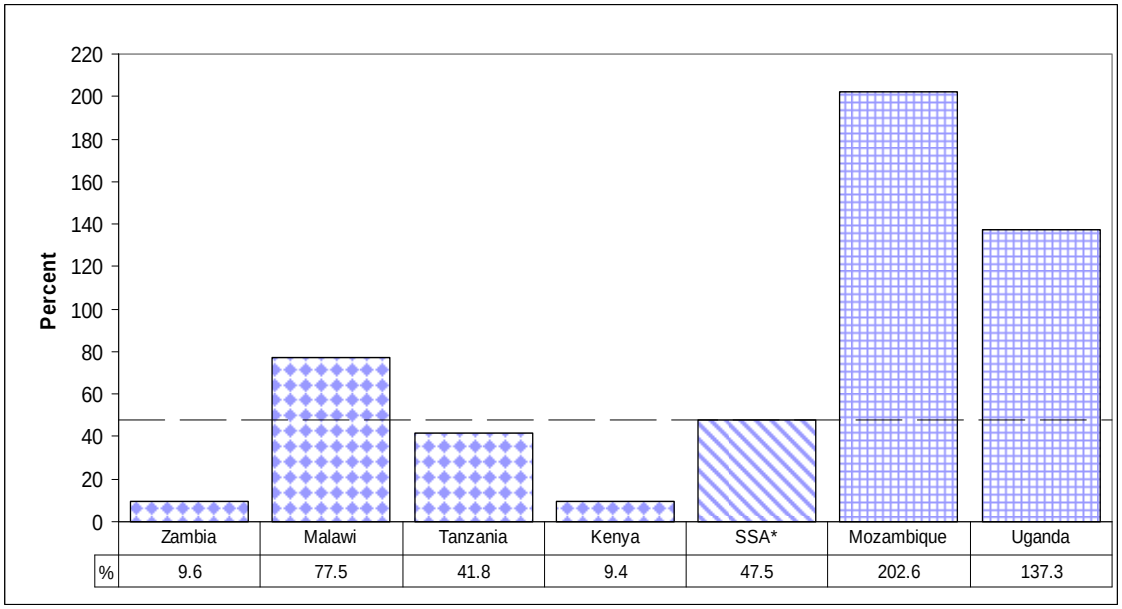
Figure 1.1. Cereal Production Index for Sub-Saharan Africa Zambia, Malawi, Tanzania, Kenya, Ethiopia, Mozambique, and Uganda, 1985 to 2008

Fig 1.1a **Fig 1.1b**



Source: FAOSTATS. http://faostat.fao.org/site/567/default.aspx#ancor

Figure 1.2. Overall Maize Production Growth, 1985 -2008



Source: FAOSTATS. http://faostat.fao.org/site/567/default.aspx#ancor

4.2.1. Maize Price Volatility

Table 1, column D summarizes the unconditional CVs for the various markets for the seven countries under study. Two conclusions are discernable from the data. First, two of the four countries pursuing interventionist trade policies, Malawi and Zambia, have highest price volatility of all eight countries examined. In the entire region, all the three Malawian markets show the greatest degree of price volatility with unconditional CVs in the range of 45-50% followed by the Zambian markets with CVs in the range of 36-45%.

Second, Mozambique, a country with the most liberalized markets in southern Africa, has the lowest price variability/volatility in the capital city of Maputo, but the other markets of Nampula and Beira have price volatility closer to that of Malawi, with unconditional CVs of 40.5% and 39.1% respectively. One may wonder why the range of unconditional CVs is huge in these markets. Northern markets (Nampula and Beira included) are integrated with markets in Malawi, so it is possible that price volatility in Malawi is transmitted to these northern Mozambican markets, however this issue requires further research before any firm conclusions can be drawn.

The third point evident from the data in Table 1 is that maize prices are least volatile in Maputo, Mozambique, South Africa, and all Kenyan markets, especially since 2005. The unconditional coefficient of variation has declined greatly in Kenya since the country's entry into the East African Commission trading agreement in January 2005 (Figure 2 and Table 1, column D). At this time, Kenya eliminated the variable maize import tariffs from Uganda and Tanzania (except for a 2.75% inspection fee). Unconditional price variances in the January 2005 to December 2007 period are lower than in the earlier sample period (1994 to 2004) by 3.5 percentage points in the case of Nairobi and to over 19 and 5.8 percentage points for the Nakuru and Mombasa markets.

Finally yet importantly, the results in Table 1 show that the magnitude of price variability does not neatly correspond to proximity to coastal ports. For example, Nampula and Beira in Mozambique are both coastal towns but have relatively high price variability as discussed above. By contrast, inland or upcountry markets in Kenya, South Africa, and Ethiopia (all of which are at least 500km from a port) show much lower price variability than similarly landlocked market/towns of Zambia and Malawi. Although Kenya is a coastal country, most of the markets for which data are available are in the central and western parts of the country, ranging from 500 to 900 kms from the port. A noticeable reduction in price instability has been noted in these markets since the elimination of regional trade barriers in 2005.

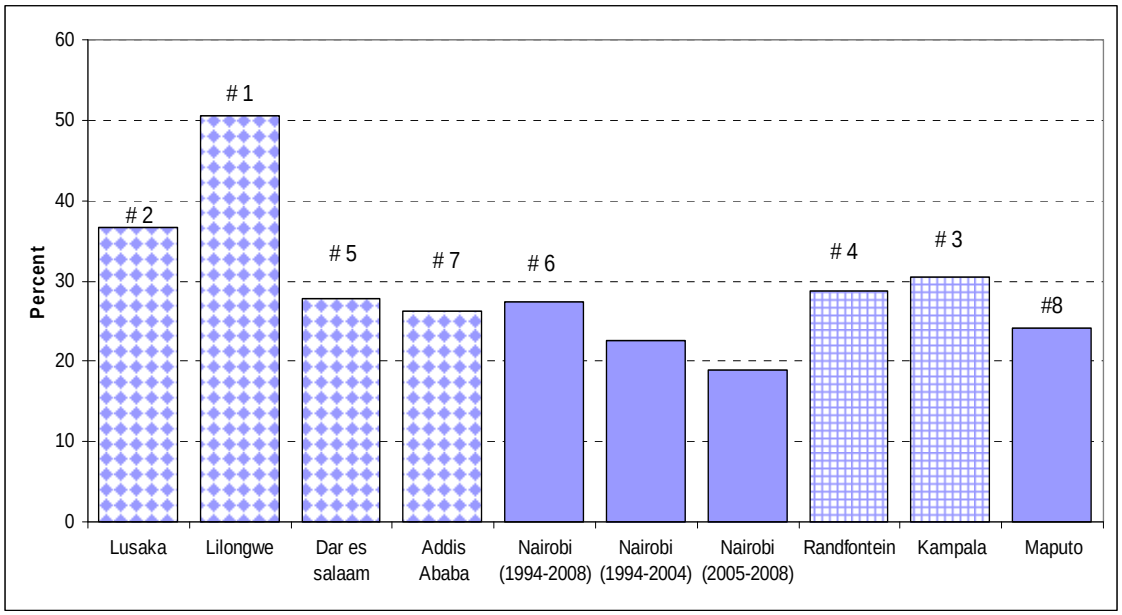
In summary, the evidence indicates that price volatility is certainly no lower in the set of countries using discretionary trade policy instruments and direct state marketing operations than in countries pursuing less interventionist approaches. If anything, the level of maize price instability is somewhat higher in the *Category B* countries. However, these findings are bivariate, in the sense that they do not control for other factors contributing to instability, nor do they account for the portion of price variation that is predictable and perhaps even beneficial for the functioning of markets. The following section addresses these issues.

Table 1. Unconditional and Unconditional Coefficient of Variation by Country and Market, 1994-2008

Country	Market	Mean Price Nominal US$ per Mt	Mean Real Price (Local currency per Mt - (CPI 2007=100)	Standard Deviation	Unconditional CV (%) (C/B*100)	Conditional CV (%)		
						Min	Max	Mean
		(A)	(B)	(C)	(D)	(E)	(F)	(G)
Mozambique	Maputo	239	7,457	1,804	24.2	0.06	27.4	7.7
	Nampula	171	5,305	2,147	40.5	0.04	73.7	12.4
	Beira	168	5,171	2,024	39.1	0.0013	44.9	10.2
Uganda*	Kampala	180	346,886	105,914	30.5	0.008	46.3	9.8
	Mbale	165	316,563	105,429	33.3	0.308	50.8	12.0
South Africa	Randfontein	156	1,307	376	28.8	0.14	34.4	6.4
Kenya (1994-2008)	Nairobi	210	23,370	6,374	27.3	0.0005	25.5	5.2
	Nakuru	180	20,012	7,204	36.0	0.010	29.1	7.2
	Mombasa	213	23,916	7,090	29.6	0.028	29.2	5.6
Kenya (1994-2004)	Nairobi	199	25,586	5,754	22.49	0.0005	25.5	5.6
	Nakuru	169	21,702	7,624	35.13	0.010	29.1	8.1
	Mombasa	203	26,211	6,669	25.44	0.173	29.2	6.1
Kenya (2005-2008)	Nairobi	238	17,277	3,279	18.98	0.056	14.8	4.3
	Nakuru	212	15,364	2,363	15.38	0.147	18.8	4.9
	Mombasa	241	17,603	3,461	19.66	0.028	13.6	4.4
Ethiopia	Addis Ababa	169	1,868	489	26.2	0.026	33.4	6.8
	Shashemane	156	1,727	491	28.5	0.022	40.4	7.0
	Nemkept	148	1,610	574	35.6	0.059	51.1	8.2
	Jimma	151	1,646	569	34.6	0.09	55.7	9.0
Zambia*	Lusaka	151	1,119,863	411,454	36.7	0.02	68.9	11.4
	Choma	128	951,930	430,758	45.3	0.01	109.2	12.8
	Ndola	148	1,091,992	394,348	36.1	0.02	66.6	9.6
Malawi	Lilongwe	167	22,676	11,455	50.5	0.09	97.3	14.6
	Blantyre	201	27,285	12,544	46.0	0.22	61.3	13.8
	Karong	167	22,807	11,324	49.6	0.23	90.5	14.3
Tanzania*	Dar es salaam	192	247,801	68,888	27.8	0.0007	48.6	8.0
	Mbeya	134	173,711	54,483	31.4	0.02	39.9	8.3
	Arusha	163	211,182	64,786	30.7	0.04	52.7	8.7

Notes: *Retail level price data used except for Tanzania, South Africa, Uganda, and Zambia. ** Since, the introduction of the EAC in January 2005, Kenya has adopted a stable trade policy regime harmonizing its import tariff rates with neighboring east African countries (from as high as 50% down to 2.75%). So in addition to the full sample results, results from the two periods are included, 1994-2004 and 2005-2008.

Figure 2. Comparison of Unconditional Coefficient of Variation for Capital City Markets/major Consumption Centers



Notes: Lusaka, capital of Zambia, Lilongwe capital of Malawi, Dar es Salaam capital of Tanzania, Addis Ababa capital of Ethiopia, Nairobi capital of Kenya, Kampala capital of Uganda, Maputo capital of Mozambique, and Randfontein is a consumption center in Gauteng Province, South Africa. Since the introduction of the EAC in January 2005 Kenya has adopted a stable trade policy regime harmonizing its import tariff rates with neighboring east African countries (from as high as 50% down to 2.75%). So in addition to the full sample results, results from the two periods are included, 1994 -2004 and 2005 -2008.

4.2.2. Maize Price Predictability

To measure the magnitude of price unpredictability in the two groups of countries, we compute the squared forecast variances for each month from a one month-ahead price forecasting model as described in Section 3.1.1. The price forecast model is based on a set of basic indicators believed to be widely available and taken into account by traders, millers, and other actors operating in the maize markets of the region. Assuming that these marketing actors utilize this basic information to predict one month-ahead prices, then the error variances represent the magnitude of the forecast error for each given month conditional on available market information. The main omitted variables in the market pertain to government policy. In the countries pursuing highly discretionary government operations and trade policies, future government behavior will not be known anyway, except by firms with insider information. Hence, the forecast error terms from joint estimation of equations 2 and 3 will contain the effects of uncertain government policies not incorporated into the model because such information was unavailable at the time that the forecasts were made.

In table 1, columns E to G present the conditional CVs for the different markets by country. The rankings of the conditional CVs are remarkably similar to those of the unconditional CVs. Malawi once again has the highest average level of price uncertainty followed by Zambia, with the conditional CV ranging from 12 to 14% for Malawi and 9 to 13% for Zambia. These results are consistent with our hypothesis that countries pursuing highly discretionary marketing and trade policies are likely to generate relatively high levels of price unpredictability in markets. Over the 14-year period, the trend in uncertainty shows that

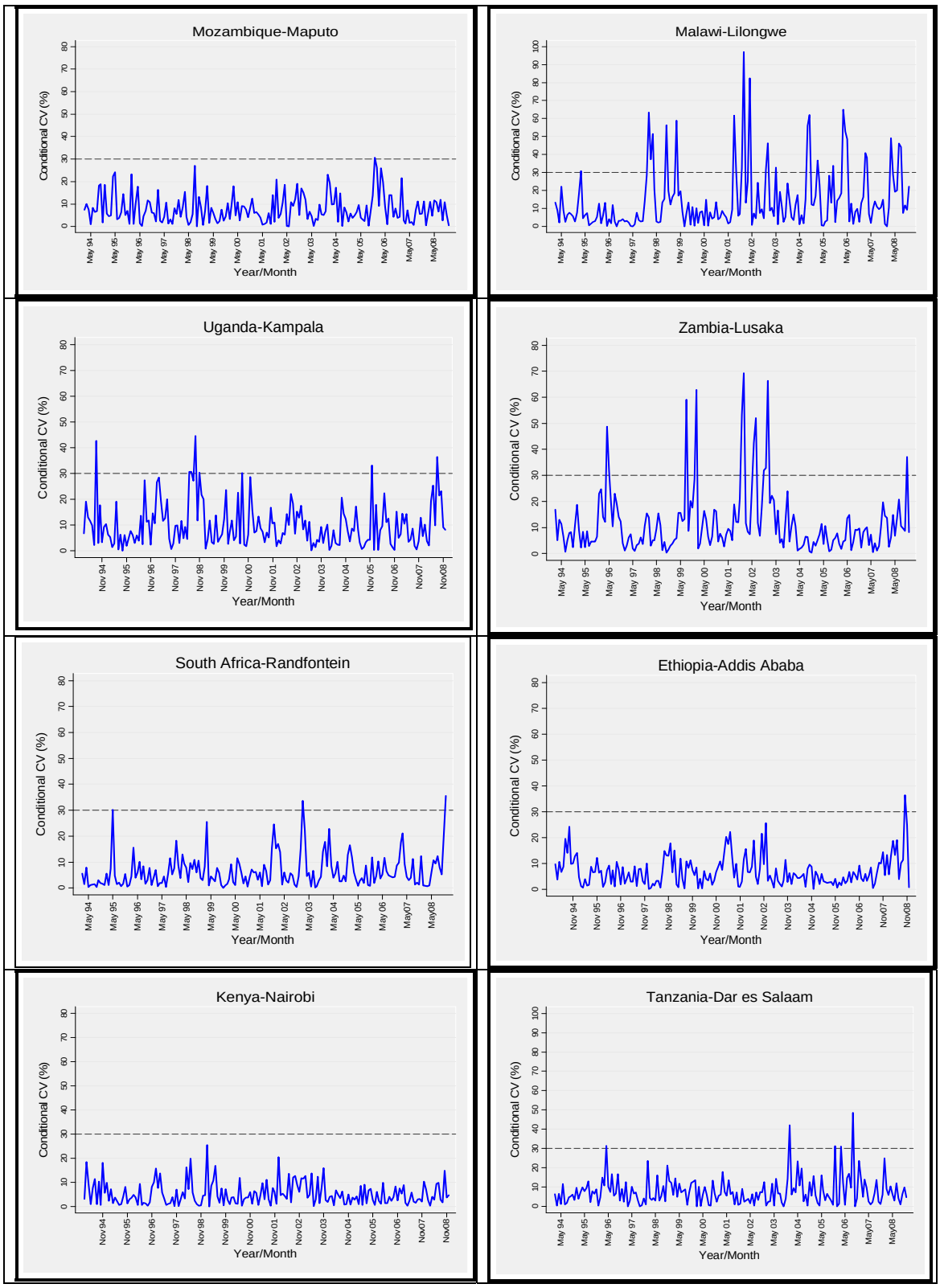
Malawi and Zambia have the highest range between the minimum and maximum conditional CVs, with the maximum values going as high as 198% for Zambia and 98% for Malawi (Figure 3 and Table 1, columns E and F).

