Price Unpredictability, Trade Policy, and the Demand for Food Staples in Eastern and Southern Africa :
An Application of the ARCH Model

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Outline

1. Main Problem
2. Objective 1-Elasticity of demand function
3. Objective 2:
4. Preliminary findings
5. Policy Implications

Main problem:

- Staple food price instability remains a major problem east and southern Africa.
- Weather in the region is highly variable, leading to large inter-annual supply shifts.
- With inelastic demand for staple foods, shifts in supply result in wide price swings.
- Unstable prices for a strategic food staple such as maize, can have severe economic, social and political consequences (Timmer, 1995, Newberry and Stiglitz 1981, Myers 1988, 1992b, and Williams and Wright 1991).

Main problem:

- In response, many governments in east and southern Africa use a variety of pricing, marketing, and trade policy tools to influence and stabilize staple food market prices.
- These interventions take two main forms:
  - direct involvement in crop purchasing and sale at controlled prices via marketing board operations, and
  - discretionary trade policy instruments, such as variable export bans, sudden changes in import tariff rates, and government import programs.

Main problem:

- unfortunately, the *ad hoc* and discretionary nature of these policies may introduce a great deal of uncertainty for participants in the marketing system, with unclear implications for overall market price volatility.

- sources of policy unpredictability that lead to price instability
    - - export bans, import quotas
        - -(Year to year & within year)
    - - sudden changes in import tariff rates
    - - when and where the marketing board will operate
    - - prices at which the marketing board buys and sells

Main problem:

- Compelling rationale for trade policy, but often the theoretical benefits of trade policy break down during implementation.
- What is good economics may not be good politics.
- Ultimately the impact of trade policy restrictions on price stability is an empirical question.
- There remains a dearth of empirical evidence in Africa to assess the overall impact of trade policy on food price volatility.

Objectives:

1. To provide a conceptual framework that shows how government investment choices and trade policies may affect the shape of the demand curve for food staples

2. To assess the impacts of various maize marketing and trade policy instruments on maize price unpredictability in Zambia and Kenya.

Why Kenya and Zambia?

- The cases of Kenya and Zambia provide an interesting contrast in approaches to addressing food price instability:

  – Since inception of the East African Commission in January 2005, Kenya has adopted a stable trade policy regime and a relatively predictable role for government operations in domestic markets.

  – By contrast, Zambia uses a variety of *ad hoc* domestic marketing and external trade policy tools to stabilize prices and enters in and out of the maize market in largely unpredictable ways.

Objectives 1

- conceptual framework showing how government investment choices and trade policies affect the shape of the demand curve for food staples

The Elasticity of Demand Function

- Weather variation are the source of major shifts in the supply of grain in the region.
- Magnitude of instability generated from supply shocks depends on the elasticity for demand.
- Most analyses of food price instability treat the elasticity of demand as an exogenous variable.
- In actuality, the shape of the demand curve is responsive to government policy.

The Elasticity of Demand Function

- How then can governments use public investments and trade policy tools to widen the scope of the market and increase demand elasticity of food staples?

