FOOD SECURITY RESEARCH PROJECT

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EXECUTIVE SUMMARY

As events in the 2008/09 season have amply demonstrated, instability in staple food market remains a major problem in Zambia. A rise in world food price levels and instability, which is projected to occur in the near future according to several international institutes, will make it all more important for developing countries to consider the strengths and weaknesses of alternative approaches for buffering their domestic food systems from potential high volatility in world markets.

The Government of Zambia currently uses a variety of pricing, marketing, and trade policy tools to influence and stabilize the price of maize, the country's main staple food commodity. However, based on anecdotal evidence and reports from stakeholders in the maize marketing system, it is not altogether clear whether the marketing and trade policies being pursued are in fact stabilizing maize prices and supplies. If stabilization policies are pursued in an *ad hoc*, stop-go, and unpredictable manner, it is possible that such policies could exacerbate rather than mitigate the extent of uncertainty and price risk borne by participants in the marketing system and create unintended consequences for the performance of food markets. There remains a dearth of empirical evidence to assess the overall impact of trade policy on food price predictability in sub-Saharan Africa in general and Zambia in particular. This paper empirically assesses the impacts of Zambia's various maize marketing and trade policy instruments on maize price unpredictability.

Monthly maize prices for several regional markets from the period January 1994 to May 2008 are applied to reduced form models with auto-distributed lag structure for the four major food markets of Lusaka, Chipata, Choma and Kabwe. Lusaka is the capital city and a large deficit market. By contrast, Choma, Chipata, and Kabwe are regional markets near the prime maize surplus-producing areas in Southern, Eastern and Central Provinces, respectively.

This study highlights five findings as follows: *First*, the government's purchases of maize to support maize prices through the Food Reserve Agency appeared to influence regional market prices in different directions, but in none of these regional markets were the effects statistically significant at even the 10% levels. By contrast, maize sales by the FRA maize are found to put strong downward pressure on next month's maize prices in all markets, with the impact being statistically significant in three of the four markets analyzed. When FRA sales are confined to periods of relatively high prices as they generally are with some notable exceptions, these results suggest that they have a stabilizing effect on market prices.

Based on the normal seasonal price movements we would expect maize prices to be relatively low after harvest in May-June and gradually rise and peak during the hunger season (December through March). Unfortunately, government maize sales at below-market prices disrupts this seasonal pattern in maize prices, which then reduces the returns to private intra-seasonal grain storage. It is likely that maize storage by both farmers and traders is under provisioned, in part because of the price risks introduced by the price depressing effects of government maize sales during the lean season. Nevertheless, the maize sales activities of the FRA, other features of government policy held constant do appear to achieve their objective of moderating the extent of seasonal maize price rises.

Second, the use of government trade policy tools such as altering maize import tariff rates and banning exports has negligible effect on the mean prices, suggesting that informal trade is largely circumventing the price impact of these trade policy tools. These findings may not be at all surprising because of the ability of informal cross-border traders to circumvent official border crossings, make deals with border police, as well as government trade reversals in some years (see Jayne et. al., 2008).

Third, the regression findings highlight the unintended effects on maize price levels resulting from time lags between announcing policy changes and actual implementation or execution of these policies. For example, announcing government intentions to import maize but then delaying the arrival of imports, or announcing that import duties will be waived but then delaying the time that they are actually waived raise the level of next month's maize price. Because government importation and the waiving of import duties often occur during production shortfall years, they usually exacerbate upward price movements during periods when prices are already high. Delays in importing grain after the government had announced its intention to import resulted in a 24% percent increase in next month's maize grain prices in Lusaka, 30% in Kabwe and 22% in Choma and Chipata. For every additional month that imports are delayed after the announcement, prices rise again by a similar amount each month. The main explanation for this large influence on prices is because when governments announce their decision to import, they usually sell the grain to millers at prices below the full cost of importation. Private trades realize that they cannot compete against subsidized imports and hence tend to stay out of the market during such periods. The damage comes when delays in government importation cause stock levels to dwindle, contributing to panic and rationing, which has sent market prices skyrocketing during such periods as occurred in Zambia in early 2002 and early 2003 and recently in 2008/09 marketing season.

Similar to delayed government imports, the effects of delayed duty waiver are also potentially very disruptive. Results show that Kabwe prices rose by 17 percent and Chipata maize prices by 14 percent for each additional month's delay in the waiver of the import duty after the government has announced that it would consider waiving the duty. The impacts of delayed duty waiver on the other two markets (Lusaka and Choma) are also positive but not statistically significant. Grain traders in Zambia have indicated that if they suspect that the import tariff will be waived later in the year, they will wait until the tariff is actually waived before attempting to import. Mobilizing imports early (while the tariff is in place) runs the risk that they would lose their market later when competing against other firms that can import more cheaply once the tariff is waived. The result is commonly a temporary under-provision of imports during the time period between a formal or informal announcement that the duty may be waived and the time that is actually waived. These forms of policy uncertainty contribute to a situation in which local prices exceed import parity levels for periods of time.

Fourth, we used the model to simulate the time path of maize prices assuming that the government did not buy or sell maize or restrict cross-border trade in any way. This can be done by setting all government policy variables in the model to zero, and comparing the time path of maize prices in this "no intervention" scenario compared to historical prices with the various government marketing and trade policy interventions. We find that the variability of maize prices in all four markets is higher with government marketing and trade policies compared to the counterfactual maize prices with all government policy interventions set to zero. In general, the coefficient of variation of maize prices in the 'no intervention' scenario is between 4.3% and 10% lower than those 'with government intervention'. Contrary to the price stabilization objectives pursued by the Zambian Government, the higher degree of price variability in the historical pattern of maize prices suggests that government marketing and trade policies have actually destabilized prices to some extent. Most of the instability appears not to be associated with FRA maize purchase and sale activities (its sales actually have helped to stabilize prices in high-priced periods), but rather the uncertainty over the timing of changes in ad hoc government trade policies. Price unpredictability tends to make trade riskier and raise the implicit risk premia that traders build into their trading margins.

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 which 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 can be impeded by uncertainty and associated risks for market participants.

These findings 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. Greater policy stability may also contribute to broader grain market development. For the most part, addressing problems of policy uncertainty involve very little cost per se, but do 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 entails a loss of control and autonomy – leaders are bound to act according to pre-defined rules and triggers. 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.

1.0 INTRODUCTION

Instability in staple food markets remains a major problem in Zambia. Events in 2008 have compounded fears about the impacts of higher and more volatile food prices in world markets. There is a widespread perception in the country that staple food prices are far too strategically and politically important to leave to the market, which would expose poor farmers and consumers to unacceptable price spikes and collapses. As a major staple, maize account for a major share of low-income consumers' expenditures in Zambia, hence short-term price spikes can have severe economic, social and political consequences. [1]

These concerns have contributed to the Government of Zambia's operations in the maize market to influence the level and stability of prices. Government interventions take two main forms: (1) direct involvement in crop purchasing, sale, and stock management via the Food Reserve Agency, and (2) discretionary trade policy instruments, such as export bans/restrictions, import tariff rates and government import programs. Unfortunately, there remains a dearth of empirical evidence to show how these marketing and trade policy interventions affect the magnitude of price instability. It is sometimes argued, particularly by marketing agents, that government marketing and trade policies sometimes prevent them from buying or importing grain that could otherwise reduce marketing costs and contribute to price stability. For example, if stabilization policies are pursued in an *ad hoc*, stop-go, and unpredictable manner, it is possible that such policies could exacerbate rather than mitigate the extent of uncertainty and price risk borne by participants in the marketing system and hence impede spatial and temporal arbitrage to keep prices within export and import parity bands.

This study empirically estimates how government trade and marketing policies designed to stabilize maize prices affect the level and stability of maize prices. To achieve this objective, we use monthly time series price data from a number of regional wholesale markets in Zambia to estimate reduced form maize price models with an auto-distributed lag structure. These models reveal the impact of lagged policy instruments on the time path of prices after controlling for other exogenous factors.

The remainder of this paper is organized as follows: section 2 presents methods and data used to analyze price unpredictability in this study and section 3 and 4 presents the findings and a summary of the implications of these findings for maize grain trade and food security respectively.