To gain more insights about temporal patterns of price predictability, we plot the conditional coefficient of variations for each capital city market/main consumption centre in Figure 3 (all other markets are show in Appendix Figures A1 and A2).[5] In the cases of Zambia and Malawi, most of the periods during which the conditional CVs spiked over 30% coincide with when the governments of these countries were directly engaged in market operations through stock releases onto markets at subsidized prices, direct importation, and/or various types of *ad hoc* restrictions on private maize trade. These policy interventions are described for the various countries in Appendices A1-A3. In Zambia, for example, the government initiated large import procurement programs in the 2001/02 and 2002/03, however, these imports were contracted too late to avoid national stockouts and the shooting of price well over import parity levels in these years. Not surprisingly, the conditional CVs for Zambian markets exceeded 50% during these periods (Figure 3 and Figure A2). A similar situation is apparent in the Malawi graphs. For example, the government was presented with a food balance sheet in May 2002 that forecast a deficit of 430,000 tons for the 2002-03 season. The government acted promptly by importing 250,000 tons of maize entirely through public channels (the NFRA) and arranged for 150,000 tons of food aid, for a total formal inflow of over 400,000 tons, nearly covering the forecast deficit. Unfortunately these decisions did not consider the large informal flows of white maize from Mozambique into southern Malawi—an estimated 150,000–250,000 tons—which left the country with a large maize surplus (Whiteside 2003). In March 2003 the government, facing a good harvest and the prospect of storing maize for more than a year, decided to sell some of its accumulated stocks, depressing market prices to very low levels (less than two-thirds the levels in Zambia and southern Mozambique). In the most recent 2007/08 and 2008/09 marketing years, the Malawi government arranged government-to-government exports despite the unavailability of market supplies to export significant quantities without greatly bidding up prices. The government also forced private trade to take place within government-mandated price bounds and restricted private importation in 2008/09 (see Tschirley and Jayne forthcoming, and Jayne and Tschirley 2009 for a detailed institutional assessment). Not surprisingly, the conditional variance of maize prices during these years is shown to be extremely high.

Tanzania results show relatively greater price forecast CVs in the 2003-2008 period compared to the period before 2004. The greater price forecast CVs or rather price uncertainty during the 2004-2008 period coincides with the period when the Tanzanian government has created new marketing institutions and implemented sudden changes in marketing and trade policies (see Temu and Manyama. 2007). For example, between 2003 and 2008, the Ministry of Agriculture and Food Security imposed an export ban by withdrawing all maize export permits given to traders and suspending the issuance of new permits. This ban was lifted in January 2006 for a month to allow maize exports and re-imposed due to food shortage in the country. The conditional CVs for Dar es Salaam maize prices rose over 30% twice during these periods in contrast to earlier years when they almost never exceeded 20%.

[5] Randfontein is not the capital of South Africa, but it is a town in the periphery of Johannesburg in the Gauteng Province of South Africa.

Figure 3. Comparison of Conditional CV for Capital City Markets/consumption Centers



The results show relatively low conditional CVs for Randfontein, South Africa and Kenyan markets. In Kenya, the average conditional variation for the period 2005 to 2008 is lower than the period 1994 to 2004. As mentioned earlier, the removal of the variable import tariff to a lower and stable import tariff in December 2004 is associated with a period of low conditional CVs at least up to 2008. After January 2008, a combination of civil disruption, drought, and *ad hoc* government attempts to reduce maize meal prices (Jayne and Tschirley 2009) have resulted in major price swings in 2008 and 2009.

The results for Mozambique in Table 6 follow the same pattern as the price volatility results, with Maputo the capital city, having the lowest price uncertainty and the other two northern markets mimicking Malawi markets. As mentioned earlier, this is not surprising because of the close proximity of the northern markets to Malawi compared to Maputo; the markets in northern Mozambique appear to be affected by market prices in Malawi since they are normally linked by informal cross-border trade**.** Therefore, one would expect that the high price uncertainty observed in Malawi is likely to be transmitted into these markets.

In Mozambique, private trade plays a more prominent role on a regular basis and the government has not directly participated in the maize import business for at least 10 years. Southern Mozambique contains the nation's largest urban population and is perpetually food deficient. The center of the country is typically but not always in surplus, whereas the north produces a surplus every year. In response to this production pattern and to the long distances and high costs of transporting maize from the north to the south, Mozambique has maintained an open border policy with respect to maize trade, regularly exporting from the north and importing from South Africa to the south. Largely for this reason, maize prices in Mozambique remained relatively stable during the 2001-02 crisis, well below levels in Zambia and Malawi (Tschirley et al. 2006).

In summary, the level of price uncertainty as measured by the conditional price variances in Table 6 is generally greater in countries implementing discretionary trade policies and directly undertaking state operations in markets, in particular Malawi and Zambia, compared to countries pursuing less interventionist approaches to price stabilization and relying on an open borders policy toward regional trade.

However, in at least one instance (northern Mozambique markets), an open borders approach appears to have made these markets more vulnerable to price instability emanating from Malawian markets.

4.3. Seasonal Analysis

Tables 2 through 9 present seasonal maize price information in the capital cities of eight countries: Lusaka, Zambia; Lilongwe, Malawi; Dar es Salaam, Tanzania; Addis Ababa, Ethiopia; Nairobi, Kenya; Maputo, Mozambique; Kampala, Uganda; and Randfontein, South Africa (all the other markets are in appendix).[6] The green cells represent the month of the lowest price while the yellow cells represent the month of the highest price in that marketing year. Three points can be gleaned from these tables:

First, there is great variation in the timing of the low and high-priced month across years in each country. In well functioning markets, a regular seasonal price pattern can be observed in which prices are lowest directly after harvest and rise gradually over the season, reflecting the

costs of storage, until they reach their peak in the months prior to the next harvest. This pattern is seen most clearly in Randfontein, South Africa. In most countries examined in these tables, the majority of the low-price months do correspond to the period immediately after the harvest and the high-price months typically occur in the lean season periods directly preceding the main harvests. However, in the capital cities of Malawi, Tanzania, Ethiopia, Kenya, and Uganda, the low-price month occurs in unexpected months in at least three or more of the 14 years for which data is available. The high-price months also occur in atypical periods in these countries as well as in Maputo for at least three of the 14 years. The lack of a regular seasonal price pattern in these countries introduces major risks to grain storage. In order to provide incentives to store grain for consumption later in the season, the expected seasonal price rise must be greater, on average, to offset the risks associated with unpredictable seasonal price movements.

Second, there are major differences across countries in the magnitude of the average seasonal price rise. Malawi has the highest intra-annual high/low price ratio at 2.45, meaning that the high price month in each year is on average 2.45 times higher than the low price month in that year. The next highest high/low price ratios are observed in Kampala (1.91), Dar es Salaam (1.82), Lusaka (1.77), Randfontein (1.67), Maputo (1.62), Addis Ababa (1.53), and Nairobi (1.47). Nairobi has the lowest mean seasonal price rises possibly due to the staggered main and secondary harvest seasons in that country and substantial regional trade with Uganda and Tanzania. However, Uganda and Tanzania also have staggered production seasons, yet the mean seasonal price rises in these countries are relatively high. In general, the mean seasonal price rises are relatively high in southern Africa, which has only one main season.

Third, similar to the conditional and unconditional CV results, there is no apparent relationship between being on a coastal port versus being landlocked in terms of the magnitude of mean seasonal price rises. The landlocked cities of Lilongwe and Kampala have the highest degree of seasonal price rises, while the equally landlocked cities of Addis Ababa and Nairobi have the lowest.

Finally yet importantly, there is also great variation in the number of months separating high-priced months from low-priced months. For example, in the 1999/00 season in Lusaka, the low price month (December) occurred one month before the high price month in January, whereas on average, the duration separating the low-priced from high-priced month was seven months. Again, findings such as these suggest great risks to seasonal storage.

These findings have obvious implications for short-run costs and risks borne by farmers, consumers, and marketing agents. Yet there are potentially even greater subtle effects. Over the long run, price-destabilizing policy uncertainty depresses investment in storage and more efficient forms of transport that could help to stabilize prices and reduce costs over the long run. Here we invoke the concept of "asset specificity" (Williamson 1975, 1981). Asset specificity refers to investments that have particular uses that cannot easily be redeployed to other uses or sold except at great cost or major loss in value. An example is investment in railway cars fitted to allow loading of grain via grain elevators. This is an efficient form of transport and handling for grain, but such railway cars have limited use outside of carrying grain loaded from elevators. Investment in grain elevators depends on the returns to storage, which in turn depend on relatively predictable seasonal price movements. Hence, indirectly, investment in cost-reducing asset-specific marketing technologies that would otherwise promote the overall development and stability of grain marketing systems could be impeded by uncertainty and associated risks for market participants.

Table 2. Seasonal Price Features for Real Maize Grain Prices, Lusaka, Zambia

Year	----------Maize Marketing Season ('000 Real Kwacha, cpi 2007=1) ----------												----------Seasonal price features----------				
	May	June	July	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	12 month low	12 month high	Year Avg.	No. of months low-high	Ratio of high/low months
1994/95	1,124	971	952	985	965	997	1,056	1,314	1,556	1,396	1,318	1,123	952	1,556	1,146	6	(1.63)
1995/96	1,118	1,026	1,054	1,291	1,433	1,559	1,645	1,913	2,130	2,201	2,178	1,383	1,026	2,201	1,577	8	(2.15)
1996/97	959	857	876	875	880	894	867	929	989	978	1,022	970	857	1,022	925	9	(1.19)
1997/98	887	812	812	941	1,072	1,173	1,316	1,492	1,579	1,533	1,490	1,248	812	1,579	1,196	6	(1.95)
1998/99	1,016	1,153	1,210	1,270	1,328	1,371	1,426	1,418	1,435	1,471	1,452	1,448	1,016	1,471	1,333	9	(1.45)
1999/00	1,377	1,300	1,270	559	666	656	646	553	1,483	1,429	1,372	1,311	553	1,483	1,052	-1	(2.68)
2000/01	1,280	1,247	1,142	1,075	1,012	941	872	951	927	905	893	907	872	1,280	1,013	-6	(1.47)
2001/02	928	944	938	1,241	1,099	1,305	1,508	2,028	2,527	2,199	1,729	1,495	928	2,527	1,495	8	(2.72)
2002/03	960	1,388	1,802	1,777	1,575	1,771	1,986	2,164	2,633	1,979	1,965	1,831	960	2,633	1,819	8	(2.74)
2003/04	1,321	898	869	985	1,027	1,203	891	1,028	1,161	1,304	1,084	973	869	1,321	1,062	-2	(1.52)
2004/05	866	758	761	764	762	845	876	871	860	826	903	898	758	903	832	9	(1.19)
2005/06	803	828	810	869	886	874	968	1,064	985	995	996	906	803	1,064	915	7	(1.33)
2006/07	533	634	546	583	560	593	608	793	774	750	691	611	533	793	640	7	(1.49)
2007/08	626	581	623	737	767	753	615	607	596	781	772	577	577	781	670	-2	(1.35)
Avg. for month	**986**	**957**	**976**	**997**	**1,002**	**1,067**	**1,091**	**1,223**	**1,402**	**1,339**	**1,276**	**1,120**	**957**	**1,402**	**1,120**	**7**	**(1.77)**

Table 3. Seasonal Price Features for Real Maize Grain Prices, Lilongwe, Malawi

Year	----------Maize Marketing Season (Real Malawi Kwacha, cpi 2007=1) ----------												----------Seasonal price features----------				
	May	June	July	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	12 month low	12 month high	Year Avg.	No. of months low-high	Ratio of high/low months
1994/95	11,885	13,543	15,364	14,350	12,491	12,421	14,996	17,673	17,594	17,482	14,176	10,786	10,786	17,673	14,397	-4	(1.64)
1995/96	9,348	10,905	13,046	13,275	13,472	14,628	14,715	18,201	17,052	17,907	22,578	16,869	9,348	22,578	15,166	10	(2.42)
1996/97	11,419	10,121	9,797	11,384	11,457	11,602	12,738	12,806	13,930	16,210	18,922	14,264	9,797	18,922	12,888	8	(1.93)
1997/98	11,564	12,142	13,560	14,053	15,311	17,388	22,743	16,730	32,330	41,464	28,128	18,154	11,564	41,464	20,297	9	(3.59)
1998/99	14,792	14,349	16,025	19,364	20,956	32,773	35,033	34,553	34,721	38,280	23,227	14,533	14,349	38,280	24,884	8	(2.67)
1999/00	14,630	14,526	15,492	16,351	17,524	16,447	19,362	18,960	15,737	19,119	19,321	12,943	12,943	19,362	16,701	-5	(1.50)
2000/01	9,704	6,137	9,326	11,767	11,874	10,804	14,860	13,819	14,734	15,575	16,323	13,156	6,137	16,323	12,340	9	(2.66)
2001/02	10,832	12,473	13,978	30,233	35,450	32,911	34,971	41,691	61,301	60,656	51,020	23,838	10,832	61,301	34,113	8	(5.66)
2002/03	21,273	23,440	25,270	20,847	20,545	20,973	23,641	33,300	22,473	29,415	30,278	25,555	20,545	33,300	24,751	3	(1.62)
2003/04	14,809	16,225	15,659	14,992	14,856	15,646	13,221	13,154	14,921	21,432	28,366	28,692	13,154	28,692	17,664	4	(2.18)
2004/05	26,104	24,549	26,999	24,253	37,647	22,833	23,746	24,296	23,245	21,115	22,445	22,189	21,115	37,647	24,952	-5	(1.78)
2005/06	22,630	25,751	30,678	25,789	24,713	36,104	39,239	37,638	35,751	36,903	56,325	38,370	22,630	56,325	34,158	10	(2.49)
2006/07	22,237	23,232	23,108	24,051	22,436	22,911	25,887	25,746	24,604	21,376	19,459	18,624	18,624	25,887	22,806	-5	(1.39)
2007/08	18,506	18,955	20,951	21,504	21,436	22,806	24,260	28,806	31,952	35,353	51,708	40,508	18,506	51,708	28,062	10	(2.79)
Avg. for month	**15,695**	**16,168**	**17,804**	**18,730**	**20,012**	**20,732**	**22,815**	**24,098**	**25,739**	**28,021**	**28,734**	**21,320**	**15,695**	**28,734**	**21,656**	**10**	**(2.45)**

Table 4. Seasonal Price Features for Real Maize Grain Prices, Dar es Salaam, Tanzania

Year	----------Maize Marketing Season ('000 Real Tanzania Shillings, cpi 2007=1)----------												----------Seasonal price features----------				
	May	June	July	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	12 month low	12 month high	Year Avg.	No. of months low-high	Ratio of high/low months
1994/95	367	305	287	288	295	312	328	346	335	315	301	314	287	367	316	-2	(1.28)
1995/96	307	253	205	208	225	246	269	278	305	330	355	411	205	411	283	9	(2.00)
1996/97	342	282	216	232	239	200	199	196	228	258	267	265	196	342	244	-7	(1.75)
1997/98	268	258	261	273	264	265	276	286	245	255	257	240	240	286	262	-4	(1.19)
1998/99	230	170	174	202	231	246	305	348	330	307	351	325	170	351	268	9	(2.07)
1999/00	271	266	233	219	215	205	183	175	172	181	176	182	172	271	206	-8	(1.58)
2000/01	188	198	208	219	221	198	194	224	237	225	199	222	188	237	211	8	(1.26)
2001/02	195	145	130	131	137	137	152	182	234	241	245	228	130	245	180	8	(1.88)
2002/03	214	207	197	189	181	172	164	155	186	185	208	233	155	233	191	4	(1.50)
2003/04	213	225	228	250	247	249	240	289	406	369	338	298	213	406	279	8	(1.91)
2004/05	210	158	198	213	225	230	205	213	200	192	214	213	158	230	206	4	(1.46)
2005/06	239	236	216	208	195	213	223	317	328	322	402	348	195	402	271	6	(2.06)
2006/07	314	317	335	350	206	213	212	171	167	163	150	137	137	350	228	-8	(2.56)
2007/08	129	126	127	135	182	207	231	247	344	367	364	332	126	367	232	8	(2.92)
Avg. for month	**249**	**225**	**216**	**223**	**219**	**221**	**227**	**245**	**266**	**265**	**273**	**268**	**216**	**273**	**241**	**8**	**(1.82)**

Table 5. Seasonal Price Features for Real Maize Grain Prices, Addis Ababa, Ethiopia

Year	----------Maize Marketing Season ('000 Real Birr, cpi 2007=1)----------												----------Seasonal price features----------				
	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	12 month low	12 month high	Year Avg.	No. of months low-high	Ratio of high/low months
1994/95	1,934	2,232	2,461	2,345	2,242	2,188	2,176	2,265	2,230	2,076	1,988	1,583	1,583	2,461	2,143	-9	(1.55)
1995/96	1,633	1,564	1,452	1,528	1,492	1,381	1,323	1,496	1,373	1,474	1,517	1,451	1,323	1,633	1,474	-6	(1.23)
1996/97	1,292	1,232	1,288	1,293	1,485	1,495	1,714	2,019	1,961	2,140	2,039	1,777	1,232	2,140	1,645	8	(1.74)
1997/98	1,578	1,818	1,826	1,863	1,815	1,816	2,007	2,056	2,026	2,188	1,700	1,727	1,578	2,188	1,868	9	(1.39)
1998/99	1,810	1,575	1,598	2,017	2,026	2,069	2,435	2,596	2,515	2,706	2,594	2,053	1,575	2,706	2,166	8	(1.72)
1999/00	1,692	1,889	2,087	2,108	2,160	2,145	2,067	2,086	2,013	1,969	1,853	1,698	1,692	2,160	1,981	4	(1.28)
2000/01	1,432	1,417	1,342	1,351	1,222	1,027	1,021	944	957	1,163	998	977	944	1,432	1,154	-7	(1.52)
2001/02	928	1,084	1,024	922	979	1,052	1,166	1,778	1,713	1,827	1,777	1,895	922	1,895	1,345	8	(2.06)
2002/03	1,841	2,332	2,174	2,025	2,037	2,001	2,223	2,327	2,275	2,243	2,068	1,555	1,555	2,332	2,092	-10	(1.50)
2003/04	1,437	1,409	1,508	1,688	1,788	1,709	1,729	1,755	1,877	1,929	1,911	1,838	1,409	1,929	1,715	8	(1.37)
2004/05	1,796	1,837	1,719	1,877	1,847	1,995	2,165	2,215	2,153	2,153	2,033	1,769	1,719	2,215	1,963	5	(1.29)
2005/06	1,618	1,659	1,720	1,778	1,683	1,769	1,821	1,823	1,796	1,761	1,735	1,590	1,590	1,823	1,730	-4	(1.15)
2006/07	1,582	1,558	1,537	1,491	1,478	1,470	1,517	1,721	1,827	2,074	2,132	2,085	1,470	2,132	1,706	5	(1.45)
2007/08	1,680	1,756	2,136	2,110	2,418	2,823	3,140	3,554	3,373	3,581	3,576	2,592	1,680	3,581	2,728	9	(2.13)
Avg. for month	**1,590**	**1,669**	**1,705**	**1,743**	**1,762**	**1,781**	**1,893**	**2,045**	**2,006**	**2,092**	**1,994**	**1,757**	**1,590**	**2,092**	**1,836**	**9**	**(1.53)**

