Food Production Shocks and Agricultural Supply Elasticities in Sub-Saharan Africa

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Estimates food supply elasticities in SSA

Identifies the supply equation using precipitation and temperature as instrumental variables

Finds stronger production responses to price shocks in SSA than elsewhere

Finds inherently stronger price responses to climate shocks

Contribution: Model supply elasticity when commodity storage is low
Food insecurity in SSA is still high and on the rise
Food markets in SSA are different than world markets

- US biofuel expansion
- Beginning of food price crisis

Cumulative per cent increase since 2006:01
Research gap

What we do know

- Market stability important for food supply (FS)
- World markets stabilized by storage (and trade)
- Global food supply elasticity is at about 0.1
- Food markets do not work well in SSA (?)
- Production, Trade and storage levels in SSA are low
- Food markets in SSA inherently volatile

What we do not know

- Market fundamentals in SSA
- e.g. Food supply elasticity in SSA
- How do food markets work if stocks are low (or non-existent)
- Storage infrastructure and stock-taking activity
- Implications for competitive storage theory
Commodity storage theory

- Markets are stabilized (quantity + price) by stock taking
- Food sellers ponder current marginal utility (MU) of produce against future MU, depending on current price & production and expected price & production
- Stockpiling is competitive when prices are low
- At the aggregate level → balancing mechanism against extreme prices and supply
- Stabilizes food markets around the world (similar to trade)
- (When global stocks are low, food prices rise vs. versa)
Supply-side equations of the world food market model (Roberts & Schlenker, 2013, AER, Ghanem & Smith, 2020, AJAE; Hendricks, Janzen and Smith, 2015, AJAE)

\[ q_t = \alpha + \beta p_t + \gamma \omega_t + f_1(t) + u_t \]
\[ p_t = \delta + \mu_1 \omega_t + \mu_2 \omega_{t-1} + f_2(t) + \epsilon_t. \]

- IV: Exogenous weather shocks (\( \omega \)) are instruments to identify supply elasticity (\( \beta \))
- Time trend \( f(t) \)
- \( q \) is production (excl. stocks)
Porteous (2019, AEJ):
- 173 markets in 34 SSA countries from 2002-2013, corn, wheat and rice

Price data:
- FAO-GIEWS, USDA-FEWS and WFP-VAM

Abatzoglou et al., (2018):
- Georeferenced precipitation and temperature data

**Unbalanced panel of 1,389 obs over 11 years**
**Results**

**Supply elasticities ($\beta$):**

<table>
<thead>
<tr>
<th>Crop</th>
<th>Elasticity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maize</td>
<td>0.17</td>
</tr>
<tr>
<td>Wheat</td>
<td>0.02</td>
</tr>
<tr>
<td>Rice</td>
<td>0.47*</td>
</tr>
<tr>
<td><strong>Overall</strong></td>
<td><strong>0.32</strong>*</td>
</tr>
</tbody>
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- **Larger supply elasticity in SSA (x3),** compared with global estimates (R&S, 2013; G&S, 2020, $\sim .10$)
- **Larger effects of temperature** (x200) and precipitation (x5) shocks on prices
- **Heterogeneous effects** across crops (and countries)
More elastic food production in SSA: Markets in SSA work well

... but volatile supplies and prices

Driven by weather shocks

Commodity storage:
  - Will reduce supply elasticity
  - Extension to the theory:
    - (a) Minimum requirement constraint
    - (b) Infrastructure assumption