Problems with Supply-Driven Production Expansion

Inelastic Demand   Elastic Demand

Slide 1
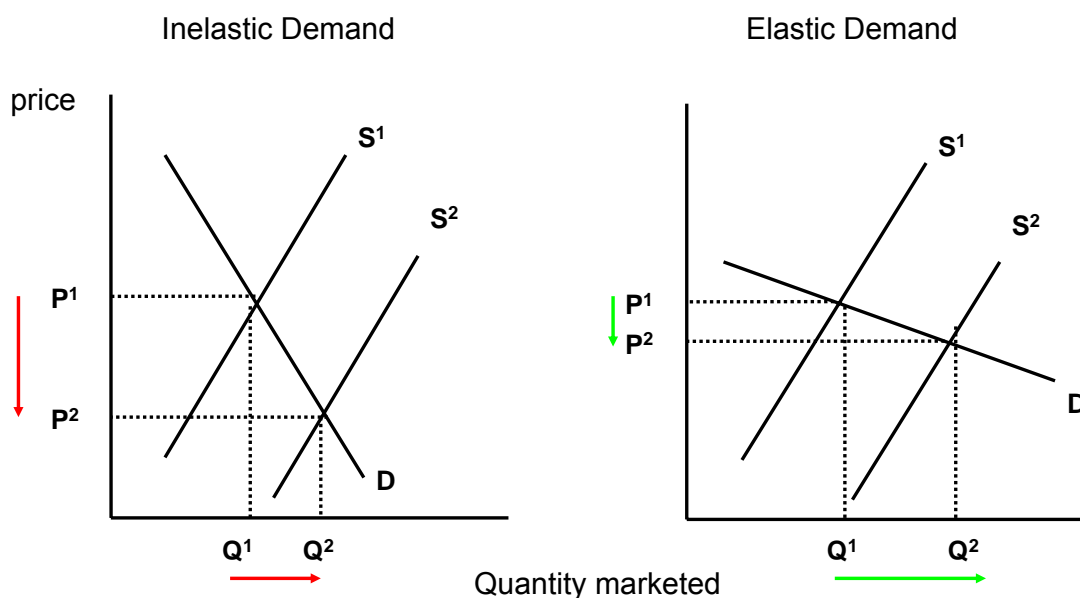
Slope of demand curve influenced by:
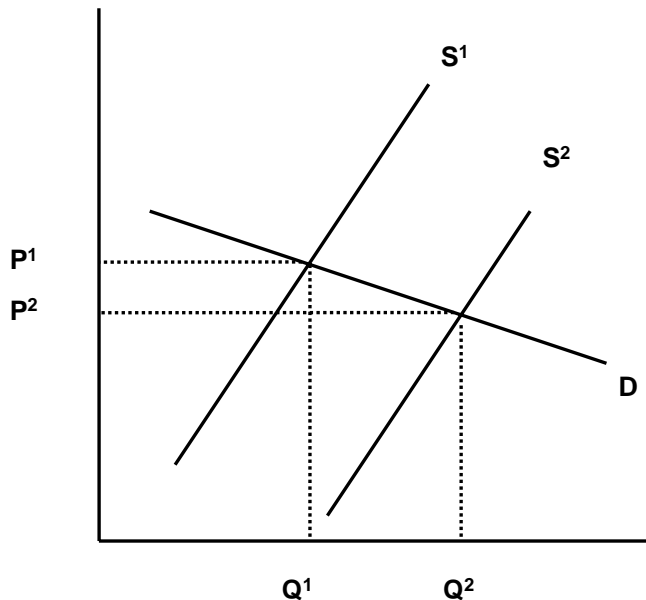
• transport infrastructure

• how diversified are food consumption patterns

• extent of investment in storage

• seasonal finance markets

• market institutions (e.g., warehouse receipt systems)

• trade / policy barriers (e.g., export bans, import tariffs)

MOST OF THESE FACTORS ARE INFLUENCED BY GOVERNMENT BEHAVIOR

Slide 2
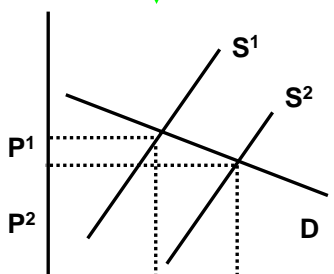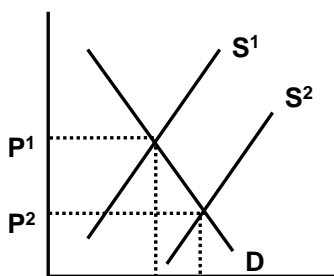
Slope of demand curve influenced by:

•**Physical & transport infrastructure development**

-Generally, the size of the market is determined by marketing costs.

-Transport costs-the largest single component of price differences between surplus and deficit area (Ahmed & Rustagi, 1984; Mittendorf, 1989).

-As transport costs decline, the size of the market expands for any particular farmer and demand becomes more elastic.

-Country's level of infrastructural development is associated with its level of agricultural productivity (Antle, 1983).

-More governments resources in physical infrastructure development may help change shape of the demand curve
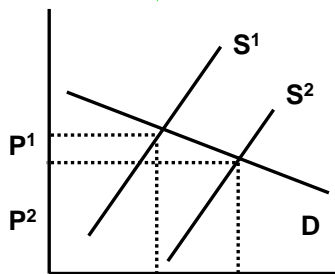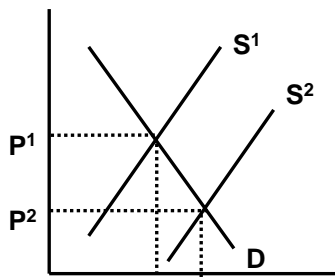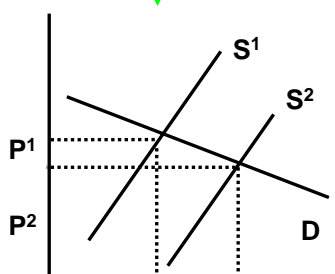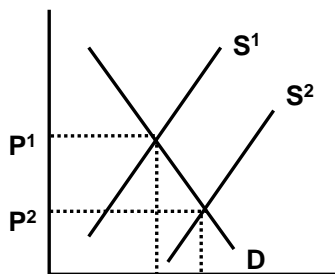
Slope of demand curve influenced by:

- **Regional trade**

  -Regional trade in combination with good transport infrastructure has potential to change shape of demand curve by:

  - ✓ expanding the size of the market
  - ✓ Mitigating local production shocks via linking areas with covariate production
  - ✓ providing consumers with an opportunity to access diversified food choices so that they can easily substitute one type of food for another

  -Unfortunately many countries in the region believe that only <u>being</u> self sufficient will offer the lasting solution not open borders.

Slope of demand curve influenced by:

- **Trade/policy barriers (e.g., export bans, import tariffs)**

  - Examples:

  -ad hoc and discretionary Export bans in Zambia

  -inconsistent rules governing inter-district trade → rife for rent seeking, higher marketing costs

  -Delay in issuing import permits during deficit years

  -traders wanting to move product from N. Mozambique to S. Malawi need to get export permit in Quelimane

  -Vacillations in trade policy inhibit bank financing for grain purchase (Uganda-Kenya example)

- **Streamlining regulations and trade policy will help capture the benefits of trade as well as change the slope of the demand curve.**
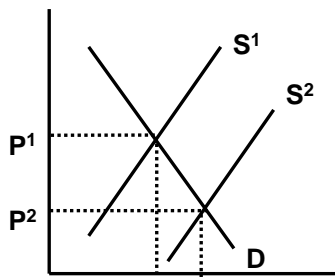
Slope of demand curve influenced by:

•**Polices affecting traders' capacity to absorb surplus production**

    •**Lack of seasonal finance market**

•**market institutions (e.g., WRS);**

•**extent of investment in storage**

-constrained supply of trader finance (Coulter and Shepherd, 1995)

-WRS can inject needed liquidity into system (incompatible with government operation in market)

-High cost/lack of medium-long term finance to finance grain storage (investment to risky since – government operation in market squeeze seasonal price rises)

-Uncertainty surrounding disposition of government storage facilities (Kopicki, 2005)**.**
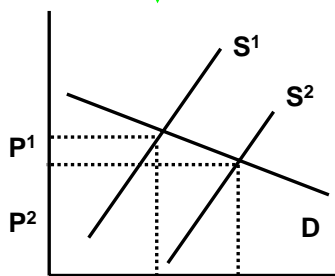
Slope of the demand curve and price instability

• This list is not exhaustive

• Price stabilization of course can impose perfectly elastic demand through controlled price.

• Our focus is on how government actions can affect the *market* elasticity of demand for food staples.

• Particular focus in this paper is on the class of discretionary, constantly changing, and unanticipated trade policy interventions implemented in east and southern Africa

Objective 2

- Empirical assessment of the impacts of various maize marketing and trade policy instruments on maize price unpredictability in Zambia and Kenya.

Price Instability VS. Price Unpredictability

- Price instability – the unconditional variance of prices, often measured as standard deviation or CV
- Price Unpredictability- the conditional variance of prices measure
- Forecast error: $P_{t+1}-E(P_{t+1}|F_t)=\varepsilon_{t+1}$
  - P_{it}=price in market t at time t+1
  - F_t=past information set containing realized values of all relevant values
  - $E(P_{t+1})$ expected price given available information F_t at time (not observable so measured via variation in past prices)

An ARCH Model

$$P_{it} = \alpha_0 + \sum_{i=1}^{s} \alpha_i P_{t-i} + \beta X_{it} + \varepsilon_{it} \qquad \varepsilon_{it} \sim N(0, h_{it}) \qquad [1]$$

$$h_{it} = \alpha_0' + \sum_{j=1}^{p} \alpha_i' \varepsilon_{t-j}^2 + \beta' Z_{it} + v_{it} \qquad v_{it} \sim i.i.d(0,1) \qquad [2]$$

- [1] and [2] used to explain maize price levels and price variance, conditional on X_{it} and Z_{it}