Table 6. Seasonal Price Features for Real Maize Grain Prices, Nairobi, Kenya

Year	----------Maize Marketing Season ('000 Real Kenya Shillings, cpi 2007=1)----------												----------Seasonal price features----------				
	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	12 month low	12 month high	Year Avg.	No. of months low-high	Ratio of high/low months
1994/95	28,033	25,818	22,846	23,026	23,879	22,826	22,827	22,664	22,995	22,089	20,581	19,142	19,142	28,033	23,060	-11	(1.46)
1995/96	18,959	18,776	18,584	18,398	18,115	19,040	23,540	25,310	26,130	26,002	26,188	27,022	18,115	27,022	22,172	7	(1.49)
1996/97	27,982	30,223	33,726	35,303	37,788	38,383	38,217	38,303	37,725	36,222	34,385	34,329	27,982	38,383	35,215	5	(1.37)
1997/98	31,679	31,456	31,896	30,395	30,632	26,413	25,847	21,687	23,379	23,209	22,283	22,493	21,687	31,896	26,781	5	(1.47)
1998/99	21,723	20,603	19,492	25,658	25,076	26,638	30,025	34,093	34,697	32,948	30,129	29,876	19,492	34,697	27,580	6	(1.78)
1999/00	30,212	30,338	29,627	30,270	28,722	28,499	29,643	32,612	32,284	31,542	29,427	28,359	28,359	32,612	30,128	-4	(1.15)
2000/01	28,533	27,970	26,327	25,061	24,551	23,178	22,026	21,860	19,514	18,358	18,032	16,834	16,834	28,533	22,687	-11	(1.69)
2001/02	14,869	14,777	19,733	18,753	19,659	20,343	20,625	17,836	17,728	14,369	17,187	19,901	14,369	20,625	17,982	6	(1.44)
2002/03	20,656	23,603	20,951	18,303	17,426	18,601	23,150	23,576	24,416	26,431	25,352	27,282	17,426	27,282	22,479	7	(1.57)
2003/04	22,520	21,813	21,366	22,502	23,261	22,976	22,697	22,143	23,251	23,847	23,249	23,103	21,366	23,847	22,727	7	(1.12)
2004/05	23,154	23,045	21,935	21,234	19,795	19,699	22,776	22,909	20,819	19,776	17,575	16,152	16,152	23,154	20,739	-11	(1.43)
2005/06	16,082	16,116	17,493	18,027	17,340	19,255	20,499	21,115	20,173	18,780	17,244	15,636	15,636	21,115	18,147	-4	(1.35)
2006/07	14,470	16,447	15,367	13,647	13,354	13,335	14,121	13,490	13,528	13,369	13,682	13,465	13,335	16,447	14,023	-4	(1.23)
2007/08	13,339	11,285	13,499	13,660	14,014	15,339	16,425	19,649	18,151	18,611	18,778	22,919	11,285	22,919	16,306	10	(2.03)
Avg. for month	**22,301**	**22,305**	**22,346**	**22,445**	**22,401**	**22,466**	**23,744**	**24,089**	**23,914**	**23,254**	**22,435**	**22,608**	**22,301**	**24,089**	**22,859**	**7**	**(1.47)**

Table 7. Seasonal Price Features for Real Maize Grain Prices, Maputo, Mozambique

Year	----------Maize Marketing Season (Real Metical cpi 2007=1)----------												----------Seasonal price features----------				
	May	June	July	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	12 month low	12 month high	Year Avg.	No. of months low-high	Ratio of high/low months
1994/95	5,828	5,729	5,761	7,044	9,122	7,979	8,089	7,339	8,052	7,998	7,763	8,976	5,729	9,122	7,473	3	(1.59)
1995/96	10,297	9,995	9,317	8,946	10,511	10,304	10,760	10,923	12,377	11,916	11,226	8,621	8,621	12,377	10,433	-3	(1.44)
1996/97	8,042	7,947	7,498	7,290	6,981	6,578	6,305	6,490	6,816	8,138	7,202	6,183	6,183	8,138	7,122	-3	(1.32)
1997/98	5,528	4,694	4,881	5,518	6,162	7,161	7,557	8,763	8,700	9,017	6,505	5,990	4,694	9,017	6,706	8	(1.92)
1998/99	5,563	5,605	5,893	8,096	8,087	9,021	7,964	8,238	7,426	5,976	5,054	3,861	3,861	9,021	6,732	6	(2.34)
1999/00	4,226	4,496	4,557	4,675	5,819	5,934	6,318	7,540	7,014	6,227	6,627	6,073	4,226	7,540	5,792	7	(1.78)
2000/01	6,615	6,674	5,790	5,386	5,450	5,722	5,458	5,395	5,413	5,453	5,432	5,357	5,357	6,674	5,679	-10	(1.25)
2001/02	5,556	5,931	6,285	6,392	7,305	8,933	9,081	11,056	10,907	10,969	8,813	6,537	5,556	11,056	8,147	7	(1.99)
2002/03	6,472	6,607	7,520	7,158	8,737	10,457	9,843	8,878	10,017	8,959	7,769	7,565	6,472	10,457	8,332	5	(1.62)
2003/04	7,622	7,495	7,648	7,635	7,394	7,471	7,336	8,552	6,847	8,684	8,500	8,406	6,847	8,684	7,799	1	(1.27)
2004/05	6,594	6,415	5,291	5,772	5,805	5,910	6,370	6,554	6,384	6,927	6,504	6,467	5,291	6,927	6,249	7	(1.31)
2005/06	6,492	6,703	6,821	7,834	8,221	7,927	9,048	11,656	12,918	12,696	8,931	6,415	6,415	12,918	8,805	-3	(2.01)
2006/07	5,536	5,606	6,763	5,990	7,008	6,868	6,909	8,025	6,544	7,228	6,538	6,629	5,536	8,025	6,637	7	(1.45)
2007/08	6,398	6,371	6,457	6,356	6,254	6,564	7,430	7,300	7,538	8,297	8,351	7,997	6,254	8,351	7,109	6	(1.34)
Avg. for month	**6,483**	**6,448**	**6,463**	**6,721**	**7,347**	**7,631**	**7,748**	**8,336**	**8,354**	**8,463**	**7,515**	**6,791**	**6,448**	**8,463**	**7,358**	**8**	**(1.62)**

Table 8. Seasonal Price Features for Real Maize Grain Prices, Kampala, Uganda

Year	----------Maize Marketing Season ('000 Real Uganda Shillings, cpi 2007=1)----------												----------Seasonal price features----------				
	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	12 month low	12 month high	Year Avg.	No. of months low-high	Ratio of high/low months
1994/95	189	199	181	221	267	298	303	242	197	233	238	304	181	304	239	9	(1.67)
1995/96	325	314	302	295	315	338	350	321	274	388	425	489	274	489	345	3	(1.79)
1996/97	499	393	430	513	604	667	678	679	507	494	463	465	393	679	533	6	(1.73)
1997/98	437	426	411	364	360	354	376	476	501	563	360	336	336	563	414	-2	(1.67)
1998/99	456	474	523	490	462	427	407	381	357	328	296	301	296	523	408	-8	(1.77)
1999/00	361	235	257	237	219	272	305	382	317	407	367	385	219	407	312	5	(1.86)
2000/01	410	258	323	294	281	263	246	225	161	149	142	133	133	410	240	-1	(3.08)
2001/02	138	163	182	185	205	269	303	253	236	318	375	422	138	422	254	11	(3.06)
2002/03	379	295	366	334	389	396	437	425	345	331	307	327	295	437	361	5	(1.48)
2003/04	381	333	315	358	376	399	383	394	340	341	402	468	315	468	374	9	(1.48)
2004/05	424	348	336	362	342	426	391	370	301	293	275	294	275	426	347	-5	(1.55)
2005/06	303	384	380	434	431	471	427	336	237	288	293	322	237	471	359	-3	(1.98)
2006/07	349	269	273	269	253	264	239	247	221	203	207	257	203	349	254	9	(1.72)
2007/08	280	304	300	281	328	379	465	549	514	374	441	544	280	549	396	7	(1.96)
Avg. for month	**352**	**314**	**327**	**331**	**345**	**373**	**379**	**377**	**322**	**336**	**328**	**360**	**314**	**379**	**345**	**6**	**(1.91)**

Table 9. Seasonal Price Features for Real Maize Grain Prices, Randfontein, South Africa

Year	----------Maize Marketing Season ('000 Real Rand, cpi 2007=1)----------												----------Seasonal price features----------				
	May	June	July	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	12 month low	12 month high	Year Avg.	No. of months low-high	Ratio of high/low months
1994/95	1,148	1,130	1,113	1,097	1,081	1,081	1,081	1,081	1,066	1,051	1,051	1,036	1,036	1,148	1,085	-11	(1.11)
1995/96	1,395	1,415	1,395	1,395	1,395	1,395	1,376	1,376	1,358	1,358	1,586	1,548	1,358	1,586	1,416	10	(1.17)
1996/97	1,435	1,323	1,306	1,232	1,271	1,237	1,201	1,204	1,155	1,193	1,210	1,144	1,144	1,435	1,243	-11	(1.25)
1997/98	1,076	1,008	996	1,063	1,234	1,284	1,234	1,485	1,566	1,418	1,239	1,272	996	1,566	1,240	6	(1.57)
1998/99	1,125	1,096	1,230	1,154	1,049	992	946	946	946	1,038	1,419	1,344	946	1,419	1,107	4	(1.50)
1999/00	1,359	1,299	1,253	1,148	1,102	1,102	1,181	1,195	1,183	1,183	1,098	1,014	1,014	1,359	1,177	-11	(1.34)
2000/01	985	861	767	724	759	858	956	961	1,107	1,159	1,120	1,107	724	1,159	947	6	(1.60)
2001/02	1,029	1,056	1,205	1,326	1,353	1,421	1,716	2,065	2,277	2,426	2,585	2,425	1,029	2,585	1,740	10	(2.51)
2002/03	2,240	2,208	2,115	2,146	2,201	2,152	2,176	2,087	1,834	1,305	1,050	945	945	2,240	1,871	-11	(2.37)
2003/04	1,026	1,047	988	1,015	1,052	1,040	1,074	1,297	1,532	1,561	1,257	1,297	988	1,561	1,182	7	(1.58)
2004/05	1,215	1,145	1,020	1,069	1,064	1,010	1,120	974	780	605	601	618	601	1,215	935	-10	(2.02)
2005/06	616	691	681	756	929	967	1,043	1,229	1,198	1,075	1,235	1,193	616	1,235	968	10	(2.00)
2006/07	1,237	1,394	1,471	1,403	1,366	1,329	1,491	1,429	1,339	1,561	1,883	1,671	1,237	1,883	1,464	10	(1.52)
2007/08	1,690	1,724	1,664	1,803	1,822	1,780	1,818	1,667	1,698	1,655	1,732	1,690	1,655	1,822	1,729	-5	(1.10)
Avg. for month	**1,255**	**1,243**	**1,229**	**1,238**	**1,263**	**1,261**	**1,315**	**1,357**	**1,360**	**1,328**	**1,362**	**1,307**	**1,229**	**1,362**	**1,293**	**8**	**(1.67)**

5. CONCLUSION AND POLICY IMPLICATIONS

Staple food price instability remains a major problem in eastern and southern Africa. Many governments in the region attempt to stabilize food prices through pricing, marketing, and trade policy instruments. However, these policies tend to be implemented in ad hoc, stop-go, and unpredictable ways that can generate uncertainty for participants in the marketing system and create unintended consequences for the performance of food markets. Government officials involved in these policy measures may not like to think of these policies as *ad hoc*; after all, they respond to perceived needs to influence the market to protect consumers and/or farmers. However, from the standpoint of traders, millers, and other marketing actors, the sudden imposition of trade controls, state operations in markets, and other actions that are difficult to anticipate can themselves be a major source of unpredictability which leads to strategic interactions between the private and public sectors in markets. These policy actions may be sources of unpredictability for the private sector unless the rules governing state operations are specified in advance so that they can reasonably anticipated, enabling market actors to update their expectations of future prices accordingly. The failure to accurately predict near-future price movements can be a source of major risk and financial loss for private traders, and those having incurred such losses often exit the market or limit their future exposure to such risks, which in turn impedes the development of more vibrant and competitive marketing systems.

To better understand the relationship between food price instability/unpredictability and policies designed to stabilize food prices, this paper first measures the magnitude of price instability and unpredictability, and then compares these measures across countries. Data on monthly maize prices over the period January 1994 to December 2008 are applied to ARCH models for major food markets in Mozambique, Uganda, South Africa, Malawi, Zambia, Tanzania, Ethiopia, and Kenya. According to our classification, *Category A* countries (Mozambique, Uganda, and South Africa) and *Category B* countries (Malawi, Zambia, and Tanzania) provide an interesting contrast in approaches to addressing food price unpredictability. *Category A* countries have for the most part embraced an open borders trade policy with a relatively stable trade policy regime and a relatively predictable role for government operations in domestic markets. By contrast, *Category B* countries use a variety of discretionary and difficult-to-predict domestic marketing and external trade policy tools to stabilize prices.

The study highlights six main findings:

First, with the exception of Malawi, none of the other countries pursuing food price stabilization and food security objectives through direct state operations over the past decade have been able to match production growth for the Sub-Saharan Africa as a whole. By contrast, Mozambique and Uganda, countries that have stable maize marketing and trade policies, have experienced more than 100% increase in maize production over the past two decades. A caveat to these conclusions is that official production statistics on which these findings are based are in some cases frequently questioned.

Second, Malawi and Zambia, countries pursuing interventionist and *ad hoc* trade policies, have the highest degree of price volatility and price uncertainty compared to all the other countries. This finding implies that these countries' highly discretionary policy environment toward domestic and external trade may have had a destabilizing effect on prices and market predictability.

Third, Mozambique, a country with the most liberalized markets in southern Africa, has the lowest price variability in the capital city of Maputo, but the other markets, Nampula and Beira, have price volatility and market uncertainty closer to that of Malawi. This is likely because markets in the northern part of Mozambique are integrated with markets in Malawi; to some extent, policy instability in Malawi is likely to have been transmitted into these markets.

Fourth, historical unconditional and conditional CVs have declined greatly in Kenya since Kenya's entry into the East African Commission trading agreement in January 2005. At this time, Kenya eliminated the variable maize import tariffs from Uganda and Tanzania (except for a 2.75% inspection fee). Since the adoption of this open borders policy toward regional trade, Kenya's maize prices have become the most stable and predictable among all the countries examined. Kenya continues to buy and sell in domestic markets through the National Cereals and Produce Board, yet its operations are relatively minor, confined mainly to 3-4 districts of the country, and fairly stable over time. Kenya's domestic maize market has become almost totally dominated by private trade, and regional trade with Uganda and Tanzania appear to be major sources of improved domestic price stability.

Fifth, there is no apparent relationship coastal vs. landlocked countries in terms of the magnitude of unconditional CV, conditional CV and mean seasonal price rises.

Sixth, in well functioning markets, one would expect to see a regular seasonal price pattern in which prices are lowest directly after the harvest and rise gradually over the season reflecting the costs of storage until they reach their peak in the months prior to the next harvest. This pattern is seen most clearly in Randfontein, South Africa. Many countries of the region experience major departures from the normal seasonal price patterns, which imparts major risks to seasonal storage.

These findings generally indicate that many governments' well-meaning attempts to stabilize prices may actually contribute to price instability. Future food prices appear to be more difficult to predict in an environment in which the extent and composition of marketing board operations are frequently changing and where cross-border trade policies also change in ways that are difficult to anticipate. There is increasing evidence that private trade and investment develops more slowly and more tentatively in countries where government policy is particularly unpredictable. While private trading systems will always result in price variation – potentially very wide price swings in landlocked countries with poor transport infrastructure – they tend not to cause the frequent food crises due to policy mistakes and inaction that are commonly seen in the region. However, these findings do not suggest that governments have no role to play in maize markets. The finding rather indicate that the price instability and unpredictability could be mitigated more effectively by limiting the state's role to adopting a rules-based and transparent approach to state operations in markets so that the private sector understands the specific market conditions that will trigger government interventions. Other positive roles of government to reduce price instability include regulating the playing field, investing in physical infrastructure, encouraging diversification of food consumption patterns, improving rural financial markets to improve traders' capacity to absorb surplus production, and encouraging the development of regional maize trade and market-based risk management instruments to stabilize maize prices.

