Outline

* Research Question:
  + 1. Can FRA purchases mitigate or exacerbate the retail price swings associated with the weather?
  + 2. whether FRA stockholding policies have a price stabilization effect on consumer prices (across years and during a year in the lean season)
  + 3. (?) Can FRA sales reduce current maize prices?
* Motivation:
  + 1. Gouel and Jean (2012) proposed a theoretically optimal food price stabilization policy for a developing country is to maintain a public stock along with a subsidy on agricultural production. They argue that the restrictions on grain exports are necessary since price soothing effect generated through buffer stocks would leak to the external market when there is both a domestic production shock and an international price spike. This is precisely the policy combination used in Zambia with its public stock building policy with FRA, farm-input subsidy and restrictions on maize exports.
  + 2. The FRA purchases substantial maize from small households in various geographic regions since the 2003/04 marketing year (corresponding to the study period in this paper). The high pan-territorial buying price makes the FRA the dominant buyer in the market (Mason and Myers 2013). In 2006 and 2007, the FRA bought more than half of the surplus maize by smallholder farmers (Ricker-Gilbert et al. 2013), which helps to build higher maize stocks. These measures to make higher stocks have led the national maize stocks to reach historically high levels after 2009 (shown in Figure 1). 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).
  + 3. The endogeneity issue of identifying the effects of FRA purchases on consumer prices.
    - First, several policies were at play, and all to a certain degree endogenous to grain production and maize prices. These policies include but not limited to temporary export bans, government subsided imported maize from South Africa and targeted fertilizer subsidy program for smallholder farmers.
      * control: most of the policies listed above are year over year variations, can be proxied by adding a time trend, year fixed effect, and weather shocks in certain years.
    - Second, the major district markets are in a certain degree connected through trade. According to the rule of one price, the prices of these markets are driven towards the same price because of potential arbitrages. However, the previous study shows that due to the incomplete infrastructure and a lack of market information system, the level of price integration in developing countries is not so much. Prices in markets far away from the primary production and consumer centers respond little (see appendix on price integration) to prices shocks outside.
      * Control: argue for relative exogenous prices in the “pure” control group (both unaffected by price arbitrage or by the FRA purchases)
    - Since the FRA targets explicitly areas that are predicted to be in surplus as locations for their purchases, we need to control for endogeneity in the amount of FRA purchase.
      * Control: Instrument for FRA purchases using long-run shares of production of each district
* Methods:
  + Identification strategy: use differential amounts of FRA purchases to identify the effect of FRA purchases on local prices.
  + The Zambia government uses CFS to get an estimate of the local production for the major districts. This gives us the opportunity to an instrument for purchases by the predicted output from the CFS while controlling for actual district level production shocks that are weather-related.
    - Price = S (fra\_sale) + D (fra\_buy)
  + Retail price as a function of supply and demand, where FRA purchases affect demand and FRA sales affect supply.
  + Without the FRA, we would expect prices to go up by the cost of storage throughout the year and would be essentially the price of South African maize plus transport price in rural areas. With FRA increasing purchases at harvest and releasing those sales throughout the year, this should increase the price at harvest to something approximating the FRA price, and lower the prices in urban areas during times when the stocks are sold, essentially 'flattening out' the price surface - both over time and space. That's the variation within the year.
    - fra\_buyt = fra\_buy t-1 + harvestt
  + As for variation between years, FRA purchases today are a function of current stocks (~ purchases from last year) and total country-wide harvest quantities, where if harvest quantities are low, purchases are higher, which should doubly-increase the price at harvest during bad years. However, it should have a bigger price-smoothing effect in those bad years (at least over time - I'm not sure if that's still true over space).
  + Factors that would affect how much FRA purchases and where each year
    - FRA storage facility available
    - Measure of local transportation cost
    - Maize production in past years
    - Maize production in current year
    - FRA Maize purchase price set for the year
  + Factors that would affect and how much and when they sell.
    - Should be mostly miller driven
    - Number of millers
    - Location to nearby millers
    - Price of maize and other grains
  + The FRA purchase price is set once every year and stay the same in the entire crop year (May to April). The price is pan-territorial, meaning the price is the same for all districts in the country. On the other hand, the FRA sales price varies month to month.
  + An instrument for FRA purchases using long-run shares of production by district (or long-run shares of FRA purchases by district) times the deviation of CFS expected total output from a long-run average (to capture the annual purchase targets). Then we don't need to worry about yearly deviations from district to district affecting our instrumented FRA purchase amounts.
  + The total amount of national harvest that year predicted by the CFS times the average share of national FRA purchases/national harvest over the past x number of years.
* Data:
  + Monthly Zambia maize prices observed from Jan. 2003 to Dec. 2008 from 32 different markets that spread out in different geolocations in Zambia (use map of markets as figure 1). There are considerable variations in the markets, including food demand, population, food production and cost of transportation. Price data were collected by the World Food Program and the Central Statistical Office in Zambia.
  + We generate measures of agriculturally-relevant precipitation from the Climate Hazards Group InfraRed Precipitation with Station (CHIRPS) dataset (Funk et al., 2015). We use the total amount of rainfall that fell during the October–April rainy season. For the same season, we define the length of the longest dry spell as the number of continuous days with no rain. To measure the beginning of the rainy season, we calculate the number of days after October 1st in which rainfall more significant than 10 mm fell three days out of 5. These three variables are taken from the prior agricultural season to predict food availability for the June/July maize harvest.
  + Temperature data are from the African Drought Monitor, also limited to the maize growing season. We created average temperature during the growing season, growing degree days (number of days where the temp was between 8 to 32 C) and heat days (days temperature greater than 30 C) following Deschênes and Greenstone (2007). The weather measures used in this paper are more accurate and complete compared to only using precipitation as in Dorosh (2009) and Chaopoto and Jayne (2009b)
  + Annual Zambia FRA purchases from 2002 to 2009 by the district from the FRA. Yearly stock and crop acreage estimate from USDA. South African prices, net imports from South Africa from Johannesburg Stock Exchange and South African Reserve Bank. List of commercial millers working with the FRA from CSO.
* Main Results (more to come)
  + The sum of FRA purchase in local markets in the previous year associated with a lower price in the next year during the lean season
  + FRA sales and price reflects that the FRA sells more maize in a month when the price is higher (reverse causality)