- X and Z is a vector of predetermined variables that are thought to influence mean price and variance of the residuals respectively

The vector of X and Z by Country

|	ZAMBIA	KENYA
Lagged prices	Yes	Yes
Lagged WFP local purchases	Yes	No
Lagged Prices in neighboring countries	Malawi, SA, Tanzania	Uganda, Tanzania
Lagged US Gulf Prices	No	Yes
Lagged Government maize purchases	Purchases (mt)	Purchase Price
Lagged Government maize sales	Sales (mt)	Sales Price
Lagged Maize import tariff rates	Yes	Yes
Lagged Government ad hoc policies (dummy variables) Export bans, import restrictions, delayed implementation of government intention to import	Yes	No

Data Sources

- Monthly retail/wholesale maize grain prices Zambia and Kenya
- Time period: Jan. 1994 to Dec. 2006
- Data comes from various sources including Ministries of Agriculture, NCPB (Kenya), FRA (Zambia), RATIN, Central Statistics Offices, WFP

Index of Variability in Monthly Maize Prices 1994-2006

Country	Market	Mean Price per US$/kg	Standard Deviation	Unconditional CV (%)
Zambia	Lusaka Into Mill	0.17	0.063	37
	Lusaka Central Mkt	0.14	0.056	40
	Choma	0.12	0.058	48
	Ndola	0.17	0.070	41
Kenya	Nairobi	0.21	0.050	24
	Kitale	0.17	0.056	33
	Nakuru	0.18	0.054	30
	Mombasa	0.20	0.050	25

NCPB and Nairobi market prices, 1994-2006, Kenya

Nairobi price | NCPB purchase price
NCPB sales price
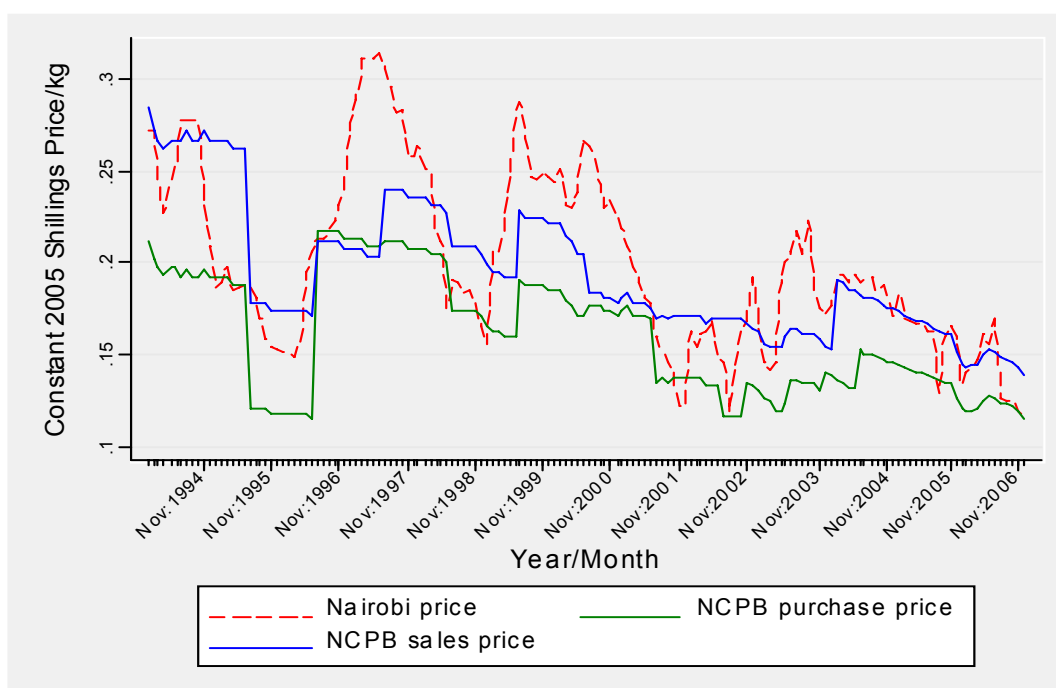
Lusaka into-Mill and Central Market prices, 1994-2006