[1] A large literature has discussed the economic consequences of food price instability (e.g., Timmer, 2000; Newberry and Stiglitz 1981; Myers, 1988, 1992b, and Williams and Wright 1991). In eastern and southern Africa, a number of studies have diagnosed the limitations of past government and market-led efforts to stabilize food prices (Pinckney, 1988, 1993; Jayne and Jones, 1997; Meerman, 1997; Barrett, 1999; Kherallah et al., 2002; Jayne et. al, 2002; Harrigan ,2003; Gabre-Madhin, Barrett, and Dorosh, 2003).

2.0 METHODS AND DATA

This section presents a detailed discussion of the data and methods used in this paper. However, before going into these details about the data and methods, it is important to present a concise discussion on why price variability/instability is not synonymous with price unpredictability, terms that could erroneously be used interchangeably. This study is mainly interested in measuring the latter particularly because price unpredictability can be disruptive to farmers, traders, and market performance in general.

2.1 Price unpredictability 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 including Zambia that have one production season. Seasonal price variation is indeed necessary to induce storage to smooth out consumption across the year. Other information available at time *t*, such as prices, weather, interest rates, and government behavior are also taken into account by economic agents to predict future prices. Price variation is therefore not the same thing as price unpredictability, and there are good reasons for believing that it is the latter that is particularly disruptive to farmers, traders, and market performance in general.

If we assume that price expectations for $t+1$ are formed based on the information set available at time t, then a measure of unpredictability for price t+1 could be represented by the forecast error between predicted and actual price.

(1) $$P_{t+1} - E(P_{t+1}) = e_{t+1}$$

where $E(P_{t+1})$ is the expected price 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.[2]

2.2 Monthly maize price model

The standard maize supply and demand models provides us with the foundation of measuring the of impacts of various government policies on price unpredictability. Equation 2 and 3 below represents the basic demand and supply models for maize grain in Zambia respectively.

(2) $Q_i^d = f(P_{it}, X_t)$
(3) $Q_i^s = g(P_{it}, X'_t)$

The quantity of maize grain (commodity i) demanded (equation 2) is a function of grain price, and a vector of other exogenous factors (X), which includes but not limited to price of

[2] See Dehn et al. (2005) for an elaboration of the differences between price instability and unpredictability.

substitutes such as bread and other wheat products, people's tastes and income, the actions of food aid procurement agencies, and government policy. On the supply side (equation 3), the quantity of maize grain supplied is a function of the price of maize grain and other factors that affect supply (X′) such as price of inputs (e.g. fertilizers and seed), price of substitutes in production, prices of maize grain in neighboring countries, technology, and government policy, just to mention a few. Unfortunately, the data requirements to solve these structural equations are huge and practically impossible to obtain in Zambia. Moreover, different structural models and/or assumptions about functional form would lead to different reduced form specifications. An alternative approach is to start with a reduced form framework that incorporates as regressors the exogenous factors in *X* and *X'* which would appear in most structural demand and supply models subject to data availability.

The reduced form model estimated in this paper is derived as follows;

$$(3) \qquad P_{it} = \alpha_0 + \sum_{s=1}^{n} \alpha_s P_{it-s} + \beta_i X_{it-1} + \varepsilon_{it} \qquad \varepsilon_{it} \sim N(0, h_{it})$$

Where P_{it} is the real maize grain price in market *i* at time *t* and X_{t-1} represents a vector of already known information at time *t-1*, ε_{it} is the disturbance term and α, β, are parameters to be estimated. Equation 4 present the full empirical model used to analyze maize markets in Zambia.

[4]

$$P_{it} = \alpha_0 + \alpha_1 P_{it-1} + \beta_1 T_{t-1} + \beta_2 Rain + \beta_3 Rprodn + \beta_4 Deficit + \beta_5 Fert + \beta_6 Bread_{t-1} + \beta_7 Gdpca + \beta_8 SAp_{t-1} +$$
$$\beta_9 WFP_{t-1} + \beta_{10} Gvtpq + \beta_{11} Gvtsq_{t-1} + \beta_{12} Tariff_{t-1} + \beta_{13} Gvt\_int_{t-1} + \beta_{14} Dduty_{t-1} + \beta_{15} Exptban_{t-1} + \sum_{q=1}^{11} \varphi D_{qt} + \varepsilon_{it}$$

where P_{it-1} is the lagged wholesale maize price in past period (*t-1*) for market *i*; *T* is a time trend, rainfall index (*Rain*), *Rprodn* is an index of production in Southern Africa. *Deficit* is a binary variable equal to 1 in years when the national maize balance sheets which are reported soon after the harvest indicate a production shortfall relative to consumption requirements, *Bread* is wheat bread prices, *Gdpca* is the gross domestic product (GPD) per capita, a proxy for income, *WFP* represents the quantity of maize purchased locally by the World Food Program, which operates local procurement program in Zambia. We also include lagged wholesale SAFEX maize prices in South Africa (*SAp*) which is believed to influence domestic market prices in Zambia. *D* is a vector of eleven binary seasonal variables to capture normal seasonal grain price movements throughout the year.

2.3 Data and variable construction

The policy variables are designed to capture the market stabilization operations of the Food Reserve (FRA) and trade policy tools. These include the monthly quantity of maize purchased and sold by the FRA, import tariff rates,[3] and a dummy variable for months when a

[3] Between 1994 and 2004, maize imports in Zambia attracted a duty of 5% for non-COMESA supplies. The COMESA Free Trade Agreement allowed duty free maize imports starting in 2000. Since 2004, duty for non-COMESA maize imports was raised from 5% to 15%.

maize export is in force.[4] Generally, import tariffs raise domestic prices by restricting imports in periods when they would otherwise occur without the tariff. *A priori* one would expect a rise in the import tariff rate to raise local prices in deficit years and have little or no effect during surplus years. In deficit years, import tariffs and especially the uncertainty as to the timing of the removal of the import tariff causes firms to hold off from importation while they wait for the removal of tariff. Therefore, we test for interaction effects between the import tariff rate and the maize deficit dummy variables.

In addition to these variables, we include a dummy variable equal to one in months after which the government has expressed receptivity to waiving the maize import tariff without actually having done so (Dduty); and another dummy variable equaling one in months after which the government has announced its decision to import maize but before actually doing so (Gvt_int). These government marketing and trade policy decisions are considered to be exogenous, although to some extent they may be a lagged response to prior months' market events.

During the drought of 2001, the government of Zambia announced its intention to import maize grain in order to protect poor consumers from rising prices. Unfortunately, these imports were delayed by 3 months, resulting in a price surge well above import parity (see Nijhoff et. al., 2003; Mwanaumo et. al., 2005).

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. 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 'the state marketing board' with a monopoly on exports. Therefore, we constructed a dummy variable equal to 1 if an export ban was in place, zero otherwise.

Export restrictions are commonly invoked when the country experiences a maize production deficit, although these sometimes occur during good production seasons in order to provide a monopoly for government exports. We also test for interaction effects between the export ban and maize deficit dummy variable. All other factors constant we expect export ban to significantly depress mean price level in a good season and to some extent mitigate the impact of rising mean prices in a bad production year.

Rainfall index: The index was constructed by summing the October to March rainfall for each subsequent marketing year, April to May. Therefore, the rainfall index is constant within each marketing year and varying across marketing years.

Fertilizer price index: Fertilizer prices are expected to be a key factor that may influence the mean level maize price in Zambia. *A priori*, we expect a positive relationship between fertilizer prices and maize grain prices. An increase in fertilizer prices is expected to curtail fertilizer use on maize hence reduced yields and increased maize prices due to the reduction in maize supply. The prior agricultural season average fertilizer prices are used for each subsequent marketing season. Therefore, fertilizer prices like the rainfall index are constant within each marketing year and varying across marketing years.

[4] Strictly speaking, export bans are not official government policy. However, a private firm seeking to export maize must first acquire an export permit from government. By restricting the issuance of export permits, as it has since 2005, this is tantamount to banning private export of maize.

Bread prices: Retail bread prices are included as the main grain substitute for maize meal porridge (*nshima*). *A priori, one* would expect a positive correlation between maize grain prices and bread prices.

WFP local purchases: World Food Program (WFP) is one of the major buyers of maize in Zambia for relief purposes elsewhere in the region. A visual assessment of the data shows that WFP tended to purchase maize in Zambia during good agricultural seasons so it is plausible to hypothesize that the volume of WFP purchases would have a positive impact on local maize prices and that this effect was most evident during periods of relatively low maize prices.

Seasonal dummy variables (D): We included 11 monthly seasonal dummy variables in the models in order to account for any potential seasonality in the price data instead of monthly dummies.