A *maize without borders* policy may be an important part of overall maize government policy that has the potential to reduce but certainly not eliminate price instability. This position is supported by other recent analysis (Dorosh, Dradri, and Haggblade 2009; Cummings, Rashid,

and Gulati 2006). In a static sense, regional trade may be feared because it allows market shocks outside the country to be transmitted into domestic markets. This is indeed true, and to some extent this was experienced in 2008 as the major rise in world food prices were transmitted to many countries in the region, regardless of their efforts to prevent it. However, in a more dynamic sense, regional trade many facilitate private investment in cost-reducing technologies and institutions and broaden the scope of the market so that markets are increasingly able to absorb prices shocks. To the extent that market development contributes to farm-level agricultural growth and multiplier effects supporting economy-wide growth, the associated income growth can make rural and urban households less vulnerable to food price shocks. Indeed, these growth processes were major features of the structural transformations in many Asian countries. Mass hunger and starvation in response to high food prices are no longer the problems they once were in most of Asia 50 years ago (Cummings, Rashid, and Gulati 2006) although food price instability remains a thorny political problem.

Given that governments in eastern and southern Africa are likely to continue intervening in food markets, the findings in this suggest that promoting more *rules based* approaches to marketing and trade policy may reduce the level of policy uncertainty and the price instability associated with it (Barro and Gordon 1983; Just 1985; Myers 1992; Taylor 1993). Concretely, this means a movement toward more rules-based interventions, for example: setting clear guidelines for when changes in tariff rates or trade barriers will be instituted, the conditions triggering stock releases, the price levels at which state stocks will be sold, the type of marketing agents eligible to buy state stocks, the conditions leading to restrictions on cross-border trade, clear regulatory guidance on phytosanitary standards, and border crossing documentation, to name a few.

Predictable and transparent rules governing state involvement in the markets would reduce market risks and enable greater coordination between private and public decisions in the market. For the most part, addressing problems of policy uncertainty involves very little cost *per se.* But it does require greater coordination and more efficient management of government operations. However, policy makers may feel that rules-based and non-discretionary marketing and trade policies entail a loss of control and autonomy – leaders would be bound to act according to pre-defined rules and guidelines. Successfully addressing these dilemmas may lie at the heart of efforts to move to a new post-liberalization system in which governments retain the ability to influence prices to achieve national food security objectives, but within a clear and transparent framework of credible commitment to support long-run private investment in the development of markets.

APPENDICES

Table A1. Zambia: Key Maize Marketing and Trade Policy Implementation, 1990 – 2007

1991/92	• Economic Structural Adjustment Program initiated 1991. Donors provide balance of payments support for fertilizer importation. Private trade legalized. • National Agricultural Marketing Board (NAMBOARD) abolished in 1990, but fertilizer and credit marketing functions transferred to other state agencies (Nitrogen Chemicals Zambia (NCZ), Credit Union and Savings Association of Zambia (CUSA), LIMA Bank and Zambia Cooperative Federation (ZCF) using a network of state-affiliated cooperatives).
1992/93	• Government removes import and export restrictions and liberalizes foreign exchange market. • Maize meal subsidies reduced in late 1991. However, severe drought delays maize market reform. • Government sets floor price, into-mill, and consumer price of maize.
1993/94	• Government appoints rural banks and co-ops as buying agents for maize. • Government unable to maintain maize floor price. • Late arrival of food aid from prior year disrupts maize market. • Sharply appreciating Kwacha discourages maize exports. • Escalating interest rates dampen private sector interest in buying and storing maize.
1994/95	• Government announces total decontrol of maize producer prices and elimination of transport subsidies. But they also refer to pending floor prices. • Value added Tax (VAT) introduced and maize and maize meal classified as *exempt*. • Politicians announce into-mill prices to allay consumer fears. • Government states its intention to end buying agent system. Nevertheless, they continue to provide credit to cooperatives and rural financial institutions to help collect loans from farmers. • Privatization of state-owned milling companies.
1995/96	• First season where government refrains from announcing any prices and private sector plays dominant role in input and commodity marketing. • Real maize prices begin to rise. Government imposes an export ban on maize grain and maize meal. • Maize and maize meal VAT changed from *exempt rating* to *zero-rated*. • Government begins leasing many storage warehouses to private traders and transporters. • Formulation of the Agricultural Sector Investment Program (ASIP), a tool for implementing the government policy of maize market liberalization and market reform, 1994. • Food Reserve Agency (FRA) established to manage the national food reserve.
1997/08	• Food Reserve Agency takes over maize input distribution on credit to smallholders. • Donors cease financing of fertilizer imports. • Pan-territorial pricing re-introduced for FRA-distributed fertilizer; makes private sector fertilizer uncompetitive in outlying areas. • Maize imported by government and sold to selected millers at $160 per ton, 30% below prevailing market prices.
2001/02	• July 2001 food balance sheet estimates 200,000 tons import requirement for maize. Import requirements are revised upward to 400,000 MT. by some government statements. • August 2001 government of Zambia (GRZ) announces intention to arrange import of 200,000 MT maize at subsidized prices. GRZ tenders to select importers, maize to be delivered October 2001 through April 2002. • Private traders do not import, despite high domestic prices, because of fear of being undercut by subsidized government imports. • Maize and maize meal VAT is zero-rated, but export permits are not issued, effectively banning legal private export of maize. • Government financing of imports is delayed. Starting November 2001, food shortages emerge and prices rise well above Cost, Insurance and Freight (CIF) price level. • Most government imports of maize did not arrive until December 2001 and January 2002 because of financing difficulties. CIF price reach $220 to $260, far above import parity. • By May 2002, only 130,000 had been imported under government program. • Sales at subsidized price of $160 per ton into mills. Selected millers receive subsidy of $70 to $100 per ton of maize purchased. • Government proposes the Crop Marketing Authority (CMA) as a semi-autonomous body corporate, a buyer of last resort whose main preoccupation is to stabilize prices and create markets in remote areas while procuring and selling at market prices and remaining self-sustaining.

2002/03	• Millers' purchases of maize from the 2002 maize harvest are depressed by the availability of subsidized imported maize from the preceding drought year. • Government pressure on the millers to keep the maize meal price low constrains demand for locally produced maize, which is available at relatively high prices due to poor harvest season. • The food balance sheet estimated that the 2002 harvest would lead to a food deficit of 600,000 tons. Consequently, an abnormally early price increase was observed in June 2002. Traders began to buy up maize in anticipation of further price increases based on the experiences of the 2001/2002 marketing season. • Government entered into a *Memorandum of Understanding* with the millers to import 300,000 MT, government to import 180,000 MT as food relief and 120,000 MT as reserves. • The flow of imports were, however, slow because of a ban on genetically modified organism (GMO) maize. Relief operators had to revisit their pipeline in order to supply non-GMO maize.
2003/04	• Relatively good maize harvest. Maize and maize meal zero rated for VAT purposes. • Government imports in response to the 2002 harvest were late in arriving, some only arriving as the 2003 harvest was being offered for sale. Several thousand tons of maize imports costing as much as US$ 270/T were arriving in Zambia as farmers were offering their new crop at prices below US$ 180/T. This scenario fueled *mutual mistrust between government and private sector in the maize market.* • Export permits not issued, effectively banning maize exports. • Government legislation gives powers to local authorities to introduce local taxes. Inter-district grain levies put in place. In some districts, taxes on maize amount to roughly 10% of the price received by farmers for maize. These taxes indirectly impede the profitability of commercialized production.
2004	• Maize and maize meal VAT status changes to *exempt.* • Government raises maize import duty to 15%. • Ministry of Agriculture and Cooperatives (MACO) sets up task force to provide planning guidelines for the establishment of the proposed Crop Marketing Authority (CMA). • Millers lobbied for a lifting on the export ban on maize, in order to maintain demand and remunerative producer prices for maize farmers. • Government issues export permits to selected trading/milling firms. • Ministry of Agriculture and the Zambian National Farmers' Union request that an Agricultural Marketing Development Plan be drawn to structure MACO's agricultural marketing policies and programs.
2005	• National Food Balance Sheet presented to government showing an import requirement of 85,000 MT, but private sector estimates are 150,000 tons. • Millers request import permits from MACO and duty waiver from Ministry of Finance and National Planning (MFNP). • In September, MACO announces a temporary waiver of import duty and issues import permits for 150,000 tons to millers and 50,000 tons to FRA. FRA purchases 120,000 MT from domestic market at above market prices in deficit year. • MFNP refuses to waive the import duty. • After heavy lobbying by all the stakeholders, MFNP agrees in late October to waive duty; MACO issues import permits. • Millers begin to contract for imports. • FRA releases 50,000 tons of maize at $210/ton in December, undercutting importers (CIF import price stands at $266-287). • MACO advised private sector to stop importing because they are failing to comply with new phytosanitary regulations. • President Mwanawasa declares a national disaster at the request of Parliament. • MT. Makulu issues phytosanitary clearance; permits imports to resume after a four-week delay. • President Mwanawasa announces that millers should lower maize prices significantly due to the abrupt strengthening of the Kwacha (up 26% in two weeks). Stakeholders meet with MACO to discuss the maize situation. • Import duty waiver extended to 31 March.

2006	• Good harvest. FRA instructed to purchase 386,000 tons of maize at $190 per ton to support maize prices. • FRA price attracted maize from Mozambique and Tanzania supplied by traders. • FRA allocated ZK150 billion and borrowed ZK150 billion but prospects of selling at a loss puts doubt on ability to repay the loan independent of subventions from the Treasury. • Government restricts export permits to traders and provides FRA with *de facto* monopoly on the export of maize; some traders and farmers allowed to use FRA export permit later in the season. • FRA has difficulty selling the maize in local markets due to good harvest and because of the above-market prices at which they purchased. • Maize stock monitoring committee put in place to report on stocks monthly. MACO's rationale is to guarantee national reserves before issuing export permit and to supply maize meal at affordable prices.
2007	• 250,000 tons FRA carryover stock largest in FRA history. • FRA sought government approval to dispose of its old stock below the breakeven price by exporting to Zimbabwe at a loss. • FRA targets to purchase record crop of 400,000 tons by increased depots to 620 in 62 districts – 10 satellite depots per district and 62 holding depots. • Target for strategic reserves revised from 80,000 tons to 200,000 tons. • FRA to pay ZK39000 per 50 kg bag and continues to attract maize from Tanzania and Mozambique. • Minister of Agriculture and Cooperative issues statement to begin allocation of export quotas to associations: Millers Association of Zambia (MAZ), Zambia National Farmers Union (ZNFU), and Grain Traders Association of Zambia (GTAZ) only. • FRA issued with export permit for 226,000, MAZ issued with 50,000, GTAZ got permit for 50,000, and ZNFU had permit for 50,000 tons and there is a balance of 50,000 not issued. • ZNFU not ready to use 2006/07 allocation; keep extending the permit. Millers and traders quick to utilize their allocation.

2008	• May 2008 food balance sheet showed a small surplus over national consumption requirements.
	• Stakeholders doubted the food balance sheet estimates arguing that demand side was underestimated.
	• FRA announced a buying price of 45,000 kwacha/ton (roughly US$ 260/ton). No export permits issued essentially banning private exportation.
	• Because of nervousness in the markets related to high world food prices, private millers and traders started the 2008 season by aggressively buying maize at prices higher than the FRA floor price.
	• The FRA countered by raising its buying price to 55,000 kwacha (US$304) per ton in an attempt to procure its target supplies.
	• Aggressive attempts by both private traders and the government pushed prices up quickly after the 2008 harvest.
	• In June of 2008, the Grain Traders Association of Zambia informed the Ministry of Agriculture that roughly 200,000 tons of maize would be required to fill residual consumption requirements in early 2009.
	• In July/August, government refused to sign Memorandum of Understanding (MoU) with GTAZ assuring them that the government would not import and sell gain to millers at subsidized prices.
	• In September, FSRP policy synthesis advising government how to respond was essentially ignored.
	• By November, neither the government nor the private sector had arranged to import maize. Food shortages emerge and the maize price surface quickly rose beyond import parity from South Africa.
	• As of December 2008:
	  o Retail maize prices were in the range of US$350 to US$400 per ton compared to US$176 per ton on the South Africa Futures Exchange (SAFEX) exchange.
	  o The government concluded that indeed imports would be necessary and contracted for over 100,000 tons of maize to be imported from South Africa revised downwards to 35,000 MT after stock audit.
	  o GRZ started subsidizing the price of maize paid by selected millers below market levels and then requiring millers to pass along lower maize meal prices to consumers.
	  o Maize grain and maize meal prices remained high.
	• In January, the maize imported by a private contractor was discovered to be GMO maize and rejected by FRA.
	• In February 2009, traders were able to sell 40,000 of the 55,000 metric tons to FRA at US$409.05 after protracted negotiations.
	• In March:
	  o Government announced the intent to discontinue subsidies to millers at the end of March 2009 as they were not effective enough in reducing consumer mealie meal prices.
	  o As a result, millers announced that breakfast meal prices were to increase by 10,000 Kwacha if subsidies were ended.
	  o FRA announces the sale of subsidized 2,500 MT to feed stock industry to cushion rising feed prices.

Sources: Howard and Mungoma 1997; Govereh, Jayne, and Chapoto 2008; Jayne et al. 2009.

Table A2. Malawi: Key Maize Marketing and Trade Policy Implementation, 1964 to 2007

1964-1980	• Maize marketed via the state agency, ADMARC. • Pan-territorial and pan–seasonal pricing in force. • State run credit schemes to support maize production by smallholder farmers. • Huge subsidies on production inputs with guaranteed market through ADMARC. • Import and exports licensing in force.
1981-1986	• Commencement of structural adjustment programs with support from development agencies. The program included annual adjustments of in smallholder producer prices, annual increases in interest rates, and periodic devaluation of the Malawian Kwacha.
1987-1988	• Liberalization of smallholder agricultural produce marketing. • Reduction of fertilizer subsidizes.
1989-1990	• Reduction in the scope of export licensing in 1989, except for maize.
1991	• Liberalization of agricultural input markets resulting in removal fertilizer subsidizes.
1994	• Easing of foreign exchange restrictions. Flotation of Malawian Kwacha.
1995	• Liberalization of agricultural producer prices, except for maize.
1996	• Introduction of a producer price band for maize.
1997	• Removal of all import and export-licensing requirement, except for maize. • Introduction of 'starter pack' free input distribution for food insecure households to improve maize production.
1998	• Devaluation of the Malawian Kwacha. • Introduction of the Agricultural Productivity Improvement Programme providing inputs on credit to targeted smallholder maize farmers.
2000-2002	• Elimination of the price band for maize. • Implementation of the targeted input Programme mainly for smallholder maize farmers. • Export of maize by the National Food Reserve Agency, contributing to a national food crisis of 2001.
2003-2004	• Reduction of ADMARC budget resulting in failure to purchase agricultural produce from smallholder farmers. • Government announced reform of ADMARC leading to creation of two companies: one commercial division and one responsible to carry out social functions.
2006-2007	• Introduction of targeted input subsidizes on fertilizers and improved maize seeds through a voucher system. • Maize purchase and sale price setting by government enforced by ADMARC. • ADMARC failed to defend the price policy.
2007-08	• Government of Malawi arranges for 400,000 MT of grain exports in view of official estimates indicating major maize surplus. The export program was able to procure only 238,000 tons and market prices soared over $300 per ton within 3 months after the buying campaign started, indicating that the national surplus was less than official estimates predicted. • Private trade banned without licenses, which were not given.
2008-09	• Government bans private maize trade in August 2008, then announces in September 2008 that private trade may take place within the price band of 45-52 kwacha/kg, considerably outside the range of market prices for much of this season. • Import permits not granted for several firms seeking to import from South Africa when maize prices exceeded $500 per ton in late 2008/early 2009.

Source: Chirwa 2007; Jayne and Tschirley 2009

Table A3. Tanzania: Key Maize Marketing and Trade Policy Implementation, 1962 - 2007

1962-1980	• This period was characterized by centralized maize marketing via a parastatal, NMC. Traders and consumers had to purchase maize grain or flour directly from NMC. • Inter-regional maize trade was restricted with cooperatives (reintroduced in 1984) acting as the sole official channel for purchasing crops from farmers.
1987-1988	• The policy of official producer price was abandoned in favor of a policy of indicative minimum prices to be paid by the cooperatives and the primary societies to producers. • Establishment of the National Strategic Reserve (SGR) with the mandate of maintaining the strategic reserves during bad and good seasons. • Government refrained from setting prices. • Supported by major development partners, the government started to implement economic and structural adjustment program. • Private traders were allowed to take a leading role in most agricultural commodities including maize. • NMC was no longer obliged to buy all the grain offered by the cooperatives.
1994-	• Direct purchases from farmers were legalized. • Private sector input supply. • Private traders allowed to trade grains. • Crop boards were dismantled with the private sector taking up the role of supplying agriculture inputs.
1996	• Government lifted the ban on grain export.
1999	• Re-establishment of the new East African Community expanding the trade area of maize grain and other food products. • Export ban was lifted to allow export of maize.
2000	• The marketing function was shifted from the Ministry of Agriculture to the new Ministry of Cooperatives and Marketing.
2003	• Minister of Agriculture and Food Security imposed an export ban by withdrawing all maize export permits given to traders and suspending the issuance of new permits.
2006	• Export ban lifted in January 2006 to allow maize exports for a month. • Export ban re-imposed due to food shortage in the country.

