Effects of Stock Holding Policy on Maize Prices: Evidence from Zambia

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Research Question:

- Are stockholding policies effective in stabilizing grain prices ?
- Households are vulnerable to price hikes for staple commodities. Volatile food prices can bring about economic and civil unrest (Bellemare 2015; Fjelde 2014; Weinberg and Bakker 2015)
- Many developing countries have intervened in their domestic agricultural markets to stabilize food prices to prevent shocks from domestic production and from the international price movement (Minot 2011).
- Not limited to emergency reserves but as long-term food self-sufficiency policies (Calpe 2017)
- Stockholding re-emerged in the early 2000s and again dominant players in African grain markets (Jayne, 2012)

Background

- Established in 1996, the FRA purchases substantial maize from small households in various geographic regions since the 2003/04 marketing year
- As a parastatal strategic food reserve/maize marketing board, has become the country's dominant buyer of smallholder maize
- However, the stock building comes at a considerable financial cost. The procurement and selling of maize at subsidized prices along with the input subsidies account for over 43% of the total agricultural budget (Nkonde et al. 2011).

Research Question:

- Can FRA purchases raise prices for surplus maize producers during time of harvest?

- Can FRA sales mitigate retail price swings associated with domestic production shocks?

Preview of Results:

- Controlling for other policies in place, we find evidence of stabilizing effects of FRA activities on retail prices in the major district markets (1%-4% decrease through FRA sales).

- FRA purchases raise local prices for surplus maize producers during the time of harvest (1%-3% increase in price for an average amount of FRA purchase)

- FRA sales help to lower the price during the lean seasons.

(0.7%-7% decrease in price for an average amount of FRA purchase)

Contribution

- Provides empirical evidence on whether stockholding programs stabilize consumer price over space and time by conducting research on a wide range of maize markets in Zambia
- Most studies evaluating stock-holding programs use VAR-type analysis on a limited number of markets while the effects of program vary over time and space
- Solve endogeneity issue in the purchase and sales by using instrumental variables