The study uses monthly wholesale price data covering the period January 1994 to May 2008 from three markets in Zambia. These include Lusaka central market, a maize deficit but consumption market and three markets in surplus maize production areas in Eastern, Central and Southern Provinces: Chipata, Kabwe, and Choma markets respectively. Prices are expressed in local currency per tonne, and are then deflated by the 2006/2007 consumer price index (CPI). The CPI is equal to 1 for the 2006/07 marketing year, May 2006 to April 2007. It is not necessary to include international maize prices in the model, first because SAFEX prices are the main international reference price used in the region and from where imports normally come to Zambia during major production shortfalls, and secondly because of the very high correlation between SAFEX prices and the international yellow maize grain prices (Free on Board (FOB) Gulf). Essentially, the impact of world maize prices are modeled via the South Africa SAFEX maize prices. We summarize the data description and sources in Table 1.

We estimate equation 4 using a log-log functional form. Hence, with the exception of the time trend and dummy variables, the estimated coefficients are elasticities. The coefficients on the dummy variables and time trend are semi-elasticities and need to be multiplied by 100 to convert the impact of these variables into a percentage. For example, a coefficient on the drought dummy of say 0.3, means that all other factors constant, maize prices increase by 30% during maize grain production shortfalls compared to surplus periods.

Table 1 : Data type, description and source

Type	Description	Data Sources
Monthly wholesale maize prices in real Kwacha per kg	Lusaka (central market), Choma, Kabwe, and Chipata markets for the period - January 1994-September 2008	Zambia Agricultural Market Information Center (AMIC).
Rainfall index in millimeters	Seasonal rainfall index	Zambia Meteorological Department
Wheat bread prices in real Kwacha per loaf	Average monthly retail wheat flour prices. Collected for purposes of computing Monthly Consumer Price Index by Central Statistics office	Central Statistics Office
Fertilizer prices in real Kwacha per kg	Average agricultural season fertilizer prices	Ministry of Agriculture and Cooperatives (MACO).
Real exchange rates index	Monthly average nominal exchange rate (Kwacha per 1 USA dollar) divided by CPI (2006/07=1)	Bank of Zambia for nominal exchange rates
Consumer Price Index (CPI)	Monthly consumer price index with base year 2006/07=1	Central Statistics Office
Government maize grain purchases and sales in metric tonnes	Monthly purchases and sales	Food Reserve Agency, various years
WFP Local purchases in metric tonnes	Monthly purchases in metric tones for the period covering January 1994 and September 2007	World Food Program data files in Zambia
Maize import tariff rates (percent)	Fixed monthly tariff rates	Ministry of Agriculture and Cooperatives (MACO).
Government ad hoc policies	Dummy variables (=1) for -Export ban/restrictions -Delay in import duty waiver -Delayed government intentions to import	Public announcement by MACO, Several Food security Research Project policy briefs on the maize sector in Zambia and FEWSnet Zambia, various years
South Africa maize grain prices converted to real Kwacha per kg	Randfontein monthly maize grain wholesale prices	South Africa Grain Information System (SAGIS); Statistical Agency of South Africa.
Regional Production index in metric tonnes	Sum of maize production in Southern Africa.	FAOstats

2.4 Measuring the impact of government marketing and trade policies on price instability and unpredictability

In order to examine the overall impact of government marketing and trade policies in Zambia, we used the model results in equation 4 to simulate a time path of the maize prices without government policies, by setting all government policy variables = 0, and compare it with the actual maize price grain price movements over time, which incorporate the effects of government interventions.

To gain more insights about the impacts of government maize marketing and trade policy on price unpredictability in Zambia, we also computed the squared differences between actual and predicted prices for each month. If we assume that market actors have access to the information as contained in the model, i.e., they know the values of the regressors with a one-month lag, and use this 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. We then plot the conditional coefficient of variation (error variances divided by the price means for each market) by market over the 1994-2007 period. However, using the specification with one month lagged values for the policy variables assumes that market actors are able to know or correctly estimate the exact value for all government policy variables in the current month when they make their price expectations for the next month. This is a rather strong assumption because it is unlikely that market actors will know government actions in advance to forecast future prices. For example, marketing actors trying to predict next month's are unlikely to know the quantities purchased and sold by FRA in April when they form price expectations for May. Such information is generally not known until at least two or three months afterward. Moreover, market actors are not likely to know with certainty whether announced government imports will actually arrive in time or would they know when the government is going to waive import tariff rates. Hence the price predictions from the model setting actual t-1 values for the policy variables is likely to result in more precise price estimates and hence smaller forecast errors than is actually the case. Therefore, we consider to alternative approaches, (1) using mean values for government variables and (2) lagging the government policy variables two periods. The first alternative approach assumes that market actors look at the past behavior of government and use the average value of these past variables to predict next month's price. This is likely to result in larger forecast errors than the first approach. Whilst, the second alternative assumes that market actors will at least know about government behavior in the past two months and use that in addition to available information to forecast next month price. However, all these approaches are mere estimates and have drawbacks because in some cases, market actors may in fact be able to make better predictions of the current value for the government variables in the model than just using past mean values. So, we feel that the actual magnitude of price unpredictability is likely to fall between the conditional CVs of these three approaches.

We present the results on the conditional coefficient of variation for three distinct periods corresponding to shifts in the maize marketing policy environment.

Phase 1: We define the first phase as the period between January 1994 and April 2000. Zambia's maize marketing and trade policy had started undergoing partial reform during this period. Under pressure from a growing budget deficit and international donors, the Zambian government took steps to liberalize maize input and product markets, and discontinued consumer subsidies on maize meal. However, continuing with the desire of market stabilization, the Zambian government established in 1996 the Food Reserve Agency (FRA), officially charged with holding strategic grain reserves. Unlike its predecessor, National Agricultural Marketing Board (NABOARD) which was the sole buyer and seller of grain in Zambia, the FRA was originally conceived to hold buffer stocks to dampen price variability and, when necessary, provide liquidity in the maize market during the initial years of market liberalization while the private sector was establishing itself. The government has remained involved in arranging maize imports, subsidizing the price at which it offers maize imports to large millers (Nijhoff et al., 2003). Up until the 2000/2001 marketing season, FRA involvement in the buying and selling of grain was very limited and all purchases and sales were done via a tender process.

Phase 2: With an increase budgetary support from the government and the looming drought of 2001/2002, the role of the Food Reserve Agency was expanded. We mark this period of expanded government operations in the domestic maize market as being from May 2000 to April 2005. During this period, FRA maize purchases were estimated to account for roughly 10% to 30% of the total quantity of maize marketed by small- and medium-scale farms. FRA started announcing maize floor prices during this period and became a so called 'buyer of last resort'. This phase marked the re-introduction of pan-seasonal and pan-territorial pricing for the first time since the dissolution of NAMBOARD in 1989. It was during this phase that Zambia faced serious maize shortfalls which called on the government to make decisions to stabilize the market without hampering private sector participation and market development. Unfortunately, the delayed, ad-hoc and mixed government actions led to huge price spikes and instability of the market.

Phase 3: Gradually, a year before the national election in 2006 saw a much more expanded role of the parastatal FRA's mandate in Zambia's maize sector, marking the beginning of phase/period 3. The period starting from May 2005 to the current day has seen FRA ramping up its buying activities. In the 2006/07 marketing year, FRA maize purchases were estimated to be over 70% of the total quantity of maize sold by the small- and medium farm sector in Zambia. In most other years since 2005, the FRA has accounted for an estimated 25% to 50% of the maize sold by small and medium scale farms.

2.6 Diagnostic tests

Before estimating the models a series of diagnostic test were conducted. *First*, we test for the presence of unit roots in the inflation-adjusted maize prices using both the Phillip-Perron test (PP) and the Augmented Dickey Fuller (ADF) test.[5] However, the PP test is considered superior to the ADF because PP test is robust to the presence of serial correlation in the residuals. Using the ADF and PP test, we reject the null hypothesis for the presence of a unit root at 5% or higher level of significance, indicating stationarity. These results are confirmed using the KPSS test which directly tests the null hypothesis that the price series trend stationary. Based on the weight of the evidence from these three tests, we conclude that the price series are stationary when deflated and hence no special treatment of the data is required before model estimations (see Table 2, column C, F and G).

[5] 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.