Lusaka Central Market Price | Lusaka Into-Mill Price
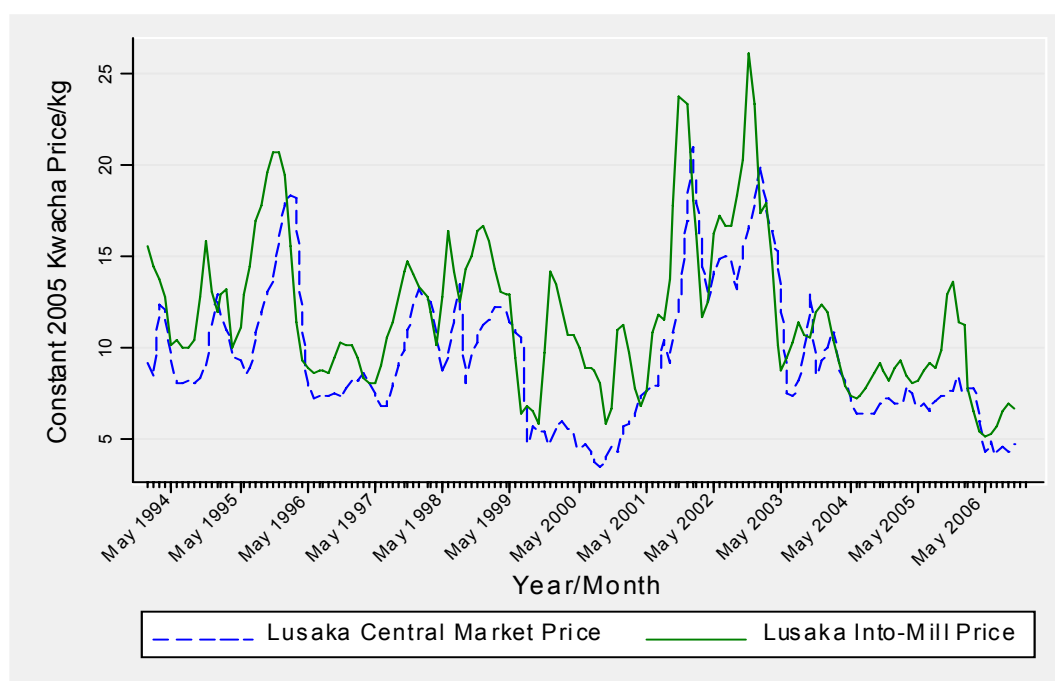
Preliminary Findings

1. WFP Purchases
   - WFP local procurement has no impact on mean price levels
   - Increase in WFP purchases tend to decrease conditional variance in Lusaka central market prices and Lusaka Into-Mill mill prices
   - WFP purchases tend to occur in Lusaka and tend to be announced well in advance

Preliminary Findings

2. Government purchases and sales
   - Zambia
     - Government purchases through FRA depresses mean prices
       - FRA activities dampen private sector normal activities between July and October
       - FRA purchases above market price disrupts normal seasonal price movements disrupting the activities of any storage agent
     - Effect on conditional variance is mixed
     - Government sales via FRA does not seem to have any effect on mean prices except on Into-Mill Prices but
     - Raise the conditional variance (Lusaka and Ndola)
     - These findings seem to suggest that government operations in the maize market are destabilizing prices

Preliminary Findings

2. Government purchases and sales
   – Kenya
     • In contrast to Zambia:
     • government purchases through NCPB raise mean prices as expected
     • To some extent government sales depress mean prices
     • NCPB activities do not have an effect on the conditional variance of prices except in Kitale where NCPB buying prices reduces the conditional variance
     • NCPB activities had a price stabilizing effect

Preliminary Findings

3. Maize Import tariffs
   • In general, as expected raising import tariffs raise mean prices in both Kenya and Zambia.
   • In Kenya, the import tariff contributed little in the way of increased unpredictability
   • Whilst, in Zambia raising maize import tariffs contributed to higher unpredictability in Into-Mill and Choma prices

Preliminary Findings

4. Maize Export Bans

    - Usefulness of maize export bans in Zambia continue to be debated.

    - Export ban depress mean prices (coefficients negative but not statistically significant)

    - Imposition of export bans tend to raise the conditional price variance

    - As expected export restrictions have stabilizing effect in drought years

Preliminary Findings

4. Import restrictions

    - Import restrictions (e.g., not issuing import permits) raise mean prices

    - Impact on conditional variance of prices is surprisingly negative (though point estimates are not statistically significant in 3 out of the four market prices.