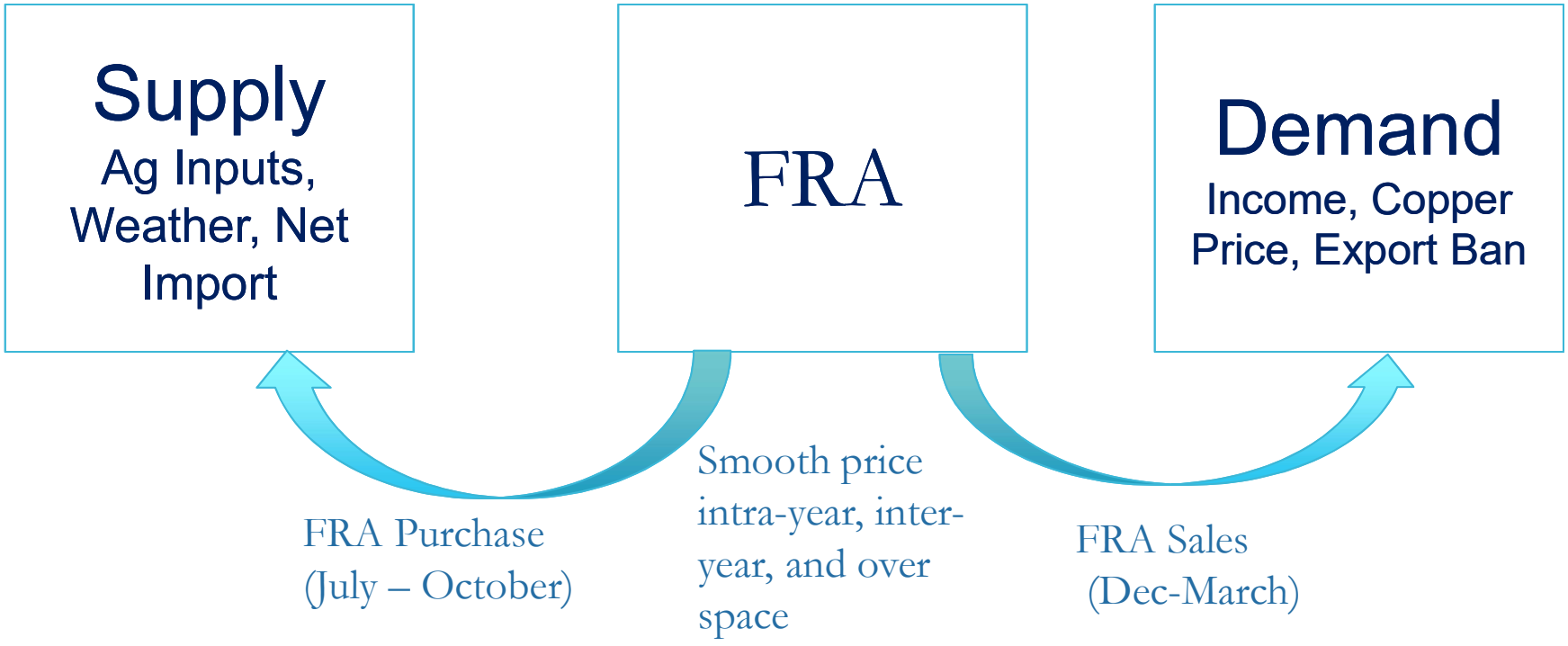
Literature Review: Theoretical

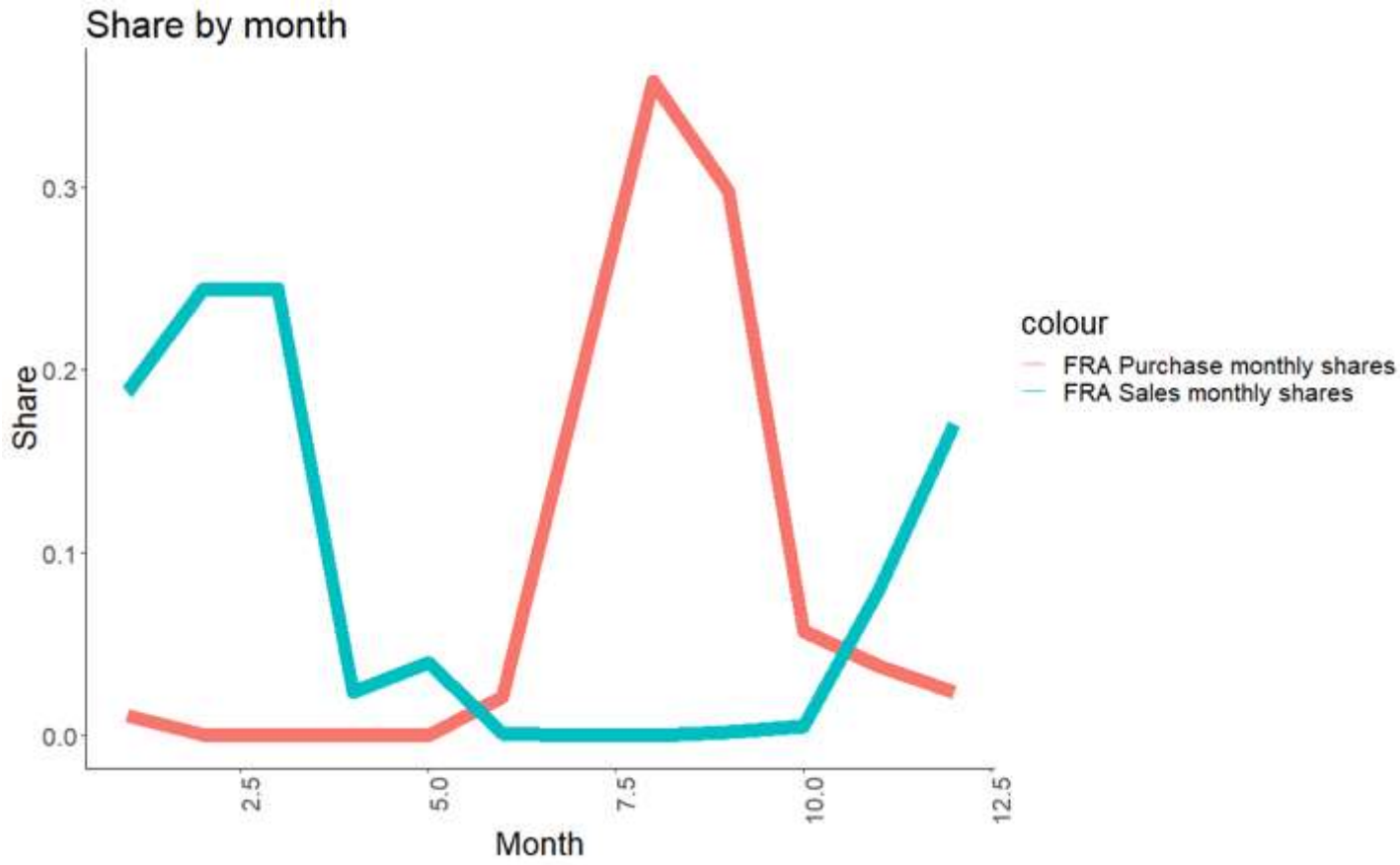
- Commodity storage models as early as Gustafson (1958), further developed by Scheinkman and Schechtman (1983) , Wright and Williams (1982), Williams and Wright (1991, Chapter 14), Miranda and Glauber (1995) and others help us understand the value of building buffer stock in stabilizing prices.
- Using a rational expectations storage model, Gouel and Jean (2012) proposed a theoretically optimal food price stabilization policy for a small developing country is to maintain a public stock along with a subsidy on agricultural production to prevent shocks from domestic production and international prices.