Second, we use the LM test to test for the presence of ARCH effects (Engle 1982).[6] With the exception of Lusaka market at 10 percent level of significance, the results in Table 3 do not support the presence of heteroskedastic errors. Therefore, ARCH in Mean and other models that account for a heteroskedastic error structure are not required, and OLS models with standard errors appear to be the most appropriate and straightforward estimation procedure to use.

Table 2: Unit root tests results by market

Constant 2007 maize prices	-----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 significance	Z(t) Statistic	p-value for Z(t)	Stationary or non-stationary at 10% level of Significance	
	(A)	(B)	(C)	(D)	(E)	(F)	(G)
Lusaka	-3.575	0.0320	Stationary	-3.119	0.1017	Stationary	Stationary
Kabwe	-3.257	0.0169	Stationary	-3.886	0.0021	Stationary	Stationary
Choma	-2.852	0.0512	Stationary	-3.299	0.0149	Stationary	Stationary
Chipata	-3.136	0.0240	Stationary	-3.649	0.0049	Stationary	Stationary

Notes: The null hypothesis is that the variable contains a unit root, and the alternative is that the variable was generated by a stationary process. Augmented Dickey-Fuller and Phillip-Perron values are Z(t) statistics with MacKinnon approximate p-values for testing the null hypothesis of a unit root. The Phillip-Perron test uses the Newey-West standard errors to account for serial correlation, whereas the augmented Dickey-Fuller test uses additional lags of the first-difference variable. The test included 1 lag in the augmented Dickey-Fuller test and 4 Newey-West lags in the Phillip-Perron test. Both models include a constant term and a time trend to account for deterministic components. The KPSS Test from Kwiatkowski et al. (1992) tests for stationarity, i.e., for a unit root. The hypotheses are thus exchanged from those of the ADF test.

Third, we test for the presence of autocorrelated error terms using the Breusch-Godfrey's LM test. Table 4, columns A and B show that OLS models without the lagged dependent variable as an explanatory variable exhibit high degree of autocorrelation. The simple Auto Distributive Lag (ADL) models with P_{t-1} as an explanatory variable do not exhibit serially correlated error terms. Therefore, we proceed to estimate the simple Auto Distributive Lag (ADL) models as specified in equations 4 and 5 with OLS.

[6] This test is performed by estimating a regression of the squared residuals on a constant and lagged residuals up to the order q.

Table 3: ARCH effects test results by market

Country/Market	lags(p)	chi2	df	Prob > chi2	Presence of Arch Effects at 1%	5%	10%
					--------Level of significance------		
Zambia							
Lusaka prices	1	2.913	1	0.0879	No	No	Yes
	2	3.196	2	0.2023	No	No	No
Kabwe prices	1	2.503	1	0.1136	No	No	No
	2	2.792	2	0.2476	No	No	No
Choma prices	1	0.766	1	0.3814	No	No	No
	2	0.756	2	0.6854	No	No	No
Chipata prices	1	0.000	1	0.9951	No	No	No
	2	0.235	2	0.8891	No	No	No

Notes: The null hypothesis tested is that there are no ARCH effects versus an alternative that which supports the presents of ARCH(p) disturbance

Table 4: Autocorrelation results by market

	No lagged own price dependent variable(P_{t-1}) (Ho: no autocorrelation)		ADL (Ho: no autocorrelation)	
	Chi square	Prob>Chi2	Chi square	Prob>Chi2
	(A)	(B)	(C)	(D)
Lusaka	39.634	0.000	0.225	0.635
Kabwe	77.358	0.000	0.397	0.5286
Chipata	66.484	0.000	2.153	0.142
Choma	74.483	0.000	0.064	0.800

3.0 RESULTS AND DISCUSSION

We estimated OLS models for four major market centers. If markets were efficient in space and in time and there were no regional differences in policy effects, then we would expect to find consistent results across markets. However, this may not be the case due to many factors including high costs in moving grain from one area to another, weak market information systems, and differential spatial impacts of marketing and trade policies, just to mention a few. Therefore, as a first step, we compute correlation coefficients for the different market pairs as a rough indicator of the degree of co-movement in monthly prices. Because we found little evidence of unit roots in these prices, examining correlations in levels rather than first differences is appropriate.

The results show relatively high correlation coefficients for all the market pairs except with Kabwe market (Table 5). It is surprising that Kabwe market prices are not highly correlated with Lusaka central market prices because these two markets are only 145 kilometers apart. Kabwe and other market pairs results seem to suggest less market integration but it is beyond the scope of this paper to explore this issue in detail. While Table 5 shows very high correlation for the other three markets pairs, it is possible that the effects of the government domestic and trade policies on staple grain may vary depending on the location of the market.

Table 5: Correlation Coefficients between maize prices between various market pairs

	Lusaka	Kabwe	Chipata	Choma
Lusaka	1			
Kabwe	0.6757	1		
Chipata	***0.7814***	0.6587	1	
Choma	***0.8797***	0.6635	***0.8310***	1

The results in Table 6 show that for all markets analyzed, the lagged maize grain price (P_{t-1}) is the major predictor of one-step ahead maize price levels. Thus, the prevailing mean price in any given month is highly dependent on the price in the preceding period. This result confirms earlier work by Deaton and Laroque (1992) who indicated that most agricultural commodity prices tend to show at least partial first-order autocorrelation, even though as reported earlier, most of the unit root tests showed these market prices to be stationary.

Most of the variables in Table 6 have expected signs but a few variables have a statistically significant effect on maize prices. Our discussion focuses on the government policy variables because the main objective of this paper is to analyze their impact on maize price levels and unpredictability. However, before we discuss the impacts of government maize marketing and trade policy it is beneficial to briefly highlight the effects of other statistically significant independent variables included in the models.

As would be expected for agricultural systems relying on rain, the coefficient on the rainfall variable is negative and statistically different from zero at 5% (except for model C without interactions terms in Chipata and Lusaka markets). Other factors constant, a good rainfall season results in higher maize production which typically reduces maize prices. Results in

Table 6 show that, on average, a 10 percent increase in rainfall results in a 5 and 2.1 percent reduction in maize prices in Lusaka, Zambia.

Because wheat bread is a substitute for maize meal products in Zambia, it is perhaps surprising that lagged wheat bread prices do not have a statistically significant impact on wholesale maize grain prices. The results in Table 6 suggest a weak substitution effect between wheat bread and maize grain.

Fertilizer is an input in maize production and one might expect that an increase in fertilizer prices would reduce maize production, other factors constant, and hence raise maize prices. The effect of fertilizer price on mean maize grain prices is positive and statistically significant for all the four markets in Zambia. The results in Table 6 show that a 10 percent increase the price of basal fertilizer causes maize grain prices to rise in the next month by 2.4 to 2.8 percent.

Last but not least, we find that the local maize procurement activities of the World Food Programme have no impact on mean price levels. WFP purchases tend to occur in the Lusaka area, and tend to be widely announced in advance. Market participants appear to incorporate this knowledge in advance into expected price movements.

3.1 Impacts of various policy variables on maize grain mean prices

Now we turn to the effects of various government policy variables on wholesale maize grain prices in Zambia, starting with the maize price stabilization operations of the government parastatal, the Food Reserve Agency (FRA).

Government maize purchase and sales program via FRA: The coefficients on lagged maize purchases by the parastatal Food Reserve Agency is negative (for Kabwe, Chipata and Choma markets), positive for Lusaka market, though these effects are statistically insignificant in all four markets. These results indicate that FRA purchases appear to have no significant impact on next month's market prices. While FRA intentions are to provide a floor price for grain trade in markets, it is sometimes the case that market prices exceed FRA buying prices, as in 2008. In such cases, FRA purchases may not exert upward pressure on maize prices as one might expect. Also, because FRA purchases result in stock accumulation, it is quite likely that marketing agents take account of the size of the government stock overhanging the market in their expectations of future prices later in the season. The FRA's pan-territorial and pan-seasonal pricing policy may also have complex and offsetting effects on the direction of near-term future market prices. The bulk of the FRA's maize procurement is soon after harvest, between July and October, when maize prices are relatively low. Typically, prices gradually rise and peak during the hunger period (December through March). Unfortunately, government purchases at the above market prices can influence seasonal price patterns and change the incentives of private agents wishing to store their maize after harvest in anticipation of a higher price later in the season.