Table A4. Kenya: Key Maize Marketing and Trade Policy Implementation, 1998 to Current

1998	• Cereal Sector Reform Program (CSRP) envisages widening of National Cereals and Produce Board (NCPB) price margin. In fact, margin narrows. Proportion of grain that millers are obliged to buy from NCPB declines. Limited unlicensed maize trade allowed. • NCPB financially restructured. Phased closure of NCPB depots. NCPB debts written-off; crop purchase fund established but not replenished.
1991	• Further relaxation of inter-district trade.
1992	• Restrictions on maize trade across districts re-imposed. NCPB unable to defend ceiling prices.
1993	• Maize meal prices deregulated. Import tariff abolished.
1995	• Full liberalization of internal maize and maize meal trade; maize import tariff re-imposed to 30%. • NCPB restricted to limited buyer and seller of last resort role. NCPB market share declines to 10-20% of marketed maize trade. NCPB operations confined mainly to high-potential areas of western Kenya.
1996	• Export ban imposed after poor harvest.
1997	• Import tariff imposed after poor harvest.
1997-2004	• External trade and tariff rate levels change frequently and become difficult to predict. NCPB producer prices normally set above import parity levels. • NCPB provided with funds to purchase a greater volume of maize. NCPB's share of total maize trade rises to 25-35% of total marketed maize.
2005 - onwards	• The government withdraws the maize import tariff from maize entering Kenya from EAC member countries. An official 2.75% duty is still assessed. Import duty of 35% still assessed on maize entering through Mombasa port.

Source: Ariga and Jayne 2007

Table A5. Unit Root Tests Results by Country and Selected Market

	Constant 2007 maize prices by country and market	-----Dickey Fuller Test------			-----Phillip Perron Test-------			KPSS Test for Stationary (at 5% level of Significance)
		Z(t) Statistic	p-value for Z(t)	Stationary or non-stationary at 10% level of Sig.	Z(t) Statistic	p-value for Z(t)	Stationary or non-stationary at 10% level of Sig.	
		(A)	(B)	(C)	(D)	(E)	(F)	(G)
Zambia	Lusaka	-3.365	0.0122	Stationary	-3.761	0.0033	Stationary	Stationary
	Choma	-3.358	0.0125	Stationary	3.942	0.0017	Stationary	Stationary
	Ndola	-3.620	0.0054	Stationary	-4.087	0.0010	Stationary	Stationary
Malawi	Lilongwe	-3.037	0.0315	Stationary	-3.062	0.0295	Stationary	Stationary
	Blantyre	-2.901	0.0453	Stationary	-3.358	0.0125	Stationary	Stationary
	Karonga	-2.408	0.1395	Non-Stationary	-2.314	0.1675	Non-Stationary	Stationary
Tanzania	Dar es salaam	-3.667	0.0046	Stationary	-4.142	0.0008	Stationary	Stationary
	Mbeya	-3.424	0.0102	Stationary	-4.106	0.0009	Stationary	Stationary
	Arusha	-3.762	0.0033	Stationary	-4.137	0.0008	Stationary	Stationary
Ethiopia	Addis Ababa	-2.745	0.0666	Stationary	-3.168	0.0219	Stationary	Stationary
	Sheshamane	-3.125	0.0248	Stationary	-3.702	0.0041	Stationary	Stationary
	Nemkept	-2.813	0.0565	Stationary	-3.185	0.0209	Stationary	Stationary
	Jimma	-2.712	0.0719	Stationary	-3.309	0.0145	Stationary	Stationary
Kenya	Nairobi	-2.202	0.2054	Non-Stationary	-2.489	0.1181	Non-Stationary	Stationary
	Nakuru	-2.713	0.0718	Stationary	-3.137	0.0239	Stationary	Stationary
	Mombasa	-3.359	0.0125	Stationary	-3.358	0.0125	Stationary	Stationary
Mozambique	Maputo	-3.109	0.0259	Stationary	-3.760	0.0033	Stationary	Stationary
	Nampula	-3.631	0.0052	Stationary	-4.165	0.0008	Stationary	Stationary
	Beira	-2.729	0.0692	Stationary	-3.738	0.0036	Stationary	Stationary
South Africa	Randfontein	-2.229	0.1958	Non-Stationary	-2.729	0.0691	Stationary	Stationary
Uganda	Kampala	-3.254	0.0171	Non-Stationary	-3.247	0.0174	Stationary	Stationary
	Mbale	-3.520	0.0075	Stationary	-3.553	0.0067	Stationary	Stationary

Notes: Phillip Perron uses Newey-West standard errors to account for serial correlation, whereas the augmented Dickey-Fuller test uses additional lags of the first-difference variable.

Table A6. ARCH Effects Test Results by Country and Market, January 1994 – December 2008

	Country/Market	Lags(p)	chi2	df	Prob > chi2	Presence of Arch Effects at			
						1%	5%	10%	15%
						----------Level of significance-------			
Mozambique	Maputo	1	0.347	1	0.5559	No	No	No	No
	Nampula	1	16.129	1	0.0001	Yes	Yes	Yes	Yes
	Beira	1	4.134	1	0.0420	No	Yes	Yes	Yes
Uganda	Kampala	1	1.120	1	0.2898	No	No	No	No
	Mbale	1	5.811	1	0.0159	No	Yes	Yes	Yes
South Africa	Randfontein	1	16.590	1	0.0000	Yes	Yes	Yes	Yes
Kenya	Nairobi	1	0.0042	1	0.8369	No	No	No	No
	Nakuru	1	10.879	1	0.0010	Yes	Yes	Yes	Yes
	Mombasa	1	5.426	1	0.0198	No	Yes	Yes	Yes
Ethiopia	Addis Ababa	1	4.882	1	0.0271	No	Yes	Yes	Yes
	Sheshamane	1	0.002	1	0.9612	No	No	No	No
	Nemkept	1	0.340	1	0.5598	No	No	No	No
	Jimma	1	0.256	1	0.6129	No	No	No	No
Zambia	Lusaka	1	4.212	1	0.0401	No	Yes	Yes	Yes
	Choma	1	2.560	1	0.1096	No	No	Yes	Yes
	Ndola	1	5.753	1	0.0165	No	Yes	Yes	Yes
Malawi	Lilongwe	1	2.446	1	0.1178	No	No	No	Yes
	Blantyre	1	0.067	1	0.7959	No	No	No	No
	Karong	1	2.722	1	0.0990	No	No	Yes	Yes
Tanzania	Dar es salaam	1	0.035	1	0.8506	No	No	No	No
	Mbeya	1	0.121	1	0.7285	No	No	No	No
	Arusha	1	2.042	1	0.1430	No	No	No	Yes

Notes: The null hypothesis tested is that there are no ARCH effects.

Table A7. Seasonal Price Features for Real Maize Grain Prices, Choma, Zambia

Year	Maize Marketing Season ('000 Real Kwacha, cpi 2007=1)												Seasonal price features				
	May	June	July	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	12 month low	12 month high	Year Avg.	No. of months low-high	Ratio of high/low months
1994/95	770	629	674	655	645	806	947	1,050	1,331	1,395	1,378	1,185	629	1,395	955	8	(2.22)
1995/96	1,019	1,058	1,111	1,301	1,480	1,466	2,007	2,183	2,451	2,300	2,465	1,162	1,019	2,465	1,667	10	(2.42)
1996/97	763	590	573	599	633	601	583	618	613	638	677	629	573	763	626	-2	(1.33)
1997/98	479	470	481	508	734	861	1,020	1,241	1,606	1,514	1,395	963	470	1,606	939	7	(3.42)
1998/99	887	1,118	1,198	1,269	1,597	1,583	1,585	1,520	1,488	1,477	1,400	1,018	887	1,597	1,345	4	(1.80)
1999/00	1,031	911	836	648	450	443	655	571	1,463	1,176	1,356	1,014	443	1,463	879	3	(3.30)
2000/01	935	808	671	782	697	774	756	733	649	763	880	1,019	649	1,019	789	3	(1.57)
2001/02	1,051	1,077	1,078	1,083	1,084	1,241	1,383	1,504	2,213	2,147	1,586	1,080	1,051	2,213	1,377	8	(2.11)
2002/03	554	777	994	1,203	1,405	1,596	1,748	1,871	1,715	1,575	1,454	1,408	554	1,871	1,358	7	(3.38)
2003/04	754	1,017	803	891	840	686	668	645	618	599	579	566	566	1,017	722	10	(1.80)
2004/05	481	539	599	659	611	654	686	847	846	819	820	703	481	847	688	7	(1.76)
2005/06	903	726	788	848	888	976	1,029	1,013	1,044	1,062	971	593	593	1,062	904	-2	(1.79)
2006/07	454	442	466	453	492	530	537	557	551	590	526	471	442	590	506	8	(1.33)
2007/08	413	436	496	556	619	555	541	596	651	893	705	526	413	893	582	9	(2.16)
Avg. for month	**750**	**757**	**769**	**818**	**870**	**912**	**1,010**	**1,068**	**1,231**	**1,211**	**1,157**	**881**	**750**	**1,231**	**953**	**8**	**(2.17)**

Table A8. Seasonal Price Features for Real Maize Grain Prices, Ndola, Zambia

Year	----------Maize Marketing Season ('000 Real Kwacha, cpi 2007=1)----------												----------Seasonal price features----------				
	May	June	July	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	12 month low	12 month high	Year Avg.	No. of months low-high	Ratio of high/low months
1994/95	1,260	1,248	1,177	1,115	1,123	1,117	1,163	1,229	1,734	1,632	1,556	1,475	1,115	1,734	1,319	5	(1.56)
1995/96	1,402	1,225	1,213	1,160	1,205	1,419	1,501	1,875	1,730	2,001	2,470	2,029	1,160	2,470	1,602	7	(2.13)
1996/97	1,030	1,039	886	873	1,014	927	1,100	1,138	1,157	1,120	1,144	1,049	873	1,157	1,040	5	(1.32)
1997/98	962	875	817	988	1,069	1,351	1,330	1,408	1,521	1,532	1,565	1,638	817	1,638	1,255	9	(2.00)
1998/99	1,303	1,047	1,167	1,531	1,858	1,906	1,969	1,947	1,961	2,001	1,767	1,558	1,047	2,001	1,668	8	(1.91)
1999/00	1,340	1,122	907	501	533	697	856	649	1,637	1,479	2,070	1,408	501	2,070	1,100	7	(4.13)
2000/01	1,211	873	839	879	920	951	980	1,126	1,137	1,147	1,169	1,026	839	1,211	1,021	-2	(1.44)
2001/02	889	741	578	761	934	1,097	1,339	1,220	1,068	1,028	920	859	578	1,339	953	4	(2.32)
2002/03	781	933	1,081	1,222	1,359	1,487	1,581	1,651	1,750	1,855	1,874	1,270	781	1,874	1,404	10	(2.40)
2003/04	664	700	735	802	860	918	973	1,017	1,060	1,116	1,167	1,005	664	1,167	918	10	(1.76)
2004/05	538	610	646	682	686	668	654	764	838	871	869	753	538	871	715	9	(1.62)
2005/06	626	689	716	838	862	943	1,044	1,091	1,140	1,141	1,343	851	626	1,343	940	10	(2.15)
2006/07	656	475	515	549	699	707	721	729	665	655	745	846	475	846	663	10	(1.78)
2007/08	738	638	636	634	632	705	722	713	743	796	804	818	632	818	715	7	(1.30)
Avg. for month	**957**	**872**	**851**	**895**	**982**	**1,064**	**1,138**	**1,183**	**1,296**	**1,312**	**1,390**	**1,185**	**851**	**1,390**	**1,094**	**8**	**(1.99)**

Table A9. Seasonal Price Features for Real Maize Grain Prices, Blantyre, Malawi

Year	----------Maize Marketing Season ('000 Real Malawian Kwacha, cpi 2007=1)----------												----------Seasonal price features----------				
	May	June	July	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	12 month low	12 month high	Year Avg.	No. of months low-high	Ratio of high/low months
1994/95	10,998	12,640	12,472	16,274	17,034	18,121	14,996	22,273	24,654	23,646	19,723	17,361	10,998	24,654	17,516	8	(2.24)
1995/96	13,252	15,267	20,031	21,051	17,874	8,547	21,341	22,334	24,654	20,632	23,486	15,441	8,547	24,654	18,659	3	(2.88)
1996/97	10,770	11,678	13,430	15,228	18,998	17,693	16,710	17,669	17,689	23,113	23,113	18,608	10,770	23,113	17,058	9	(2.15)
1997/98	18,021	21,757	18,614	24,346	31,791	33,867	47,274	45,727	50,821	58,834	38,046	27,232	18,021	58,834	34,694	9	(3.26)
1998/99	30,874	25,542	31,845	35,081	38,123	46,205	46,405	48,337	45,644	40,479	37,241	24,719	24,719	48,337	37,541	-4	(1.96)
1999/00	18,718	21,622	25,520	28,388	26,620	28,547	30,878	34,428	30,582	25,434	23,019	18,747	18,718	34,428	26,042	7	(1.84)
2000/01	11,488	12,220	12,702	14,372	12,981	17,210	18,356	17,690	16,006	15,927	18,908	18,026	11,488	18,908	15,490	10	(1.65)
2001/02	15,641	18,344	25,239	33,826	37,896	42,186	41,969	46,254	63,467	64,033	43,761	27,849	15,641	64,033	38,372	9	(4.09)
2002/03	20,921	29,875	31,724	30,654	29,379	32,307	36,576	37,131	34,863	34,408	30,201	17,779	17,779	37,131	30,485	-4	(2.09)
2003/04	12,197	15,309	18,074	13,876	16,673	24,686	31,881	23,181	29,657	30,313	31,644	25,136	12,197	31,881	22,719	6	(2.61)
2004/05	19,752	22,895	23,887	26,912	27,190	24,444	22,880	28,869	24,931	24,898	18,759	19,884	18,759	28,869	23,775	3	(1.54)
2005/06	22,305	28,321	30,912	31,342	32,816	40,248	44,658	44,492	49,320	65,629	50,129	23,981	22,305	65,629	38,680	9	(2.94)
2006/07	18,144	21,317	23,119	23,256	21,560	23,865	23,457	25,746	34,446	36,230	16,272	13,233	13,233	36,230	23,387	-2	(2.74)
2007/08	9,303	10,386	16,499	17,204	16,588	24,326	38,414	46,090	47,471	44,191	31,027	29,452	9,303	47,471	27,579	8	(5.10)
Avg. for month	**16,599**	**19,084**	**21,719**	**23,701**	**24,680**	**27,304**	**31,128**	**32,873**	**35,300**	**36,269**	**28,952**	**21,246**	**16,599**	**36,269**	**26,571**	**9**	**(2.65)**

Table A10. Seasonal Price Features for Real Maize Grain Prices, Karonga, Malawi

Year	----------Maize Marketing Season ('000 Real Malawian Kwacha, cpi 2007=1)----------												----------Seasonal price features----------				
	May	June	July	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	12 month low	12 month high	Year Avg.	No. of months low-high	Ratio of high/low months
1994/95	12,950	13,724	11,207	12,250	15,087	12,421	11,280	12,105	11,206	10,646	9,451	9,245	9,245	15,087	11,798	-7	(1.63)
1995/96	7,704	7,870	17,874	16,120	14,176	13,806	13,637	15,590	14,998	15,247	15,766	16,998	7,704	17,874	14,149	2	(2.32)
1996/97	13,235	11,159	11,678	13,342	13,705	13,777	12,806	17,532	16,148	14,608	18,367	15,262	11,159	18,367	14,302	9	(1.65)
1997/98	14,088	14,053	12,882	14,176	18,750	22,902	24,839	23,715	24,654	27,736	36,589	18,939	12,882	36,589	21,110	8	(2.84)
1998/99	14,568	13,708	15,409	23,113	24,928	27,757	31,812	29,884	40,542	38,580	36,559	37,306	13,708	40,542	27,847	7	(2.96)
1999/00	23,681	20,689	18,674	18,128	17,225	16,122	16,927	15,790	13,481	12,503	12,579	13,431	12,503	23,681	16,603	-9	(1.89)
2000/01	11,750	9,915	10,719	10,030	10,918	10,563	10,915	11,029	9,744	10,312	10,935	11,236	9,744	11,750	10,672	-8	(1.21)
2001/02	11,781	13,685	15,419	24,988	30,937	29,878	37,929	45,996	53,006	46,961	45,096	29,047	11,781	53,006	32,060	8	(4.50)
2002/03	27,067	23,385	19,306	19,723	21,401	24,928	24,772	32,050	22,473	24,099	25,055	20,466	19,306	32,050	23,727	5	(1.66)
2003/04	19,480	18,207	20,206	19,990	18,965	18,965	18,491	20,084	19,150	18,715	18,715	28,692	18,207	28,692	19,972	10	(1.58)
2004/05	26,104	24,549	26,999	24,253	37,647	22,833	23,746	24,296	23,245	21,115	22,445	22,189	21,115	37,647	24,952	-5	(1.78)
2005/06	22,630	25,751	30,678	25,789	24,713	36,104	39,239	37,638	35,751	36,903	56,325	38,370	22,630	56,325	34,158	10	(2.49)
2006/07	22,237	23,232	24,701	24,603	25,847	23,062	26,415	26,776	28,157	22,825	22,704	16,076	16,076	28,157	23,886	-3	(1.75)
2007/08	17,005	20,617	20,123	23,117	22,968	28,694	32,021	32,848	35,704	45,040	49,439	28,129	17,005	49,439	29,642	10	(2.91)
Avg. for month	**17,449**	**17,182**	**18,277**	**19,259**	**21,233**	**21,558**	**23,202**	**24,667**	**24,876**	**24,663**	**27,145**	**21,813**	**17,182**	**27,145**	**21,777**	**9**	**(2.23)**