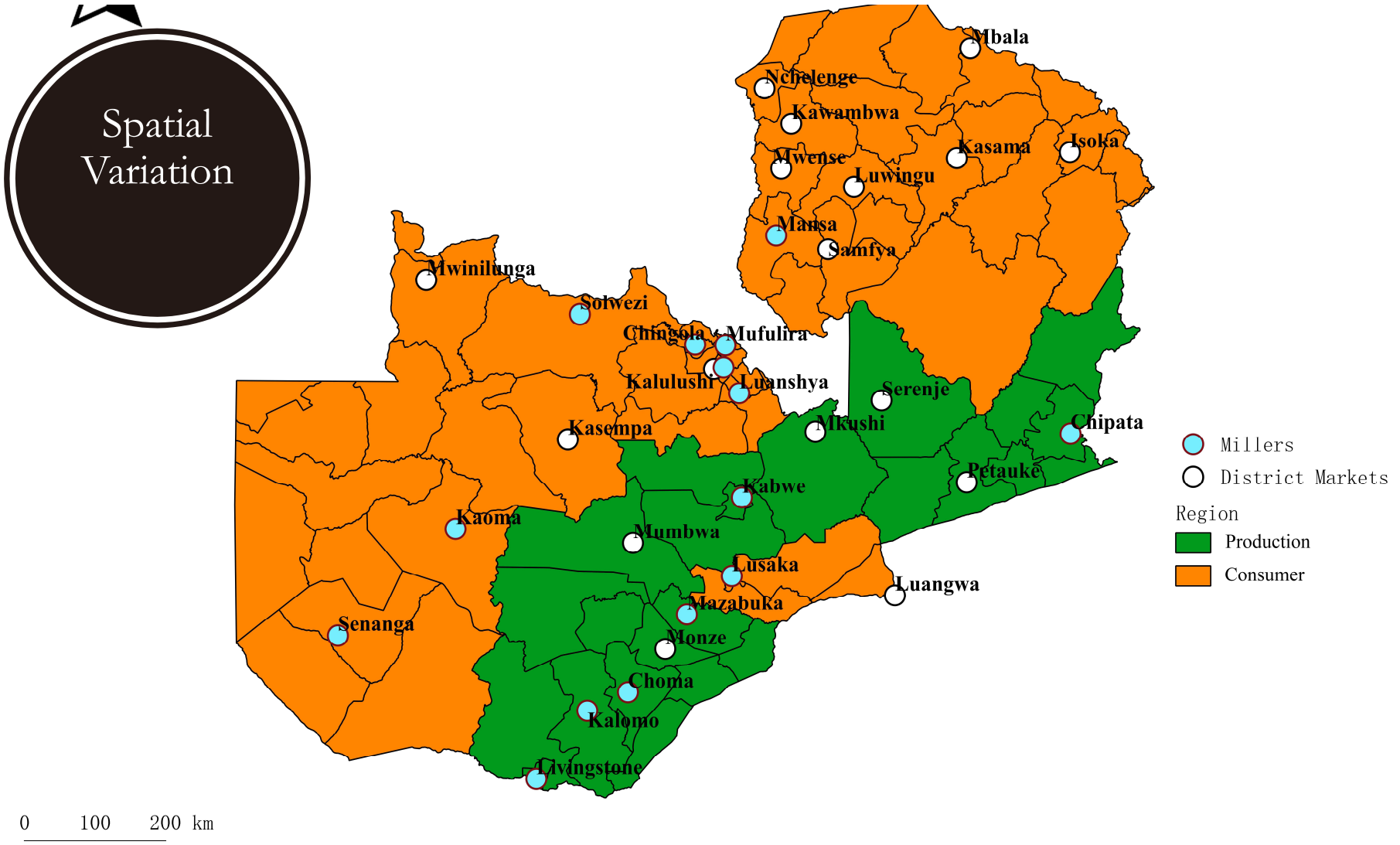
Literature Review: Empirical

	Country	Stabilizing	Purchase	Sales
Jayne et al. (2008)	Kenya	Yes	Positive	
Chapoto and Jayne (2009)	Zambia		No effect	Negative
Mason and Myers (2013)	Zambia	Yes	Positive	
Pierre et al (2018)	Tanzania		No effect	Negative(for some mkts)
Rashid and Negassa (2011)	Ethiopia	Yes		
Intal et al. (2012)	Philippines	Yes	No effect	
This Study	**Zambia**	**Yes**	**Positive**	**Negative**

Framework: a system of Demand and Supply




Share by month
Share
0.3
0.2
0.1
0.0
2.5
5.0
7.5
10.0
12.5
Month
colour
FRA Purchase monthly shares
FRA Sales monthly shares


Spatial Variation
Mbala
Nchelenge
Kawambwa
Mwense
Kasama
Isoka
Luwingu
Mansa
Samfya
Mwinilunga
Solwezi
Chingola
Mufulira
Kalulushi
Luanshya
Serenje
Kasempa
Mkushi
Chipata
Petauke
Kabwe
Kaoma
Mumbwa
Lusaka
Luangwa
Mazabuka
Senanga
Monze
Choma
Kalomo
Livingstone
Millers
District Markets
Region
Production
Consumer
0
100
200 km

Reduced Form Model

$$Y_{it} = Y_{i,t-1} + FRA\_buy_{it}\alpha + FRA\_sale_{it}\beta + W_{i,t-1}\gamma + X_{it} + month_t + mkt_i + \varepsilon_{it}$$

Y_{it} is price and price deviations at district i at time t
$W_{i,t-1}$ is a vector of weather variables from the previous growing season
X_{it} is a vector of other demand/supply shifter , and ε_{it} is a random error term.

Following Chapoto and Jayne (2009)

Endogeneity: Purchase

- FRA targets explicitly areas that are predicted to be in surplus as locations for their purchases and possibly target more purchase in a bad year

    - Instrument for FRA purchases using FRA stated purchase behavior (purchase target directed by CFS prediction of harvest)
    - If not, FRA actions are correlated with changes in production over time and space. Overestimate the effect of FRA purchases on stabilizing the prices since FRA purchase are typically made in places of surplus maize and price tend to be more stable.

Construction of IV: FRA Purchase

- Predicted FRA purchases at district i at month t:
  - Predicted national production of a certain year * Long-run average of district i's share in the total national production * Average monthly shares of FRA purchase
  (Predicted production and long-run average shares calculated from the Crop Forecast Survey)
- Relevance
  - CFS is sampled to estimate national harvest and used as references for setting goals for FRA purchases and FRA purchase price
- Argument around Exclusion Restriction
  - Using long-run averages shares, not specific to a specific year's harvest and hence not impacting the current local prices directly
  - CFS estimate may not be accurate in terms of actual harvest and hence not strongly correlated with the current prices

Endogeneity: Sales

- A possible reverse causality exists as FRA tends to sell more maize when the price is higher.
    - Instrument for FRA Sales using predicted production weighted by distance to nearby millers and number of millers and limit to months that sales tend to occur
    - Strip out annual * district variation where other policy might respond to local supply and demand
    - If not, the effects of sales would appear to increase prices

Construction of IV: FRA Sales

- Predicted FRA Sales at district i at month t:
  - Predicted district i's FRA stock of a certain year * Distance weights to nearby districts with millers * Average monthly shares of FRA Sales