By contrast, FRA maize sales put clear downward pressure on next month's maize prices. The impact of FRA maize sales is statistically significant in all the markets analyzed except for Kabwe market. When FRA sales are confined to periods of relatively high prices as they generally are with some notable exceptions, they reduce the magnitude of seasonal price increases and hence appear to have a stabilizing effect on market prices.

Table 6: OLS Estimates

Coefficients	Dependent Variable-Log of Maize Grain Prices							
	Lusaka (A)	Lusaka (B)	Kabwe (C)	Kabwe (D)	Chipata (E)	Chipata (F)	Choma (G)	Choma (H)
Log of maize price$_{t-1}$	0.601**	0.590**	0.740***	0.742***	0.681**	0.645**	0.780**	0.764**
	(4.61)	(4.44)	(13.2)	(12.6)	(9.63)	(9.25)	(11.1)	(10.3)
Time Trend	0.000	0.000	0.001	0.001	0.001	0.002	0.000	0.001
	(0.063)	(0.029)	(0.40)	(0.31)	(0.32)	(1.17)	(0.20)	(0.60)
Maize deficit period (=1)	0.123**	1.184	0.031	-0.949	0.215**	6.715*	0.112*	6.384*
	(2.81)	(0.65)	(0.69)	(-0.29)	(3.46)	(2.44)	(2.17)	(2.59)
Log of rainfall index	-0.501**	-0.513**	-0.271*	-0.252	-0.244	-0.416*	-0.485*	-0.618**
	(-3.16)	(-3.33)	(-1.84)	(-1.44)	(-1.23)	(-2.36)	(-2.46)	(-3.60)
Log of regional maize	-0.167	-0.193	0.199	0.195	-0.108	-0.045	-0.070	-0.036
production index	(-1.39)	(-1.52)	(1.42)	(1.36)	(-0.72)	(-0.30)	(-0.52)	(-0.27)
Log of fertilizer prices $_{t-1}$	0.231**	0.242**	0.255***	0.243**	0.173	0.282**	0.162+	0.234**
	(2.97)	(3.22)	(2.87)	(2.28)	(1.44)	(2.76)	(1.72)	(2.82)
Log of bread prices $_{t-1}$	-0.156	-0.156	0.048	0.042	0.102	0.124	-0.096	-0.082
	(-0.54)	(-0.54)	(0.19)	(0.16)	(0.40)	(0.52)	(-0.27)	(-0.23)
Log of South Africa prices $_{t-1}$	0.063	0.061	0.268***	0.255***	0.009	0.139+	0.015	0.101
	(1.02)	(0.93)	(3.78)	(2.95)	(0.14)	(1.80)	(0.19)	(1.08)
Log of real GDP per capita$_{t-1}$	0.136	0.120	-0.082	-0.080	-0.118	-0.077	-0.048	-0.039
	(1.05)	(0.91)	(-1.03)	(-0.96)	(-1.13)	(-0.67)	(-0.49)	(-0.37)
Log of WFP Purchases $_{t-1}$	0.001	0.001	-0.002	-0.002	-0.005	-0.006	-0.005	-0.005
	(0.14)	(0.18)	(-0.37)	(-0.35)	(-1.38)	(-1.63)	(-1.19)	(-1.23)
Log of Government purchases$_{t-1}$	0.006	0.006	-0.006	-0.005	-0.003	-0.005	-0.003	-0.005
	(1.29)	(1.29)	(-1.13)	(-1.06)	(-0.70)	(-1.01)	(-0.72)	(-1.00)
Log of Government sales$_{t-1}$	-0.031**	-0.028**	-0.007	-0.007	-0.031*	-0.042**	-0.030**	-0.035**
	(-3.14)	(-2.72)	(-0.68)	(-0.58)	(-2.44)	(-3.19)	(-2.63)	(-2.76)
Log of tariff rates $_{t-1}$	-0.006	-0.007	0.014	0.013	-0.035	-0.035	-0.001	0.006
	(-0.26)	(-0.31)	(0.52)	(0.47)	(-1.29)	(-1.35)	(-0.042)	(0.27)
Delayed Imports (=1) $_{t-1}$	0.239**	0.220*	0.299***	0.305***	0.224*	0.238**	0.192*	0.169*
	(3.18)	(2.54)	(2.99)	(2.79)	(2.28)	(2.74)	(2.30)	(2.12)
Delayed import duty waiver (=1) $_{t-1}$	0.031	0.040	0.170**	0.170**	0.141*	0.136+	0.049	0.051
	(0.55)	(0.68)	(2.43)	(2.39)	(2.06)	(1.95)	(0.60)	(0.62)
Export ban (=1) $_{t-1}$	-0.006	-0.019	-0.015	-0.016	-0.049	0.001	-0.071+	-0.050
	(-0.18)	(-0.49)	(-0.41)	(-0.44)	(-1.15)	(0.030)	(-1.84)	(-1.08)
Export ban* Deficit period		0.072		-0.003		0.028		-0.092
		(1.48)		(-0.069)		(0.58)		(-1.63)
South Africa prices* Deficit period		-0.086		0.071		-0.469*		-0.442*
		(-0.66)		(0.31)		(-2.41)		(-2.53)
Import Tariff *Deficit period		0.066		-0.014		-0.047		0.057
		(0.78)		(-0.13)		(-0.60)		(0.61)

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Monthly dummies:								
June (Aug.)	0.081	0.072	0.010	0.011	0.182*	0.164*	0.152+	0.154+
	(1.36)	(1.13)	(0.18)	(0.19)	(2.44)	(2.32)	(1.94)	(1.92)
July (Sept.)	0.093	0.084	0.057	0.058	0.245**	0.230**	0.199**	0.206**
	(1.54)	(1.32)	(1.58)	(1.49)	(3.47)	(3.41)	(2.70)	(2.72)
Aug. (Oct.)	0.066	0.060	0.115**	0.113**	0.247**	0.242**	0.216**	0.235**
	(0.69)	(0.59)	(2.34)	(2.15)	(3.55)	(3.62)	(2.73)	(2.85)
Sept (Nov.)	0.073	0.066	0.145**	0.143**	0.257**	0.260**	0.219*	0.242**
	(1.17)	(0.99)	(2.45)	(2.32)	(4.05)	(4.05)	(2.54)	(2.68)
Oct. (Dec)	0.131*	0.118+	0.145***	0.144***	0.227**	0.231**	0.248**	0.266**
	(2.17)	(1.78)	(3.06)	(2.84)	(2.84)	(2.98)	(3.55)	(3.51)
Nov. (Jan)	0.128*	0.116+	0.211***	0.210***	0.284**	0.290**	0.295**	0.315**
	(2.23)	(1.86)	(4.54)	(4.23)	(4.32)	(4.47)	(4.03)	(3.97)
Dec. (Feb)	0.234**	0.225**	0.186***	0.184***	0.295**	0.306**	0.282**	0.307**
	(3.68)	(3.27)	(3.97)	(3.59)	(3.79)	(3.86)	(4.03)	(4.03)
Jan.(Mar)	0.330**	0.321**	0.001	-0.001	0.364**	0.381**	0.391**	0.420**
	(4.16)	(3.92)	(0.016)	(-0.014)	(4.08)	(4.27)	(3.84)	(3.91)
Feb.(Apr)	0.239**	0.229**	0.088	0.087	0.377**	0.397**	0.289**	0.315**
	(3.93)	(3.59)	(1.12)	(1.06)	(5.57)	(5.97)	(4.37)	(4.23)
Mar.(May)	0.230**	0.219**	0.115**	0.114**	0.345**	0.363**	0.277**	0.298**
	(4.01)	(3.64)	(2.22)	(2.10)	(4.72)	(5.12)	(4.13)	(3.91)
Apr.(Jun.)	0.169**	0.158*	0.059	0.058	0.321**	0.348**	0.058	0.085
	(2.93)	(2.55)	(1.15)	(1.06)	(4.40)	(4.80)	(0.73)	(0.97)
Constant	7.242+	8.051+	-5.761	-5.492	6.285	2.925	6.630	4.836
	(1.89)	(1.96)	(-1.43)	(-1.31)	(1.28)	(0.61)	(1.40)	(1.03)
F-statistic								
Export ban*Deficit period	-	0.29	-	0.08	-	2.95*	-	3.24*
SA prices* Deficit period t	-	0.32	-	5.14**	-	3.18*	-	3.55*
Import Tariff *Deficit period t	-	1.80	-	0.13	-	3.19*	-	2.37*
Observations	174	174	174	174	174	174	174	174
R-squared	0.87	0.87	0.87	0.88	0.90	0.91	0.88	0.89

Notes: t statistics in parentheses, ** p<0.01, * p<0.05, + p<0.1. Models cover the months between January 1994 and April 2008

*Maize import tariffs***:** Raising or lowering import tariff rates has a negligible effect on domestic maize wholesale prices in Zambia, even during production shortfalls. The tariff elasticity with respect to real maize prices never exceeds 0.08 for any of the four markets analyzed, and the effects are never statistically different from zero at even the 20% level. The results also fail to indicate any differential effect of import tariff between good and bad season since the interaction term between the binary variable *deficit* and the import tariff rate is statistically insignificant for all markets tested (Columns B, D , F and H). These findings may not be at all surprising because of common anecdotal reports that traders tend to circumvent paying the tariff by smuggling across borders, making deals with border police, and because of trade reversals in some years (see Jayne et. al., 2008).