Preliminary Findings

5. Delayed implementation of government intentions

    - Raised mean prices and conditional price variance

    - Untimely implementation of government announcement and policies not good for the development of markets

Zambia: Conditional Mean Equation

	Lusaka Into-Mill	Lusaka central market	Choma	Ndola
WFP Purchases	-0.0254 (-1.22)	0.0066 (0.35)	0.0279 (1.35)	-0.118 (-1.48)
Government sales	0.381*** (3.93)	-0.0707 (-0.76)	-0.104 (-0.93)	0.254 (1.11)
Government purchases	-0.346*** (-4.79)	-0.103 (-1.34)	-0.0611 (-0.62)	-0.773*** (-3.96)
Import Tariff	0.0796** (2.16)	0.0881** (2.22)	-0.00140 (-0.038)	-0.140 (-1.50)
Import restrictions	3.105*** (6.48)	0.172 (0.44)	-0.0039 (-0.006)	1.832** (2.14)
Delayed implementation of intention to import	2.142 (0.16)	1.508*** (3.29)	-0.418 (-0.85)	1.535** (2.26)
Export ban	-0.484 (-1.37)	-0.350 (-0.89)	-0.0422 (-0.12)	3.055*** (3.33)
Drought *Export ban	1.090* (1.91)	-0.575 (-1.59)	0.240 (0.41)	-2.251* (-1.94)
Drought *Import tariff	0.0625* (1.84)	0.00114 (0.040)	0.0096 (0.23)	-0.0186 (-0.23)

Zambia: Conditional Variance Equation

|	Lusaka Into-Mill	Lusaka central market	Choma	Ndola
WFP Purchases	-0.215** (-2.38)	0.0151 (0.15)	-0.156* (-1.87)	0.164** (2.57)
Government sales	0.275 (1.00)	0.906*** (3.06)	0.00803 (0.027)	0.588** (2.10)
Government purchases	0.486* (1.72)	-0.643 (-1.46)	-0.824*** (-3.16)	-0.328 (-1.12)
Import Tariff	0.666*** (4.56)	0.194 (1.23)	0.325** (2.55)	-0.147 (-1.34)
Import restrictions	-0.100 (-0.062)	-1.616 (-0.87)	-2.927*** (-2.65)	-1.882 (-0.81)
Delayed implementation of intention to import	1.893** (2.10)	3.622*** (3.08)	-0.963 (-1.17)	0.0666 (0.080)
Export ban	1.693 (1.51)	0.461 (0.24)	1.895** (2.06)	2.423*** (2.78)
Drought *Export ban	-1.969 (-1.41)	-4.633** (-2.16)	-1.626** (-1.98)	-3.988*** (-3.39)
Drought *Import tariff	0.496*** (4.55)	0.0178 (0.092)	0.123 (1.07)	-0.273** (-2.31)

Kenya: Conditional Mean Equation

	Nairobi price	Kitale Price	Nakuru Price	Mombasa Price
Government NCPB Buying Price	0.00184 (1.10)	0.00793*** (3.78)	0.00396** (2.17)	0.00162 (1.03)
Government NCPB Selling Price	-0.0002 (-0.16)	-0.0022 (-0.98)	0.0026* (1.85)	0.0005 (0.30)
Import Tariff	0.0007*** (4.93)	0.0003 (1.20)	0.0007*** (4.43)	0.0001 (0.70)

Conditional Variance equation

|	Nairobi price	Kitale Price	Nakuru Price	Mombasa Price
Government NCPB Buying Price	0.183 (0.64)	-0.733** (-2.39)	0.0182 (0.034)	0.179 (0.94)
Government NCPB Selling Price	-0.361(-1.16)	0.171 (0.74)	-0.343 (-0.76)	-0.343 (-0.76)
Import Tariff	0.107*** (2.73)	0.0072 (0.25)	0.0335 (0.75)	0.0091 (0.60)