- Relevance
  - Predicted FRA stock from CFS correlated with actual FRA stocks that a district has
- Exclusion
  - Distance to districts with milling companies don't change, at least not in a few years
  - Using long-run averages shares, not specific to a specific year's harvest and hence not impacting the current local prices directly

Endogeneity: Simultaneous policies

- "It is practically impossible to separate stockholding policies from other domestic policies. Any government program that involves buying or releasing cereals leads to the creation of public stocks" (Deuss 2014)
- Fertilizer Input Subsidy Program , Export Ban on maize, government initiated imports
  - Mostly year-over-year variations
  - Removed by having the lagged price and agriculture-related weather shocks in the regression

Data

- Monthly Zambia retail maize prices of 32 markets from Jan. 2003 to Dec. 2008
- Annual Zambia FRA purchases from 2002 to 2009 by the district from the FRA, and monthly national total purchase
- Monthly national FRA sales from the FRA
- Agriculturally-relevant precipitation from the Climate Hazards Group InfraRed Precipitation with Station (CHIRPS) during the October–April growing season.
- Temperature data from the African Drought Monitor

Variables	*Mean*	*SD*	*Min*	*Max*
Dependent variables				
Maize Price (ZMK/ kg)	573.8051	182.0592	235.3799	1555.6
Price Deviation Squared	26094.09	52640.71	0.029471	674142.8
Key variables				
FRA Purchase (MT)	257.4658	845.5297	0	10310.93
FRA Sales (MT)	5.122118	31.83187	0	655.8752
Explanatory variables				
Days without rain	27.453	11.520	1.000	56.000
Precipitation(mm)	1068.551	197.276	550.444	1640.263
Mean Temperature (°C)	24.918	0.837	23.220	27.064
Heat days	3.885	5.457	0.000	28.000
SAFEX Price (ZMK/ kg)	789.909	217.037	468.753	1279.758
Instrumental variables				
Production Region				
Predicted purchase target	3358.519	15746.14	0	216272
Predicted sales target	2016.894	6715.656	0	86699.47

Price Regressions

Price	(1) FE	(2) FE+IV	(3) FE+IV	(4) FE+IV
FRA Purchase	0.011**	0.016**	0.017***	0.021***
	(0.003)	(0.007)	(0.007)	(0.007)
FRA Sales	-0.382**	-5.673***	-5.513***	-5.522***
	(0.125)	(1.296)	(1.293)	(1.203)
Lag price	0.552***	0.502***	0.487***	0.441***
	(0.074)	(0.032)	(0.031)	(0.033)
Year Dummy	No	No	No	Yes
Weather Vars	Yes	Yes	Yes	No
Net Imports	No	No	Yes	Yes
N	2232	2232	2232	2232
Cluster	32	32	32	32
Anderson canon. corr. LM statistic	-	25.007	24.128	27.983
Cragg-Donald Wald F statistic	-	12.362	11.917	13.845

Price Deviation Regressions

Price Deviation	(1) FE	(2) FE+IV	(3) FE+IV	(4) FE+IV
FRA Purchase	1.523*	1.520	2.322	3.662*
	(0.700)	(2.052)	(2.003)	(1.914)
FRA Sales	-31.865	-1228.549***	-1120.732***	-1042.131***
	(21.126)	(379.197)	(376.521)	(338.846)
Lag price	0.395**	0.381***	0.367***	0.319***
	(0.120)	(0.025)	(0.024)	(0.024)
Year Dummy	No	No	No	Yes
Weather Vars	Yes	Yes	Yes	No
Net Imports	No	No	Yes	Yes
N	2232	2232	2232	2232
Cluster	32	32	32	32
Anderson canon. corr. LM statistic	-	27.038	25.558	29.493
Cragg-Donald Wald F statistic	-	13.378	12.631	14.603

Results:

- Controlling for other policies in place, we find evidence of stabilizing effects of FRA activities on retail prices in the major district markets (1%-4% decrease through FRA sales).

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Other things to consider…

- Management and transparency: late payment
- Fiscal impact: worth it ?
- Opportunity cost in investing other programs
- Crowding out of the private sector: government face a bigger role, and then more pressure on the budget
- International spillovers: for large country, generates nervousness on the international markets; for small country, impact neighboring countries

Other things to consider…

- Spatial lag
- Transportation cost
- Robustness checks
  - Subset samples : by region, by distance

Thank you !