*Export ban***:** The impact of the maize export ban in Zambia continues to be debated. Although, the results are not statistically significant, the coefficient on the impact of lagged export ban on maize price is negative in all markets. This is consistent with expectations that an export ban depresses prices but the lack of statistical significance in all the markets except Choma market means that informal trade is occurring and partially venting surpluses across borders even though there is an official ban on exports. The export ban /maize deficit period interaction term is positive though not statistically significant for Lusaka and Chipata markets and negative for Kabwe and Choma markets.

Import restrictions: As one would predict, discretionary government actions like delaying imports and delaying the announcement of duty waivers raise mean price levels. Table 6 columns A to H show that the point estimates of these two variables measuring the discretionary government actions are positive and statistically significant (with the exception of Lusaka and Choma markets for the delayed import duty waiver variable which are positive but not statistically significant at 10% level. Because these *ad hoc* policy actions occur mainly during production shortfall years, they usually exacerbate upward price movements during periods when prices are already high. The delay in importing grain into Zambia after the government had announced their intention to import grain resulted in a 24% percent increase in next month's maize grain prices in Lusaka, 30% in Kabwe and 22% in Choma and Chipata. For every additional month that imports are delayed after the announcement, prices rise again by a similar amount each month. The main explanation for this major influence on prices is because when governments announce their decision to import, they usually sell the grain to millers at below the full cost of importation. Private trades realize that they cannot compete against subsidized imports and hence tend to stay out of the market during such periods. Hence, by the government's actions, all of the burden of importing sufficient quantities in a timely way thus falls on its shoulders. The damage comes when delays in government importation lead to tight supplies and even rationing, which has sent market prices skyrocketing during such periods as occurred in Zambia in early 2002 and early 2003 as can be seen in Figure 1.

Similar to delayed government imports, the effects of delayed duty waiver are also potentially very disruptive. Results in Table 6, Columns A to H, show that Kabwe prices rose by 17 percent and Chipata maize prices by 14 percent for each additional month's delay in the waiver of the import duty during a deficit situation. Grain traders in Zambia have indicated that if they suspect that the import tariff will be waived later in the year, they will wait until the tariff is actually waived before attempting to import. Mobilizing imports early (while the tariff is in place) runs the risk that they would lose their market later when competing against other firms that can import more cheaply once the tariff is waived. The result is commonly a temporary under-provision of imports, which can produce a situation in which local prices exceed import parity levels for periods of time. The impacts of delayed duty waiver on the other two markets (Lusaka and Choma) are also positive but not statistically significant.

Events in the 2005/06 marketing year in Zambia illustrate how uncertainty over the maize import tariff rate can affect market levels and volatility. Table 7 provides a brief chronology of events after May 2005, when it became apparent that the country was facing a food production shortfall.

Table 7: A Chronology of events in the Maize Market, 2005

Date	Action/No Action	Implications/Comments
January	• Government raises maize import duty from 5% to 15%	Raises the price at which importation becomes attractive, adversely affecting consumers in a shortfall year
May	• National Food Balance Sheet presented to government showing an import requirement of 85,000 tonnes • Millers, traders, and donors estimate that the commercial import requirement is instead 150,000 tonnes	To what extent is the National FBS able to accurately determine import requirements?
June	• Private sector requests lifting of the 15% import duty • Government refuses	CIF import price from South Africa is at US $210 per tonne
August 12	• Millers agree that 186,000 imports required • Millers request import permits from MACO and duty waiver from MFNP	CIF import price increases to $236 per tonne
August 26	• MACO announces lifting of import ban and that it will issue import permits for 150,000 tons millers and 50,000 tons to FRA • Ministry of Finance and National Planning still refuses to waive the import duty	Private sector continue to lobby government on waiving of duty
September 13	• After heavy lobbying by all the stakeholders, MFNP agrees to waive duty	No imports yet as permits not yet issued
September 26	• MACO issues permits • Millers begin to contract for imports	CIF price $256/ton
October and November	• FRA releases 50,000 tons of locally procured maize through tender at $210/ton (CIF import price stands at $266-287);	FRA's selling of maize substantially below import price causes many millers to opt for cheaper FRA maize instead of importing
November 8	• MACO advised private sector to stop importing because they are failing to comply with new phytosanitary regulations	Imports further slowed
November 15-18	• Millers finance trip to South Africa for Mt. Makulu phytosanitary unit Inspector to confirm that 8 new pests are not present in regions where traders are arranging exports to Zambia	"Wait and see" approach taken by private sector as they await the outcome of the inspection
November 21	• President Mwanawasa declares a national disaster at the request of Parliament.	
November 23:	• Mt. Makulu issues phytosanitary clearance; permits imports to resume	Thirteen days lost; CIF price from South Africa rises to $278 per tonne
December 3	• President Mwanawasa announces that millers should lower maize prices significantly due to the abrupt strengthening of the Kwacha (up 26% in two weeks)	Traders and millers who have already paid up contracts at the old exchange rate stand to lose 26% on their imports
December 7	• Stakeholders meet with MACO to discuss the maize situation	Exchange rate reduces Kwacha price of imports; but rising grain prices and transport costs combine to offset these gains
December 19	• Importation period extended to 31st March, 2006 • MACO writes to Ministry of Finance and National Planning to extend the import duty waiver	Potential for the uncertainty over the extension of the waiver to constrain imports (CIF price from South Africa rises to $320/tonne
December 28	• Import duty waiver extended to 31st March	

Source: Mwanaumo et al., 2005.

3.2 Impact of government marketing and trade policies on time path of maize prices

In order to examine the overall impact of government marketing and trade policies in Zambia, we use the model results to simulate a time path of the maize prices without government policies, by setting all government policy variables = 0, and compare this simulated "no intervention" time path with those of actual maize prices, which of course incorporate the effects of government interventions. The 'with' and 'without' government intervention maize price time paths are summarized in table 8 and graphed in Figures 1(a-d).