Nairobi: Conditional Variance Plot

Fig 2. Conditional CV, Nairobi
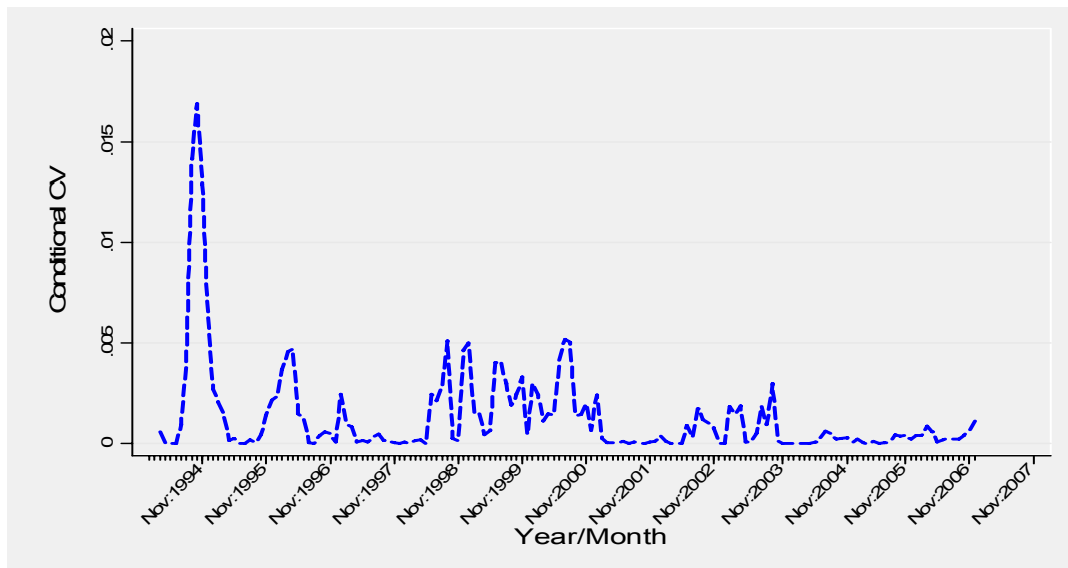
Lusaka: Conditional Variance Plot

Fig 2. Conditional CV, Lusaka
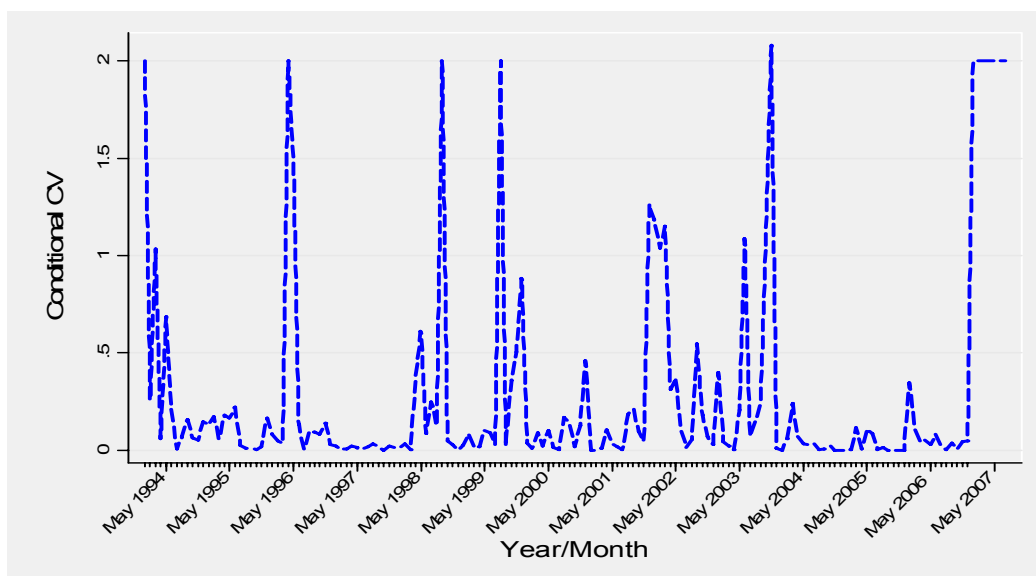
Policy Implications

- Elasticity of demand is not exogenous from standpoint of government.
- There are possibilities for government to deal with food staple price instability through trade policies and investment to raise the elasticity of demand for food markets.
- Stop-go and unpredictable policies in dealing with price instability generate uncertainty for participants and not good for the performance of food markets

Policy Implications

- Ad hoc type of trade and marketing policy tools used in east and southern countries to stabilize prices have for the most part destabilized them.
- A 'Maize without borders' policy may be an important part of overall government policy with the potential to stabilize grain prices for both consumers and producers.
- Trade can save limited tax resources by limiting government activities in the grain market and only limited to managing strategic reserves.

Policy Implications

- Private trading systems will always result in some price variation, but they tend not to cause the frequent food crises due to policy mistakes and inaction that are commonly seen in the region

thank you