Table A11. Seasonal Price Features for Real Maize Grain Prices, Nampula, Mozambique

Year	----------Maize Marketing Season ('000 Metical Kwacha, cpi 2007=1)----------												----------Seasonal price features----------				
	May	June	July	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	12 month low	12 month high	Year Avg.	No. of months low-high	Ratio of high/low months
1994/95	3,048	3,043	3,182	3,728	4,884	7,580	7,205	6,637	9,005	7,441	7,860	6,784	3,043	9,005	5,866	7	(2.96)
1995/96	6,473	6,379	6,151	6,799	8,450	8,407	9,904	9,410	13,077	15,115	10,137	4,795	4,795	15,115	8,758	-2	(3.15)
1996/97	4,308	3,877	4,136	4,024	4,104	3,880	3,858	4,527	4,880	6,365	4,859	3,902	3,858	6,365	4,393	3	(1.65)
1997/98	3,109	2,744	3,454	4,137	4,988	5,347	6,738	8,096	8,786	6,785	5,258	3,518	2,744	8,786	5,247	7	(3.20)
1998/99	3,352	3,569	5,034	5,443	6,940	6,510	6,510	6,503	7,374	7,209	4,728	2,600	2,600	7,374	5,481	-3	(2.84)
1999/00	2,748	2,506	2,792	3,637	3,907	3,731	4,295	5,139	5,526	5,001	4,659	2,759	2,506	5,526	3,892	7	(2.21)
2000/01	2,725	2,172	2,381	3,018	3,221	3,289	3,600	3,563	3,568	4,493	5,348	3,019	2,172	5,348	3,367	9	(2.46)
2001/02	2,524	3,126	4,145	4,664	5,527	5,719	7,229	6,908	8,682	9,910	8,688	4,020	2,524	9,910	5,928	9	(3.93)
2002/03	3,438	4,165	5,102	5,515	5,618	5,791	5,626	6,205	6,905	6,567	4,867	3,956	3,438	6,905	5,313	8	(2.01)
2003/04	3,386	3,906	4,636	4,095	4,901	4,709	4,711	4,500	5,540	5,674	5,804	4,736	3,386	5,804	4,717	10	(1.71)
2004/05	3,475	3,282	3,282	3,337	3,720	4,361	4,159	4,429	4,786	4,744	4,451	3,509	3,282	4,786	3,961	7	(1.46)
2005/06	3,696	3,598	3,642	5,699	6,075	6,732	9,042	9,804	8,967	9,882	9,522	3,156	3,156	9,882	6,651	-2	(3.13)
2006/07	3,018	3,927	4,447	4,313	4,905	4,805	4,758	5,057	5,137	5,027	4,816	4,049	3,018	5,137	4,522	8	(1.70)
2007/08	3,147	2,980	3,995	4,025	4,389	4,940	5,005	5,804	6,074	7,296	6,401	4,460	2,980	7,296	4,876	8	(2.45)
Avg. for month	**3,460**	**3,519**	**4,027**	**4,459**	**5,116**	**5,414**	**5,903**	**6,184**	**7,022**	**7,251**	**6,243**	**3,947**	**3,460**	**7,251**	**5,212**	**9**	**(2.49)**

Table A12. Seasonal Price Features for Real Maize Grain Prices, Beira, Mozambique

Year	----------Maize Marketing Season ('000 Real Metical, cpi 2007=1)----------												----------Seasonal price features----------				
	May	June	July	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	12 month low	12 month high	Year Avg.	No. of months low-high	Ratio of high/low months
1994/95	3,921	4,073	3,648	3,354	3,678	3,200	3,312	4,508	6,508	7,482	7,265	5,698	3,200	7,482	4,721	4	(2.34)
1995/96	3,919	4,542	4,156	4,543	3,754	4,209	6,297	8,775	8,069	9,043	7,899	6,791	3,754	9,043	6,000	5	(2.41)
1996/97	6,564	5,322	5,498	4,514	3,736	3,436	3,692	3,341	3,208	3,154	3,551	3,000	3,000	6,564	4,085	-11	(2.19)
1997/98	2,823	2,412	2,405	2,483	2,409	2,904	3,844	6,336	6,242	6,157	6,174	5,280	2,405	6,336	4,122	5	(2.63)
1998/99	3,772	3,769	3,573	3,876	4,813	5,953	5,713	6,828	7,753	9,005	8,030	5,826	3,573	9,005	5,742	7	(2.52)
1999/00	3,924	4,051	3,913	3,625	3,581	3,225	3,433	3,543	3,303	2,922	2,972	2,967	2,922	4,051	3,455	-8	(1.39)
2000/01	2,679	2,612	2,639	2,782	2,556	2,665	2,697	3,158	3,341	3,255	3,214	3,138	2,556	3,341	2,895	4	(1.31)
2001/02	2,838	2,711	3,985	5,106	6,556	7,146	8,330	9,681	10,362	10,758	9,432	6,299	2,711	10,758	6,934	8	(3.97)
2002/03	3,721	5,285	5,394	5,677	6,219	6,610	6,929	8,302	8,210	6,707	5,915	4,803	3,721	8,302	6,148	7	(2.23)
2003/04	3,957	3,779	3,796	4,589	4,956	5,128	5,388	6,606	6,835	6,866	7,179	4,939	3,779	7,179	5,335	9	(1.90)
2004/05	3,691	3,799	4,077	4,376	4,569	4,450	4,401	4,700	4,487	4,292	4,631	3,769	3,691	4,700	4,270	7	(1.27)
2005/06	3,568	3,886	4,627	5,208	6,509	7,445	8,199	9,675	10,606	10,128	9,903	5,828	3,568	10,606	7,132	8	(2.97)
2006/07	3,598	3,652	4,870	4,770	4,573	4,025	4,248	4,311	4,429	4,433	4,318	3,992	3,598	4,870	4,268	2	(1.35)
2007/08	3,579	3,512	4,220	4,127	4,703	5,891	8,106	7,752	7,475	7,258	6,322	4,941	3,512	8,106	5,657	5	(2.31)
Avg. for month	**3,754**	**3,815**	**4,057**	**4,216**	**4,472**	**4,735**	**5,328**	**6,251**	**6,488**	**6,533**	**6,200**	**4,805**	**3,754**	**6,533**	**5,055**	**9**	**(2.20)**

Table A13. Seasonal Price Features for Real Maize Grain Prices, Nakuru, Kenya

Year	----------Maize Marketing Season ('000 Real Kenya Shillings, cpi 2007=1)----------												----------Seasonal price features----------				
	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	12 month low	12 month high	Year Avg.	No. of months low-high	Ratio of high/low months
1994/95	18,502	20,884	17,580	17,227	18,021	17,580	18,907	18,065	18,128	17,546	17,633	16,153	16,153	20,884	18,019	-10	(1.29)
1995/96	14,710	11,752	12,399	13,346	13,639	14,656	16,957	16,594	18,832	20,754	25,511	22,163	11,752	25,511	16,776	8	(2.17)
1996/97	21,660	22,770	26,693	30,743	34,482	37,370	41,725	44,716	43,168	41,170	36,946	28,616	21,660	44,716	34,172	7	(2.06)
1997/98	23,077	22,261	22,163	27,752	30,008	23,881	23,778	22,728	22,534	22,505	21,933	21,467	21,467	30,008	23,674	-7	(1.40)
1998/99	18,153	14,000	15,278	17,677	18,572	19,713	25,828	27,550	29,128	29,043	22,364	25,390	14,000	29,128	21,891	7	(2.08)
1999/00	25,449	24,967	24,967	22,986	26,452	25,799	25,006	28,025	27,809	27,597	27,902	25,272	22,986	28,025	26,019	4	(1.22)
2000/01	21,062	19,898	18,632	19,898	19,425	16,545	17,014	14,943	14,686	14,686	14,555	10,280	10,280	21,062	16,802	-11	(2.05)
2001/02	9,617	9,247	8,877	8,877	8,877	9,247	12,429	12,501	12,573	12,573	14,473	14,709	8,877	14,709	11,167	9	(1.66)
2002/03	15,088	14,520	14,317	16,358	17,594	19,229	22,059	23,655	25,340	22,886	22,671	19,014	14,317	25,340	19,394	6	(1.77)
2003/04	16,534	15,111	18,229	20,445	22,439	22,822	22,697	19,320	22,228	21,385	19,375	19,483	15,111	22,822	20,006	4	(1.51)
2004/05	18,812	19,012	18,064	17,124	15,553	16,673	17,434	16,661	17,200	15,002	17,575	16,690	15,002	19,012	17,150	-8	(1.27)
2005/06	16,082	16,474	15,994	15,671	13,723	15,244	17,424	19,190	19,543	18,172	16,665	15,170	13,723	19,543	16,613	4	(1.42)
2006/07	13,939	12,424	10,949	11,100	12,951	13,153	13,621	13,221	13,273	12,855	13,306	13,760	10,949	13,939	12,879	-2	(1.27)
2007/08	13,156	12,763	12,461	12,232	12,513	14,553	16,986	16,429	15,686	17,028	21,037	19,810	12,232	21,037	15,388	7	(1.72)
Avg. for month	**17,560**	**16,863**	**16,900**	**17,960**	**18,875**	**19,033**	**20,848**	**20,971**	**21,438**	**20,943**	**20,853**	**19,141**	**16,863**	**21,438**	**19,282**	**7**	**(1.64)**

Table A14. Seasonal Price Features for Real Maize Grain Prices, Mombasa, Kenya

Year	----------Maize Marketing Season ('000 Real Kenya Shillings, cpi 2007=1)----------												----------Seasonal price features----------				
	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	12 month low	12 month high	Year Avg.	No. of months low-high	Ratio of high/low months
1994/95	29,631	30,924	28,933	29,050	28,391	25,924	24,912	23,622	24,608	24,293	23,583	23,073	23,073	30,924	26,412	-10	(1.34)
1995/96	24,203	24,999	23,197	21,535	21,187	22,578	24,646	29,223	29,896	31,149	32,366	33,608	21,187	33,608	26,549	7	(1.59)
1996/97	34,813	35,943	37,063	38,582	39,288	35,723	34,405	33,751	35,228	35,826	26,700	29,303	26,700	39,288	34,719	-6	(1.47)
1997/98	28,999	29,448	31,318	29,746	29,432	24,622	21,400	22,089	22,299	22,857	23,333	23,007	21,400	31,318	25,712	-4	(1.46)
1998/99	23,333	21,000	20,615	27,753	28,690	28,375	33,016	32,069	38,048	29,576	28,945	29,939	20,615	38,048	28,447	6	(1.85)
1999/00	31,597	32,793	33,185	33,014	29,919	27,403	29,128	33,560	31,708	30,189	24,929	23,366	23,366	33,560	30,066	-4	(1.44)
2000/01	24,554	25,830	25,619	26,450	22,981	23,141	22,378	21,416	18,138	18,174	17,107	15,476	15,476	26,450	21,772	-8	(1.71)
2001/02	16,404	16,460	15,720	15,202	15,720	13,482	14,962	16,453	17,064	15,627	17,730	18,635	13,482	18,635	16,121	6	(1.38)
2002/03	19,399	18,592	20,689	20,662	19,270	21,296	21,569	21,475	24,043	24,418	21,465	21,230	18,592	24,418	21,176	8	(1.31)
2003/04	21,296	22,273	25,495	22,297	23,633	22,776	21,184	21,162	21,858	23,110	22,662	21,983	21,162	25,495	22,478	-5	(1.20)
2004/05	22,430	22,037	22,938	20,149	19,795	21,016	22,315	23,603	24,012	23,049	21,630	20,190	19,795	24,012	21,930	4	(1.21)
2005/06	19,124	20,726	17,493	17,426	17,730	19,100	20,499	22,357	22,064	18,780	15,089	15,358	15,089	22,357	18,812	-3	(1.48)
2006/07	15,374	13,745	12,833	11,743	11,911	12,180	13,621	13,288	13,484	13,793	13,174	14,100	11,743	15,374	13,270	-3	(1.31)
2007/08	14,031	14,040	16,777	15,683	16,244	16,646	18,866	19,236	18,131	18,218	16,984	17,459	14,031	19,236	16,859	7	(1.37)
Avg. for month	**23,228**	**23,486**	**23,705**	**23,521**	**23,156**	**22,447**	**23,064**	**23,807**	**24,327**	**23,504**	**21,835**	**21,909**	**21,835**	**24,327**	**23,166**	**-2**	**(1.44)**

Table A15. Seasonal Price Features for Real Maize Grain Prices, Mbeya, Tanzania

Year	----------Maize Marketing Season ('000 Real Tanzania Shillings, cpi 2007=1)----------												----------Seasonal price features----------				
	May	June	July	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	12 month low	12 month high	Year Avg.	No. of months low-high	Ratio of high/low months
1994/95	215	181	176	180	181	185	209	210	208	190	203	190	176	215	194	-2	(1.22)
1995/96	165	157	141	124	137	152	155	175	188	172	198	215	124	215	165	8	(1.74)
1996/97	188	157	112	121	133	141	143	136	126	133	154	183	112	188	144	-2	(1.68)
1997/98	159	150	141	165	164	165	169	171	170	157	147	143	141	171	159	5	(1.21)
1998/99	123	110	126	146	170	169	189	244	268	251	260	212	110	268	189	7	(2.44)
1999/00	154	139	130	134	138	129	125	128	117	102	100	114	100	154	126	-10	(1.54)
2000/01	100	98	100	93	90	90	89	88	86	81	93	108	81	108	93	2	(1.34)
2001/02	123	141	156	172	188	202	214	222	233	248	251	210	123	251	197	10	(2.04)
2002/03	148	118	149	151	160	169	176	172	155	173	172	184	118	184	161	10	(1.56)
2003/04	135	134	151	158	152	165	169	197	209	232	256	208	134	256	180	9	(1.91)
2004/05	165	112	137	145	142	158	160	144	264	380	131	146	112	380	174	8	(3.38)
2005/06	113	160	158	150	153	183	189	250	288	345	359	313	113	359	222	10	(3.17)
2006/07	296	224	196	201	187	187	182	168	159	123	116	118	116	296	180	-10	(2.54)
2007/08	107	107	127	157	170	154	195	204	261	279	277	252	107	279	191	8	(2.62)
Avg. for month	**156**	**142**	**143**	**150**	**155**	**161**	**169**	**179**	**195**	**205**	**194**	**186**	**142**	**205**	**170**	**8**	**(2.03)**

Table A16. Seasonal Price Features for Real Maize Grain Prices, Arusha, Tanzania

Year	----------Maize Marketing Season ('000 Real Tanzania Shillings, cpi 2007=1)----------												----------Seasonal price features----------				
	May	June	July	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	12 month low	12 month high	Year Avg.	No. of months low-high	Ratio of high/low months
1994/95	371	281	237	216	205	214	216	222	203	194	191	186	186	371	228	-11	(1.99)
1995/96	165	163	143	137	139	146	161	172	185	187	200	207	137	207	167	8	(1.51)
1996/97	181	166	146	143	147	153	189	209	219	215	217	221	143	221	184	8	(1.54)
1997/98	232	236	233	224	215	198	180	165	159	152	143	138	138	236	190	-10	(1.71)
1998/99	131	130	132	140	145	146	283	263	255	267	264	259	130	283	201	5	(2.18)
1999/00	288	312	212	197	175	172	196	183	169	169	165	162	162	312	200	-10	(1.92)
2000/01	191	213	199	190	183	185	191	194	187	181	171	173	171	213	188	-9	(1.25)
2001/02	150	114	108	106	108	105	113	152	191	183	183	188	105	191	142	3	(1.83)
2002/03	187	142	116	112	127	175	144	147	150	145	155	180	112	187	148	-3	(1.67)
2003/04	208	202	217	231	223	221	242	288	335	328	356	331	202	356	265	9	(1.76)
2004/05	247	232	219	235	238	230	227	228	211	207	218	229	207	247	227	-9	(1.19)
2005/06	254	263	219	204	204	200	209	252	303	331	359	386	200	386	265	6	(1.93)
2006/07	414	326	241	215	198	187	177	162	190	184	154	144	144	414	216	-11	(2.87)
2007/08	146	156	164	184	207	213	243	289	301	353	295	321	146	353	239	9	(2.42)
Avg. for month	**226**	**210**	**185**	**181**	**180**	**182**	**198**	**209**	**218**	**221**	**219**	**223**	**180**	**226**	**204**	**-4**	**(1.84)**