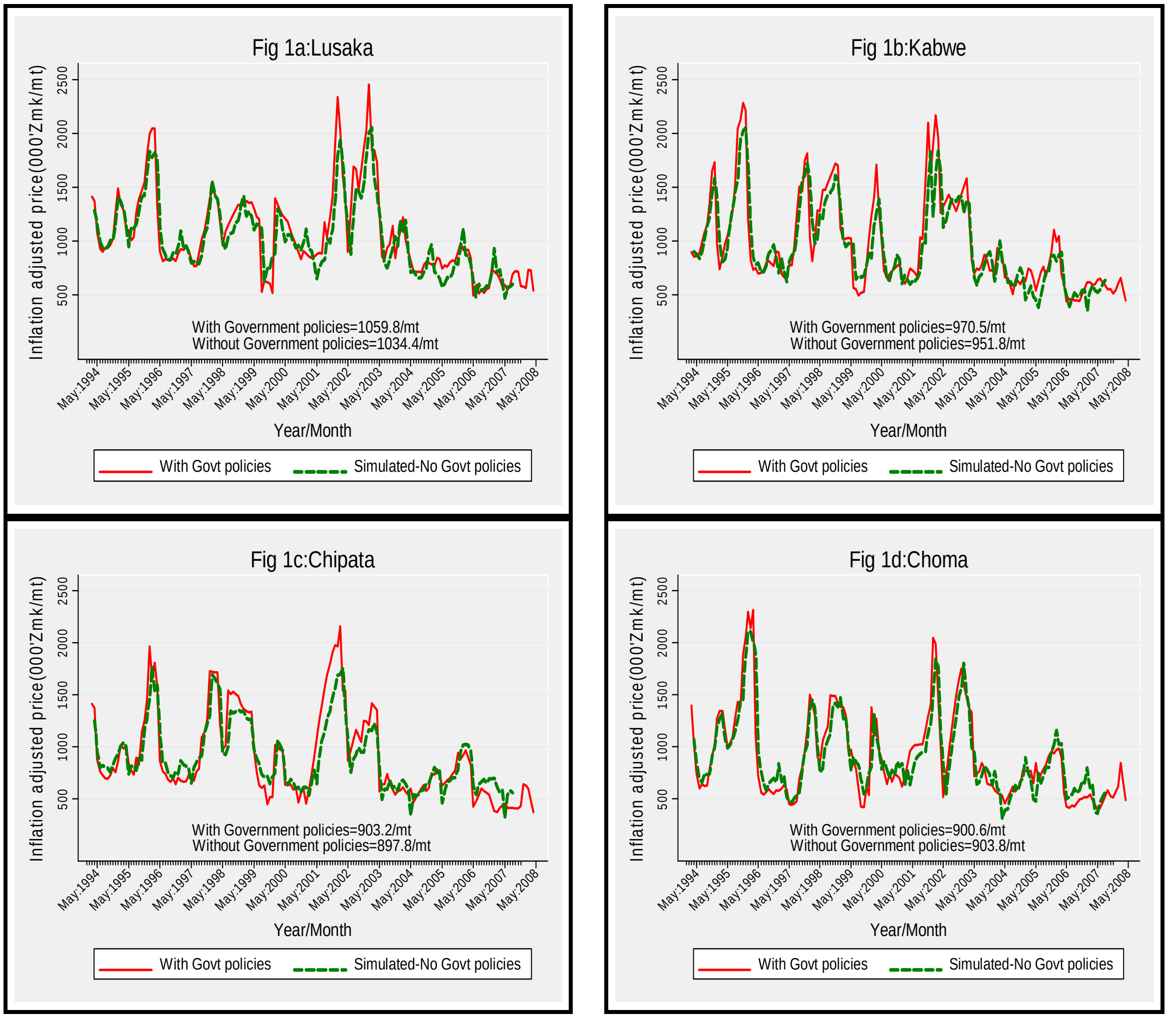
In general, the 'historical' and 'without intervention' prices are very similar in most periods. The main divergences in these prices occur in years of production shortfalls, such as the 2001/02, 2002/03, 2005/06 seasons, which is primarily when the various trade policy dummy variables in the model were in effect (=1). The results in Table 8 show that the unconditional coefficient of variation for maize grain prices in Zambia is higher with government marketing and trade policies compared to the counterfactual maize prices setting all government policy interventions to zero. The 'no intervention' CVs are between 10% and 30% lower than the CVs based on historical prices, with the highest difference recorded for Chipata market, near the border with Malawi and Mozambique.

Contrary to the maize price stabilization objectives pursued by the Zambian Government, the findings of this study indicate that the government marketing and trade policies have actually had a destabilizing effect on maize prices. This does not mean that the policy tools themselves are unable to stabilize prices; rather, the main reason for the results has to do with how the policies were implemented. The most important policy-related contributors to food price volatility were the time lags between the announcement of import duty waivers and the actual waiver, and the time lag between announcement of government imports and actual importation. Both of these delays exacerbated the extent of the maize price spikes during the 2001/02, 2002/03 and 2005/06 seasons.

Table 8: Unconditional coefficient of variation for maize grain prices in Zambia, with and without government policies comparison.

Market	Coefficient of Variation (%)		
	Historical prices (with Government Intervention)	**Simulated prices setting Government Intervention variables =0**	**% Difference**
	(A)	(B)	(C)
Lusaka	36.8	32.0	15.0
Kabwe	44.0	39.7	10.8
Choma	45.7	35.0	30.6
Chipata	45.8	40.5	13.1

Figure 1 (a-d): Comparison of historical and simulated "no intervention" real maize grain prices



Measures of price unpredictability

Recalling that unpredictability can be defined as the forecast error between one-step ahead actual and predicted prices, we used the predicted prices from the models presented in Table 6, computed the squared forecast errors from these models, and plotted the conditional coefficient of variations in Figure 2a-d. As mentioned earlier, the specification with one month lagged values for the policy variables is rather too strong since it assumes that market actors are able to know or correctly estimate the exact value for all government policy variables in the current month when they make their price expectations for the next month. Therefore, we go a step further and compare in Table 9 results for one month lagged values for policy variables assuming one month (cv1) with two months lag values (cv2) and results using mean values for government variables (cv3) for the whole period under analysis as well as the three phases proposed earlier. As expected, the results from the alternative assumptions result in larger forecast errors than the one month lag specification (Figure 2 a-d and Table

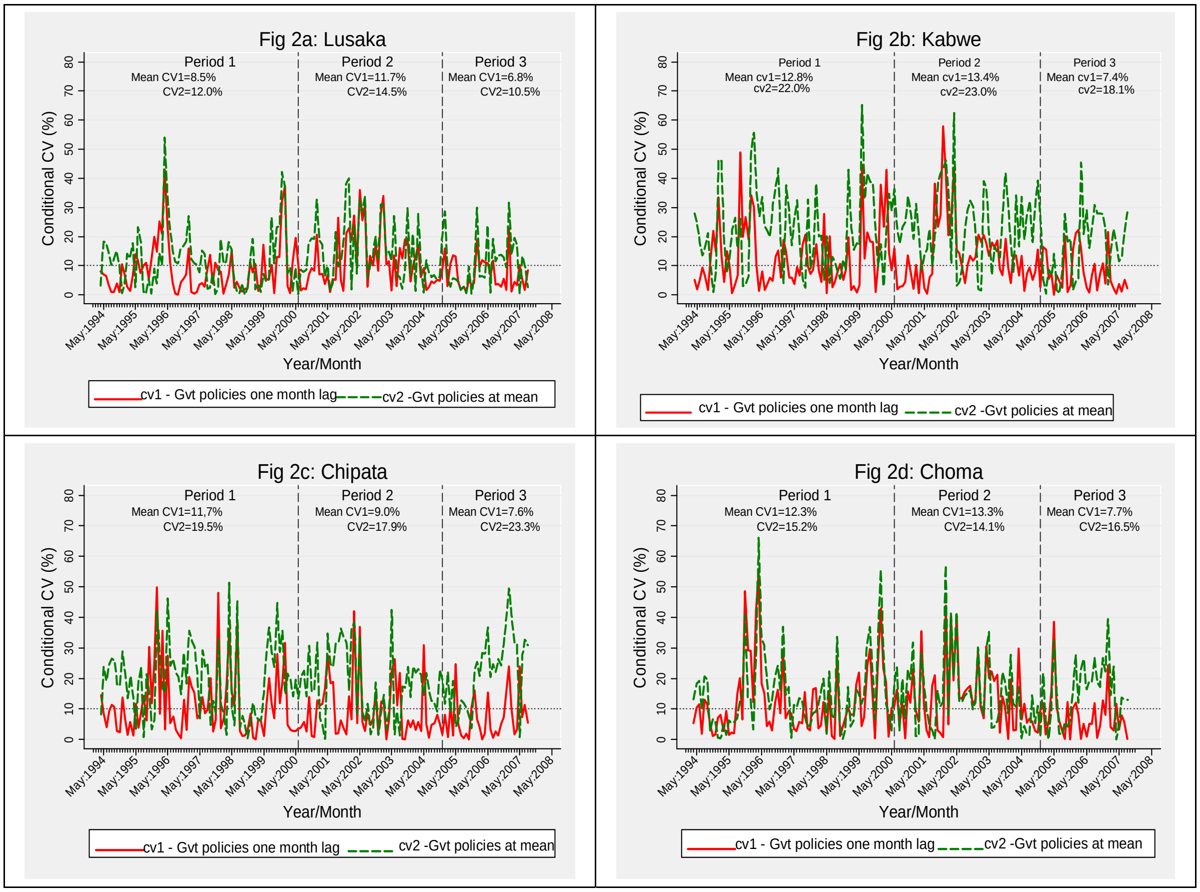
9). Since all these approaches are mere estimates we feel that the actual magnitude of price unpredictability is likely to fall between the conditional CVs of these three approaches.