Table A17. Seasonal Price Features for Real Maize Grain Prices, Mbale, Uganda

Year	Maize Marketing Season ('000 Real Uganda Shillings, cpi 2007=1)												Seasonal price features				
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	12 month low	12 month high	Year Avg.	No. of months low-high	Ratio of high/low months
1994/95	142	186	183	224	243	269	255	270	197	180	172	247	142	270	214	7	(1.90)
1995/96	249	270	246	265	258	324	355	277	255	343	376	416	246	416	303	9	(1.69)
1996/97	455	420	415	470	523	602	718	679	417	338	435	416	338	718	491	-3	(2.12)
1997/98	410	408	386	391	411	410	378	378	402	375	311	263	263	411	377	-7	(1.56)
1998/99	243	311	338	326	317	304	301	294	288	279	266	274	243	338	295	2	(1.39)
1999/00	342	233	259	254	228	274	317	354	248	348	329	350	228	354	295	3	(1.55)
2000/01	388	256	325	315	293	266	255	208	126	127	128	121	121	388	234	-11	(3.21)
2001/02	131	142	167	180	254	261	286	246	223	293	355	371	131	371	242	11	(2.83)
2002/03	374	302	303	302	404	404	459	499	302	306	314	310	302	499	357	-1	(1.65)
2003/04	342	302	315	393	408	392	396	374	340	335	396	419	302	419	368	10	(1.39)
2004/05	347	276	287	336	342	356	370	284	195	200	187	246	187	370	286	-4	(1.98)
2005/06	243	332	325	326	320	320	313	306	215	262	236	297	215	332	291	-7	(1.54)
2006/07	351	271	233	202	187	179	175	225	201	185	167	237	167	351	218	-10	(2.11)
2007/08	281	306	394	391	518	444	436	440	509	388	525	544	281	544	431	-11	(1.93)
Avg. for month	**307**	**287**	**298**	**313**	**336**	**343**	**358**	**345**	**280**	**283**	**300**	**322**	**280**	**358**	**314**	**-2**	**(1.92)**

Table A18. Seasonal Price Features for Real Maize Grain Prices, Sheshamane, Ethiopia

Year	----------Maize Marketing Season ('000 Real Ethiopia Birr, cpi 2007=1)----------												----------Seasonal price features----------				
	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	12 month low	12 month high	Year Avg.	No. of months low-high	Ratio of high/low months
1994/95	1,596	2,024	2,271	2,153	1,985	1,958	1,934	2,020	1,946	1,529	1,412	1,307	1,307	2,271	1,845	-9	(1.74)
1995/96	1,380	1,368	1,284	1,304	1,326	1,344	1,286	1,457	1,336	1,523	1,406	1,129	1,129	1,523	1,345	-2	(1.35)
1996/97	1,012	1,022	1,130	1,199	1,377	1,526	1,739	1,958	1,976	1,928	1,709	1,421	1,012	1,976	1,500	8	(1.95)
1997/98	1,386	1,514	1,727	1,495	1,424	1,509	1,646	1,691	1,459	1,436	1,485	1,390	1,386	1,727	1,513	2	(1.25)
1998/99	1,412	1,455	1,390	1,857	1,813	2,046	2,543	2,672	2,601	2,682	2,365	1,557	1,390	2,682	2,033	7	(1.93)
1999/00	1,424	1,845	1,947	1,922	2,124	2,217	2,273	2,348	2,279	2,216	2,165	1,745	1,424	2,348	2,042	7	(1.65)
2000/01	1,300	1,364	1,333	1,165	1,066	999	937	930	844	1,013	1,117	1,073	844	1,364	1,095	-7	(1.62)
2001/02	969	942	889	974	1,082	1,232	1,339	1,704	1,834	1,799	1,642	1,801	889	1,834	1,351	6	(2.06)
2002/03	1,910	2,076	2,029	2,001	1,986	1,998	2,032	2,330	2,145	2,029	1,869	1,291	1,291	2,330	1,975	-4	(1.81)
2003/04	1,206	1,226	1,269	1,474	1,569	1,502	1,552	1,568	1,557	1,613	1,640	1,682	1,206	1,682	1,488	11	(1.39)
2004/05	1,582	1,722	1,719	1,864	1,779	1,982	2,178	2,280	2,218	2,089	2,008	1,362	1,362	2,280	1,899	-4	(1.67)
2005/06	1,440	1,659	1,759	1,640	1,633	1,806	.	1,835	1,762	1,648	1,646	1,278	1,278	1,835	1,646	-4	(1.44)
2006/07	1,349	1,487	1,477	1,448	1,410	1,379	1,497	1,532	1,692	2,025	1,799	1,349	1,349	2,025	1,537	-2	(1.50)
2007/08	1,507	1,575	1,880	1,929	2,216	2,343	3,148	3,331	3,611	3,545	3,254	2,080	1,507	3,611	2,535	8	(2.40)
Avg. for month	**1,391**	**1,520**	**1,579**	**1,602**	**1,628**	**1,703**	**1,854**	**1,975**	**1,947**	**1,934**	**1,823**	**1,462**	**1,391**	**1,975**	**1,701**	**7**	**(1.70)**

Table A19. Seasonal Price Features for Real Maize Grain Prices, Nemkept, Ethiopia

Year	----------Maize Marketing Season ('000 Real Ethiopia Birr, cpi 2007=1)----------												----------Seasonal price features----------				
	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	12 month low	12 month high	Year Avg.	No. of months low-high	Ratio of high/low months
1994/95	2,090	1,986	2,349	2,251	2,257	2,080	2,068	2,094	1,971	1,813	1,771	1,682	1,682	2,349	2,034	-9	(1.40)
1995/96	1,534	1,415	1,322	1,286	1,124	1,049	951	1,112	1,129	947	1,056	1,154	947	1,534	1,173	-9	(1.62)
1996/97	900	1,076	990	992	986	1,061	1,278	1,694	1,624	1,896	1,867	1,432	900	1,896	1,316	9	(2.11)
1997/98	1,579	1,448	1,451	1,416	1,415	1,602	1,888	2,090	2,008	1,980	2,116	1,829	1,415	2,116	1,735	6	(1.50)
1998/99	1,557	1,377	1,269	1,473	1,559	1,529	1,934	2,287	2,253	2,447	2,420	2,007	1,269	2,447	1,843	7	(1.93)
1999/00	1,611	1,462	1,732	1,792	1,658	1,563	1,522	1,421	1,248	1,314	1,335	1,090	1,090	1,792	1,479	-8	(1.64)
2000/01	1,118	1,166	952	844	675	565	563	547	606	578	620	578	547	1,166	734	-6	(2.13)
2001/02	495	656	730	570	567	666	773	1,059	1,054	1,194	1,269	1,380	495	1,380	868	-11	(2.79)
2002/03	1,495	1,891	1,881	1,635	1,550	1,603	1,783	2,036	1,984	2,065	1,923	1,672	1,495	2,065	1,793	9	(1.38)
2003/04	1,413	1,316	2,115	2,111	2,437	2,342	2,291	2,272	1,542	1,641	1,683	1,668	1,316	2,437	1,903	3	(1.85)
2004/05	1,511	1,435	1,342	1,460	1,573	1,550	1,573	1,733	1,741	1,756	1,705	1,655	1,342	1,756	1,586	7	(1.31)
2005/06	1,262	1,299	1,364	1,324	1,322	1,370	1,390	1,411	1,545	1,479	1,567	1,456	1,262	1,567	1,399	10	(1.24)
2006/07	1,349	1,317	1,203	1,180	1,220	1,245	1,249	1,502	1,482	1,869	1,951	1,752	1,180	1,951	1,443	7	(1.65)
2007/08	1,685	1,492	1,871	1,979	2,191	2,375	2,970	3,317	3,263	3,310	3,159	2,393	1,492	3,317	2,501	6	(2.22)
Avg. for month	**1,400**	**1,381**	**1,469**	**1,451**	**1,467**	**1,471**	**1,588**	**1,755**	**1,675**	**1,735**	**1,746**	**1,554**	**1,381**	**1,755**	**1,558**	**6**	**(1.77)**

Table A20. Seasonal Price Features for Real Maize Grain Prices, Jimma, Ethiopia

Year	----------Maize Marketing Season ('000 Real Ethiopia Birr, cpi 2007=1)----------												----------Seasonal price features----------				
	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	12 month low	12 month high	Year Avg.	No. of months low-high	Ratio of high/low months
1994/95	1,890	2,198	2,387	2,450	2,269	2,306	2,300	2,434	2,522	2,145	1,611	1,293	1,293	2,522	2,151	-3	(1.95)
1995/96	1,263	1,095	1,228	1,192	1,142	902	783	1,150	865	1,077	1,005	964	783	1,263	1,056	-6	(1.61)
1996/97	920	998	1,039	1,144	1,174	1,320	1,568	1,740	1,925	2,035	1,856	1,445	920	2,035	1,430	9	(2.21)
1997/98	1,383	1,383	1,524	1,528	1,475	1,709	1,862	2,068	1,986	1,896	1,419	1,451	1,383	2,068	1,640	7	(1.50)
1998/99	1,263	1,382	1,419	1,736	1,916	1,937	2,379	2,710	2,304	2,630	2,362	1,737	1,263	2,710	1,981	7	(2.14)
1999/00	1,492	1,548	1,853	1,964	1,901	1,916	1,912	1,922	1,888	1,833	1,673	1,368	1,368	1,964	1,773	-8	(1.44)
2000/01	1,041	1,054	1,065	1,022	863	714	745	729	699	756	800	865	699	1,065	863	-6	(1.52)
2001/02	822	726	890	760	747	774	913	1,322	1,247	1,512	1,337	1,357	726	1,512	1,034	8	(2.08)
2002/03	1,420	1,871	1,801	1,674	1,668	1,865	1,963	2,140	2,098	2,148	1,934	1,473	1,420	2,148	1,838	9	(1.51)
2003/04	1,059	1,176	1,379	1,459	1,660	1,738	1,847	1,891	1,935	1,973	1,726	1,513	1,059	1,973	1,613	9	(1.86)
2004/05	1,425	1,435	1,454	1,585	1,655	1,752	1,869	1,942	1,882	1,846	1,540	1,375	1,375	1,942	1,647	-4	(1.41)
2005/06	1,325	1,415	1,529	1,627	1,658	1,694	1,749	1,788	1,751	1,806	1,612	1,190	1,190	1,806	1,595	-2	(1.52)
2006/07	1,239	1,344	1,313	1,341	1,347	1,390	1,394	1,502	1,622	1,606	1,466	1,331	1,239	1,622	1,408	-8	(1.31)
2007/08	1,498	1,585	1,999	2,121	2,394	1,080	3,014	3,456	3,708	3,768	3,618	2,291	1,080	3,768	2,544	4	(3.49)
Avg. for month	**1,289**	**1,372**	**1,491**	**1,543**	**1,562**	**1,507**	**1,736**	**1,914**	**1,888**	**1,931**	**1,711**	**1,404**	**1,289**	**1,931**	**1,612**	**9**	**(1.83)**

Table A21. Maximum Likelihood Estimates of ARCH Models, Zambia and Malawi

Mean Equation: Dependent Variable is Natural Log of Real Maize Price						
	Zambia			Malawi		
Covariates	Lusaka	Choma	Ndola	Lilongwe	Blantyre	Karong
	(A)	(B)	(C)	(D)	(E)	(F)
$Price_{t-1}$	0.659**	0.789**	0.750**	0.786**	0.857**	0.847**
	(29.7)	(35.5)	(29.8)	(28.5)	(22.6)	(50.2)
Time trend	937.1**	3725**	910.5	132.4**	69.37	-4.650
	(3.30)	(5.82)	(1.51)	(3.78)	(1.15)	(-0.21)
Real exchange $rate_{t-1}$	12.89*	68.42**	22.25+	138.0*	72.22	-27.47
	(2.10)	(5.38)	(1.83)	(2.19)	(0.64)	(-0.70)
Real exchange rate	0.0602**	-0.0197	-0.0136	0.245	-0.0938	1.715**
Volatility	(4.92)	(-1.42)	(-0.52)	(0.43)	(-0.050)	(3.29)
Local maize	-12517**	-23200**	-23464**	-213.9**	-32.39	-103.1**
production '(00000)	(-7.35)	(-6.35)	(-8.31)	(-5.60)	(-0.33)	(-3.47)
Gulf yellow	0.255**	0.0703*	0.0622+	0.0581	0.0575	0.297**
maize $price_{t-1}^{*}$	(11.0)	(2.11)	(1.68)	(0.87)	(0.47)	(6.30)
Real GDP per $capita_{t-1}$	-0.0205**	-0.107**	-0.0408**	-0.839*	-0.548	0.161
	(-2.93)	(-7.78)	(-3.07)	(-2.52)	(-0.92)	(0.77)
Seasonal dummies						
January (=1)	162790**	141018**	263297**	4009*	8202**	-470.7
	(15.8)	(3.86)	(7.98)	(2.53)	(3.71)	(-0.48)
February (=1)	169952**	164646**	252611**	6775**	6709**	-178.0
	(11.6)	(4.49)	(8.92)	(5.01)	(3.08)	(-0.20)
March (=1)	145623**	142926**	191176**	6403**	-1943	1264
	(9.32)	(3.91)	(6.68)	(4.36)	(-0.92)	(1.42)
April (=1)	42898**	-29530	146365**	-50.89	-2653	561.3
	(2.63)	(-0.88)	(6.43)	(-0.070)	(-1.21)	(0.53)
May (=1)	-	-	-	-	-	-
	-	-	-	-	-	-
June (=1)	-8510	91454*	45090	2335	6061*	965.0
	(-0.92)	(2.33)	(1.41)	(1.56)	(2.23)	(1.01)
July (=1)	40161**	116929**	102142**	5240**	7343**	-37.38
	(5.05)	(2.85)	(3.42)	(4.15)	(2.81)	(-0.040)
August (=1)	147314**	102975**	180112**	3647**	6664*	1083
	(15.2)	(3.06)	(4.50)	(2.59)	(2.40)	(1.08)
September (=1)	119387**	172628**	223139**	3016*	6054*	1197
	(11.9)	(4.93)	(7.43)	(2.10)	(2.25)	(1.32)
October (=1)	194603**	148393**	236166**	4039**	6841**	1094
	(20.2)	(4.28)	(7.21)	(2.88)	(2.99)	(1.17)
November (=1)	175263**	125563**	282094**	5227**	8764**	3372**
	(13.7)	(3.39)	(11.4)	(4.18)	(4.07)	(3.30)
December (=1)	157983**	132867**	270823**	4565**	8021**	2438*
	(16.8)	(3.68)	(9.25)	(3.56)	(3.41)	(2.45)
Constant	22140	-200266+	192344+	-2440	-1797	-872.6
	(0.56)	(-1.96)	(1.73)	(-0.92)	(-0.38)	(-0.58)
Variance Equation: Dependent Variable is Conditional Variance in Log Real Maize Price						
Lagged variance	3.005**	2.618**	1.700**	1.766**	-0.0531	3.098**
	(7.27)	(6.94)	(5.53)	(4.43)	(-0.75)	(5.60)
Constant	328352	104674	334095**	494183**	252570**	216452*
	(0.23)	(1.64)	(2.79)	(3.92)	(8.73)	(2.38)
Log likelihood	-2371.5	-2367.1	-2354.9	-1746.5	-1774.4	-1744.1
N	179	179	179	179	179	179

Note: Estimated asymptotic Standard errors in parentheses. P-values: ** p<0.01, * p<0.05, + p<0.10

Table A22. Maximum Likelihood Estimates of ARCH Models, Tanzania and Kenya

Mean Equation: Dependent Variable is Natural Log of Real Maize Price						
	Tanzania			Kenya		
Covariates	Dar es Salaam	Mbeya	Arusha	Nairobi	Nakuru	Mombasa
	(A)	(B)	(C)	(D)	(E)	(F)
$Price_{t-1}$	0.867**	0.909**	0.914**	0.947**	0.917**	0.916**
	(22.8)	(30.1)	(45.1)	(25.8)	(27.3)	(27.7)
Time trend	602.9+	429.8+	503.8**	4.194	-9.767	-30.05
	(1.88)	(1.89)	(3.34)	(0.35)	(-0.62)	(-1.45)
Real exchange $rate_{t-1}$	75.04	42.57	10.23	3.696	-25.57	-71.87
	(1.53)	(1.35)	(0.50)	(0.13)	(-0.65)	(-1.41)
Real exchange rate	0.0660	-0.179	-0.266*	-0.848	-0.945	-0.492
Volatility	(0.34)	(-0.36)	(-2.13)	(-0.43)	(-0.33)	(-0.17)
Local maize	-4.974	-12.95	-138.3**	-46.21	-36.29	-27.50
production '(00000)	(-0.088)	(-0.40)	(-6.57)	(-0.74)	(-0.45)	(-0.39)
Gulf yellow	-0.0690	-0.0631	0.106**	0.0944	0.0429	0.140*
maize $price_{t-1}^{*}$	(-1.08)	(-1.31)	(3.13)	(1.45)	(0.70)	(2.16)
Real GDP per $capita_{t-1}$	-0.281+	-0.189+	-0.224**	-0.00821	0.0299	0.100
	(-1.79)	(-1.76)	(-3.13)	(-0.19)	(0.51)	(1.36)
Seasonal dummies						
January (=1)	40497**	28989**	7457	866.6	880.8	-63.98
	(4.21)	(3.97)	(1.53)	(1.52)	(1.44)	(-0.075)
February (=1)	17771	17262*	-1393	980.0+	2244**	-732.1
	(1.53)	(2.40)	(-0.32)	(1.69)	(3.53)	(-0.85)
March (=1)	31142**	32203**	4832	550.7	1801**	-1019
	(2.96)	(4.93)	(1.04)	(0.81)	(2.71)	(-1.01)
April (=1)	13639	15984*	9732**	710.9	1578*	-1336
	(1.26)	(2.41)	(3.25)	(1.10)	(2.53)	(-1.54)
May (=1)	-	-	-	2043**	3325**	116.7
	-	-	-	(3.25)	(5.34)	(0.13)
June (=1)	-4935	7344	-9281	1412**	1448*	535.2
	(-0.45)	(1.12)	(-1.53)	(2.63)	(2.19)	(0.61)
July (=1)	5490	19087*	-11182*	1118+	1857*	-130.2
	(0.49)	(2.57)	(-2.32)	(1.78)	(2.11)	(-0.15)
August (=1)	23617	26447**	-688.6	197.1	585.8	-1287
	(1.62)	(3.00)	(-0.13)	(0.26)	(0.94)	(-1.38)
September (=1)	13665	25264*	4527	364.2	1685**	-2019*
	(1.27)	(2.44)	(1.14)	(0.49)	(2.74)	(-2.29)
October (=1)	22350	27966**	13778**	1163+	-163.3	-578.5
	(1.57)	(3.26)	(3.67)	(1.75)	(-0.25)	(-0.55)
November (=1)	22230+	30417**	22001**	-	-	-
	(1.81)	(3.43)	(5.69)	-	-	-
December (=1)	34214**	32028**	20820**	851.9	605.9	-356.8
	(3.30)	(5.17)	(4.21)	(1.27)	(0.97)	(-0.39)
Constant	-9108	-10661	39107**	-11.35	2491	6518
	(-0.31)	(-0.62)	(4.05)	(-0.0038)	(0.75)	(1.50)
Variance Equation: Dependent Variable is Conditional Variance in Log Real Maize Price						
Lagged variance	-0.0519**	0.0345	2.251**	-0.0831**	0.642**	0.175
	(-4.53)	(0.35)	(5.20)	(-4.72)	(2.92)	(1.40)
Constant	7472**	3292**	62271*	2944203**	1707049**	2631449**
	(10.4)	(7.64)	(2.18)	(9.87)	(4.96)	(6.39)
Log likelihood	-2070.5	-2012.3	-2044.5	-1570.6	1592.8	-1591.0
N	179	179	179	179	179	179

Note: Estimated asymptotic Standard errors in parentheses. P-values: ** p<0.01, * p<0.05, + p<0.10

Table A23. Maximum Likelihood Estimates of ARCH Models, Ethiopia and Uganda

Mean Equation: Dependent Variable is Natural Log of Real Maize Price						
	Ethiopia				Uganda	
Covariates	Addis Ababa	Sheshamane	Nemkept	Jimma	Kampala	
	(A)	(B)	(C)	(D)	(E)	(F)
$Price_{t-1}$	0.879**	0.903**	0.918**	0.781**	0.871**	0.792**
	(21.2)	(21.1)	(21.4)	(26.3)	(17.7)	(24.1)
Time trend	0.906	2.104	0.546	7.240**	298.5	-966.3*
	(0.51)	(0.69)	(0.15)	(3.28)	(0.64)	(-2.19)
Real exchange $rate_{t-1}$	8.454	40.96	1.478	154.5**	52.74	-218.0**
	(0.22)	(0.57)	(0.016)	(3.12)	(0.58)	(-2.61)
Real exchange rate	218.9*	272.6+	228.9	-57.14	0.440	0.634
Volatility	(2.47)	(1.84)	(1.54)	(-0.72)	(0.30)	(0.60)
Local maize	0.0114	-0.941	-0.657	-9.532**	650.5	-3476
production ‘(00000)	(0.0033)	(-0.22)	(-0.13)	(-4.07)	(0.099)	(-0.72)
Gulf yellow	0.0445	0.0451	0.0394	-0.121*	0.0848	0.271**
maize $price_{t-1}^{*}$	(0.0072)	(0.71)	(0.56)	(-2.53)	(0.97)	(3.51)
Real GDP per $capita_{t-1}$	-0.0874	-0.219	-0.0321	-0.767**	-0.182	0.637*
	(-0.45)	(-0.62)	(-0.075)	(-3.12)	(-0.67)	(2.57)
Seasonal dummies						
January (=1)	223.5**	124.3+	258.7**	230.5**	-16916	-18357
	(3.89)	(1.70)	(4.18)	(6.36)	(-0.75)	(-0.94)
February (=1)	243.2**	107.1	116.7+	174.7**	-21569	135.7
	(4.17)	(1.52)	(1.75)	(4.29)	(-1.14)	(0.010)
March (=1)	203.0**	111.6	228.4**	228.1**	-8285	-4977
	(3.22)	(1.35)	(3.09)	(6.66)	(-0.37)	(-0.37)
April (=1)	211.3**	160.6*	220.5**	277.8**	7463	-19832
	(3.18)	(1.99)	(2.77)	(7.13)	(0.35)	(-1.10)
May (=1)	326.7**	236.4**	306.3**	288.0**	-11827	-21551
	(5.73)	(3.57)	(4.35)	(6.54)	(-0.56)	(-1.46)
June (=1)	360.6**	207.9*	344.0**	292.2**	-20315	-59057**
	(5.86)	(2.33)	(4.43)	(6.99)	(-1.21)	(-4.73)
July (=1)	215.6**	102.3	139.8+	223.9**	-74722**	-70560**
	(2.65)	(1.34)	(1.77)	(5.25)	(-3.38)	(-5.47)
August (=1)	278.9**	116.3	273.3**	229.6**	-28116+	-15769
	(4.40)	(1.63)	(3.63)	(4.94)	(-1.69)	(-1.16)
September (=1)	61.24	15.35	232.1+	-73.45+	-29434	-24619+
	(1.07)	(0.16)	(1.94)	(-1.93)	(-1.34)	(-1.80)
October (=1)	-27.96	-293.0**	24.04	-68.03*	7055	-11760
	(-0.49)	(-5.11)	(0.35)	(-2.14)	(0.30)	(-0.71)
November (=1)	-	-	-	-	-	-
	-	-	-	-	-	-
December (=1)	226.4**	191.7**	146.1+	74.22*	-53759**	-51697**
	(4.52)	(2.83)	(1.86)	(2.34)	(-2.83)	(-3.37)
Constant	1.663	-228.5	-116.7	-355.9	10620	212215**
	(0.0060)	(-0.55)	(-0.20)	(-1.18)	(0.12)	(3.17)
Variance Equation: Dependent Variable is Conditional Variance in Log Real Maize Price						
Lagged variance	0.482*	-0.00278	-0.0376	1.264**	0.207	0.717**
	(2.45)	(-0.061)	(-0.64)	(3.78)	(1.57)	(2.99)
Constant	15764**	27928**	34894**	5971*	167010**	954908**
	(4.62)	(10.2)	(8.78)	(2.20)	(7.54)	(3.64)
Log likelihood	-1159.2	-1170.0	-1151.1	-1165.3	-2171.4	-2170.1
N	179	179	179	179	179	179

Note: Estimated asymptotic Standard errors in parentheses. P-values: ** p<0.01, * p<0.05, + p<0.10

Table A24. Maximum Likelihood Estimates of ARCH Models, Mozambique, and South Africa

Mean Equation: Dependent Variable is Natural Log of Real Maize Price				
	Mozambique			South Africa
Covariates	Maputo	Nampula	Beira	Randfontein
	(A)	(B)	(C)	(D)
$Price_{t-1}$	0.807**	0.802**	0.857**	0.905**
	(19.8)	(31.0)	(28.2)	(28.3)
Time trend	7.177	19.07**	0.553	1.183
	(1.24)	(4.59)	(0.10)	(0.62)
Real exchange $rate_{t-1}$	11.40	82.36*	-75.76+	37.80
	(0.23)	(2.29)	(-1.75)	(0.55)
Real exchange rate	53.01**	21.21	40.69	33.54*
Volatility	(2.99)	(1.02)	(1.34)	(2.46)
Local maize	-91.53	-142.9**	-195.6**	-0.481
production '(00000)	(-1.25)	(-2.69)	(-2.99)	(-1.39)
Gulf yellow	0.117	-0.0320	0.112+	0.0587
maize $price_{t-1}^{*}$	(1.54)	(-0.53)	(1.74)	(1.57)
Real GDP per $capita_{t-1}$	-0.0154	-0.300**	0.224+	-0.00731
	(-0.11)	(-3.00)	(1.78)	(-0.46)
Seasonal dummies				
January (=1)	569.4*	1554**	1245**	44.79
	(2.00)	(5.45)	(4.13)	(1.18)
February (=1)	572.1+	629.6*	926.0**	-20.55
	(1.87)	(2.28)	(3.10)	(-0.67)
March (=1)	-430.4	-137.1	627.4*	54.30+
	(-1.35)	(-0.52)	(2.10)	(1.67)
April (=1)	-366.3	-890.1**	-260.5	-39.33
	(-1.14)	(-2.58)	(-1.00)	(-1.38)
May (=1)				
June (=1)	258.5	608.8**	798.9*	23.64
	(0.54)	(2.68)	(2.42)	(0.75)
July (=1)	239.6	1150**	1034**	18.34
	(0.70)	(4.64)	(3.45)	(0.52)
August (=1)	572.4+	846.9**	865.5**	27.23
	(1.78)	(3.17)	(2.75)	(0.82)
September (=1)	871.8**	1269**	998.9**	49.84
	(2.73)	(5.22)	(3.51)	(1.27)
October (=1)	694.0*	819.5**	938.0**	26.40
	(2.20)	(3.24)	(3.20)	(0.70)
November (=1)	577.9	1286**	1420**	104.6**
	(1.45)	(5.05)	(5.40)	(3.41)
December (=1)	879.7**	1479**	1658**	43.64
	(2.92)	(5.04)	(6.35)	(1.36)
Constant	758.1	338.7	2154+	-101.2
	(0.48)	(0.31)	(1.65)	(-0.46)
Variance Equation: Dependent Variable is Conditional Variance in Log Real Maize Price				
Lagged variance	0.0576	1.081**	0.265+	0.902**
	(0.64)	(3.86)	(1.75)	(3.50)
Constant	509730**	230635**	341216**	4919**
	(6.75)	(3.01)	(5.37)	(4.36)
Log likelihood	-1435.2	-1448.2	-1416.5	-1083.3
N	179	179	179	179

Note: Estimated asymptotic Standard errors in parentheses. P-values: ** p<0.01, * p<0.05, + p<0.10

Figure A1. Comparison of Conditional CV by Market and Country

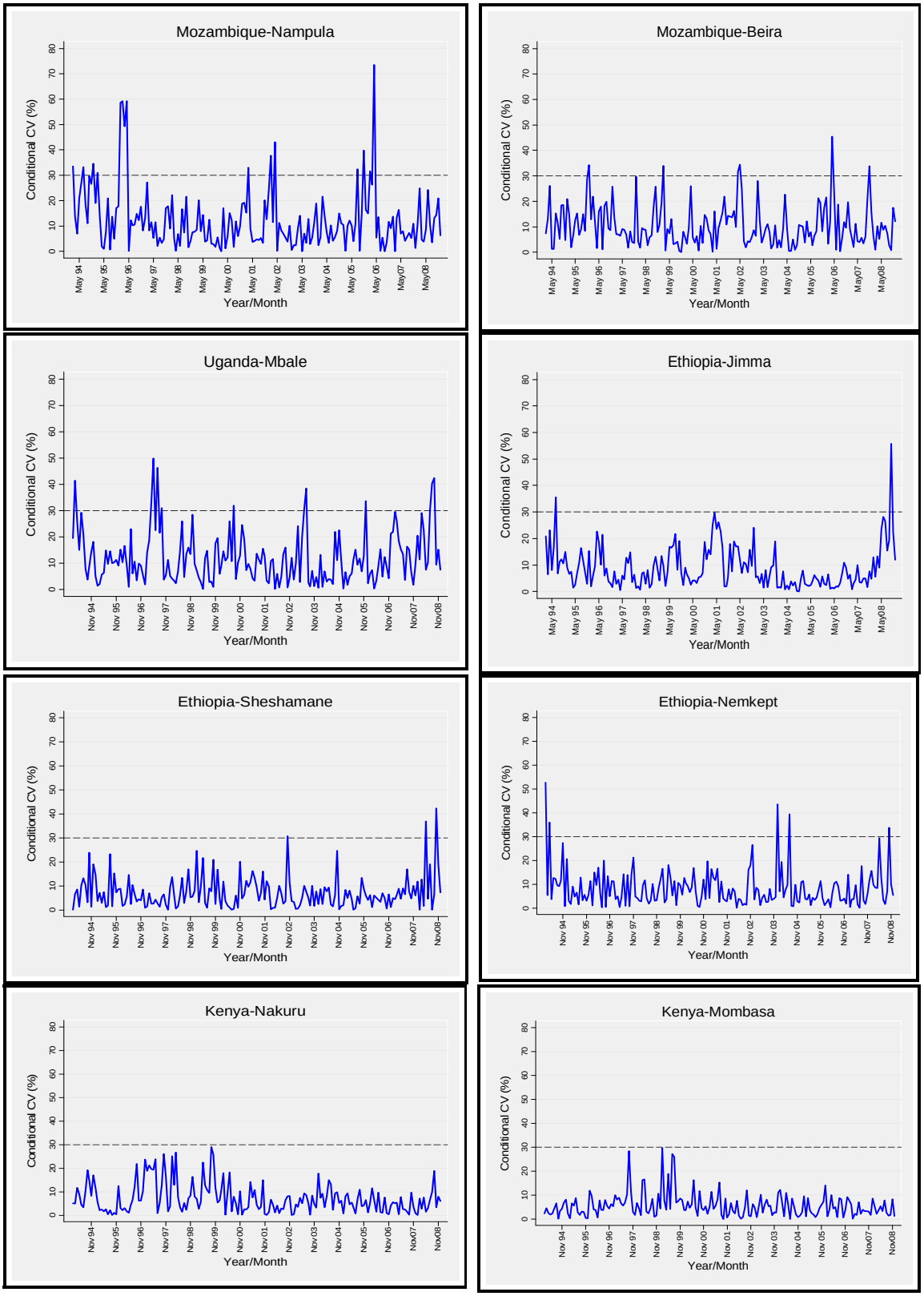
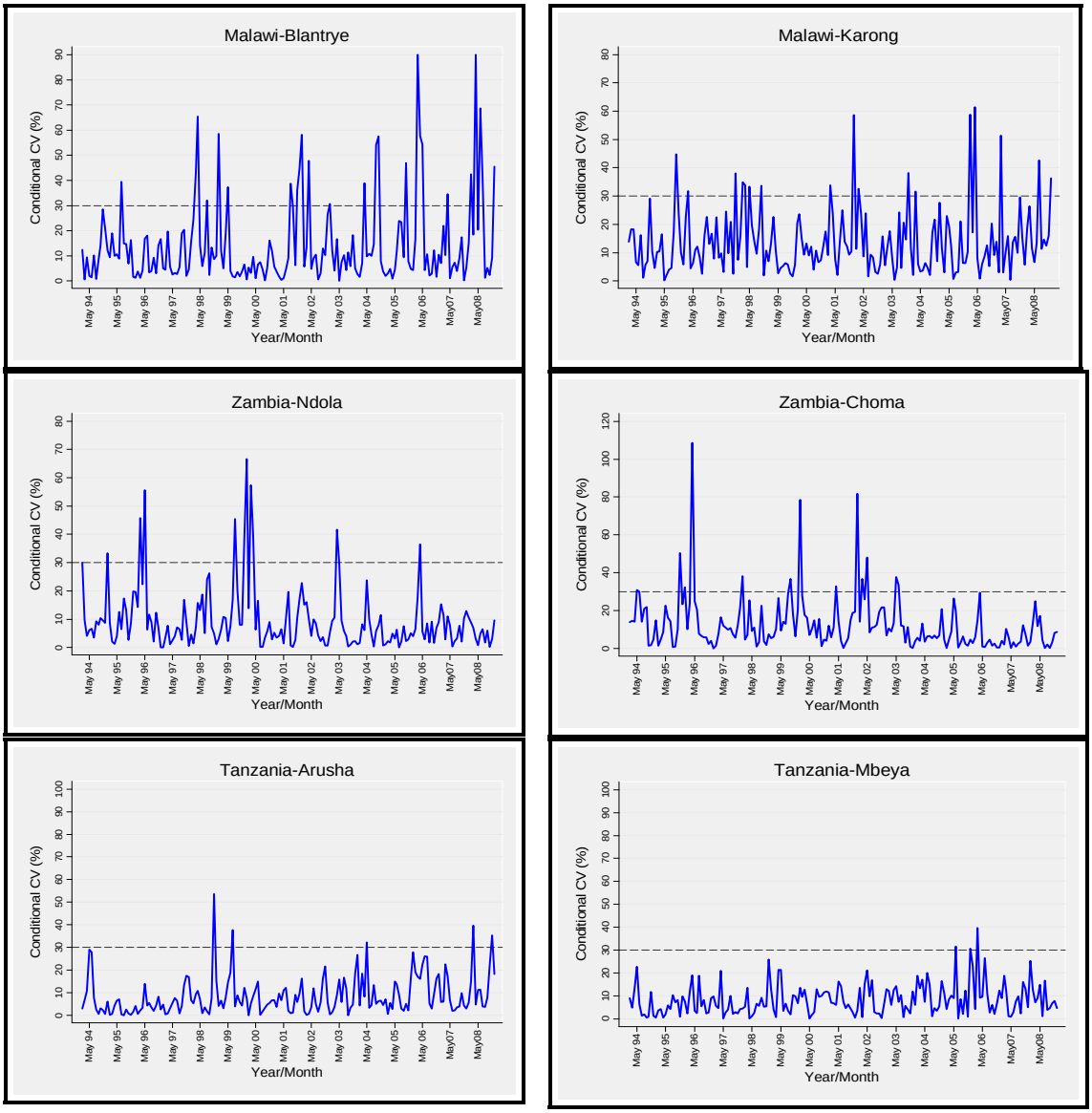


Figure A2. Comparison of Conditional CV by Market and Country



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