Table 9: Comparison of conditional CV when government policy variables are lagged 1 month, 2 months and averaged over the sample period

Market	Overall Jan. 1994 – Dec. 2007			Period 1 (Jan .1994-Apr. 2000)			Period 2 (May . 2000-Apr. 2005)			Period 3 (May 2005 onwards)		
	One lag	Two lags	Mean Values	One lag	Two lags	Mean Values	One lag	Two lags	Mean Values	One lag	Two lags	Mean Values
	(A)	(B)	(C)	(D)	(E)	(F)	(G)	(H)	(I)	(J)	(K)	(L)
Lusaka	9.4%	10.0%	12.7%	8.5%	9.6%	12.0%	11.7%	11.8%	14.5%	6.8%	7.1%	10.5%
Kabwe	12.1%	12.8%	21.7%	12.8%	14.5%	22.0%	13.4%	13.2%	23.0%	7.4%	7.9%	18.1%
Choma	10.0%	10.7%	19.6%	12.3%	12.3%	15.2%	13.3%	10.0%	14.1%	7.7%	7.7%	16.5%
Chipata	11.9%	12.1%	15.0%	11.7%	13.0%	19.5%	9.0%	12.9%	17.9%	7.6%	8.0%	23.3%

For each market, the figures show that price instability was highest during the second period followed by the first period and then by Period 3, with the exception of Chipata. Generally, Figures 2a-d show that discretionary trade policy barriers and *ad hoc* government policies exacerbate price instability since the spikes in price instability coincide with periods when the government of Zambia implemented ad hoc measures to deal with maize shortfall in 2001/02, and 2004/05 marketing seasons and huge maize purchases by FRA in 2006/07 marketing season whilst the export ban was in place. These findings are somewhat an indication that the Zambian governments' well-meaning attempts to stabilize prices actually destabilize them because FRA operations and often on and off closed border policy put a cloud of uncertainty on the maize market depressing the long-term development of commercial markets. In such an environment private trade develops more slowly and more tentatively where government policy is unpredictable. As prices become more unpredictable, they make trade riskier and raise the implicit risk premia that traders build into their trading margins. These findings suggest that cost-effective means to reduce the unpredictability of maize prices in Zambia may have a high payoff in terms of raising both producer and consumer welfare.

Figure 2 (a-d): Comparison of Conditional Coefficient of Variation (Price unpredictability) by Country and Market.



4.0 CONCLUSION:

Staple food price instability remains a major problem in Zambia. The Zambia government has continued to 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. Policy tools to reduce price instability can themselves be a source of price instability.

This paper assessed the impacts of various maize marketing and trade policy instruments on maize price unpredictability in Zambia. Monthly maize prices for several regional markets from the period January 1994 to April 2008 are applied to reduced form Auto-distributed lag models for four major food markets in the country. This study highlights five findings: *First*, the government's purchases of maize to support maize prices through the Food Reserve Agency appeared to influence regional market prices in different directions, but in none of these regional markets were the effects statistically significant at even the 10% levels. By contrast, maize sales by the FRA maize are found to put strong downward pressure on next month's maize prices in all markets, with the impact being statistically significant in three of the four markets analyzed. When FRA sales are confined to periods of relatively high prices as they generally are with some notable exceptions, these results suggest that they have a stabilizing effect on market prices.

Based on the normal seasonal price movements we would expect maize prices to be relatively low after harvest in May-June and gradually rise and peak during the hunger season (December through March). Unfortunately, government maize sales at below-market prices disrupts this seasonal pattern in maize prices, which then reduces the returns to private intra-seasonal grain storage. It is likely that maize storage by both farmers and traders is under provisioned, in part because of the price risks introduced by the price depressing effects of government maize sales during the lean season. Nevertheless, the maize sales activities of the FRA, other features of government policy held constant do appear to achieve their objective of moderating the extent of seasonal maize price rises.

Second, the use of government trade policy tools such as altering maize import tariff rates and banning exports has negligible effect on the mean prices, suggesting that informal trade is largely circumventing the price impact of these trade policy tools. These findings may not be at all surprising because of the ability of informal cross-border traders to circumvent official border crossings, make deals with border police, as well as government trade reversals in some years (see Jayne et. al., 2008).

Third, the regression findings highlight the unintended effects on maize price levels resulting from time lags between announcing policy changes and actual implementation or execution of these policies. For example, announcing government intentions to import maize but then delaying the arrival of imports, or announcing that import duties will be waived but then delaying the time that they are actually waived raise the level of next month's maize price. Because government importation and the waiving of import duties often occur during production shortfall years, they usually exacerbate upward price movements during periods when prices are already high. Delays in importing grain after the government had announced its intention to import resulted in a 24% percent increase in next month's maize grain prices in Lusaka, 30% in Kabwe and 22% in Choma and Chipata. For every additional month that imports are delayed after the announcement, prices rise again by a similar amount each month. The main explanation for this large influence on prices is because when governments announce their decision to import, they usually sell the grain to millers at prices below the full cost of importation. Private trades realize that they cannot compete against subsidized imports and hence tend to stay out of the market during such periods. The damage comes when delays in government importation cause stock levels to dwindle, contributing to panic and rationing, which has sent market prices skyrocketing during such periods as occurred in Zambia in early 2002 and early 2003 and recently in 2008/09 marketing season.

Similar to delayed government imports, the effects of delayed duty waiver are also potentially very disruptive. Results show that Kabwe prices rose by 17 percent and Chipata maize prices by 14 percent for each additional month's delay in the waiver of the import duty after the government has announced that it would consider waiving the duty. The impacts of delayed duty waiver on the other two markets (Lusaka and Choma) are also positive but not statistically significant. Grain traders in Zambia have indicated that if they suspect that the import tariff will be waived later in the year, they will wait until the tariff is actually waived before attempting to import. Mobilizing imports early (while the tariff is in place) runs the risk that they would lose their market later when competing against other firms that can import more cheaply once the tariff is waived. The result is commonly a temporary under-provision of imports during the time period between a formal or informal announcement that the duty may be waived and the time that is actually waived. These forms of policy uncertainty contribute to a situation in which local prices exceed import parity levels for periods of time.

Fourth, we used the model to simulate the time path of maize prices assuming that the government did not buy or sell maize or restrict cross-border trade in any way. This can be done by setting all government policy variables in the model to zero, and comparing the time path of maize prices in this "no intervention" scenario compared to historical prices with the various government marketing and trade policy interventions. We find that the variability of maize prices in all four markets is higher with government marketing and trade policies compared to the counterfactual maize prices with all government policy interventions set to zero. In general, the coefficient of variation of maize prices in the 'no intervention' scenario is between 4.3% and 10% lower than those 'with government intervention'. Contrary to the price stabilization objectives pursued by the Zambian Government, the higher degree of price variability in the historical pattern of maize prices suggests that government marketing and trade policies have actually destabilized prices to some extent. Most of the instability appears not to be associated with FRA maize purchase and sale activities (its sales actually have helped to stabilize prices in high-priced periods), but rather the uncertainty over the timing of changes in ad hoc government trade policies. Price unpredictability tends to make trade riskier and raise the implicit risk premia that traders build into their trading margins.

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 which 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 can be impeded by uncertainty and associated risks for market participants.

These findings 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. Greater policy stability may also contribute to broader grain market development. For the most part, addressing problems of policy uncertainty involve very little cost per se, but do 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 entails a loss of control and autonomy – leaders are bound to act according to pre-defined rules and triggers. 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.

Last but not least, a "maize without borders" policy may be an important part of overall maize government policy that has a potential to considerably stabilize maize price for both consumers and producers. Open border policies protect domestic food markets against domestic shocks by allowing more food to be imported in times of shortage and exported in times of plenty. This study shows that taking the opposite action has not helped Zambia because trade barriers and government policies tend to exacerbate price unpredictability. This has an effect of dampening investment in the maize sector. Embracing open border policies and relying on regional trade to stabilize maize prices could be a win-win situation in terms of both efficiency and price instability (Badiane and Resnick, 2005). However, efficient regional trade certainly depends on the long-run development of key infrastructure, especially better road connections. In the short to medium term, however, policy and institutional changes can facilitate regional trade by becoming more rules-based, setting clear criteria for when changes in tariff rates or trade barriers will be instituted, and preferably reducing trade restrictions and cross-border trade barriers, both regulatory (e.g., phytosanitary standards) and bureaucratic (e.g., border crossing documentation).

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