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

by **Bernhard Dalheimer**[a,b] **& Dela Dem Doe Fiankor**[c]

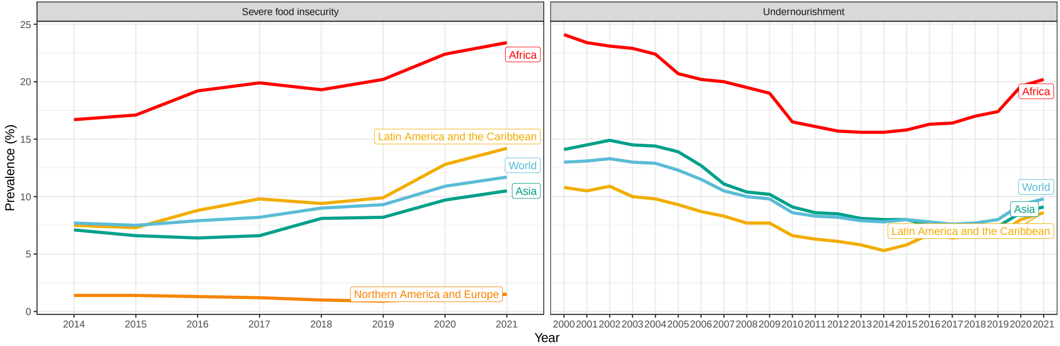
[a]**Kiel University**
Department of Agricultural Economics
[b]**University of Minnesota**
Department of Applied Economics
[c]**Agroscope**

American Association of Agricultural and Applied Economics Meetings
Anaheim, CA
August 2, 2022

This paper...

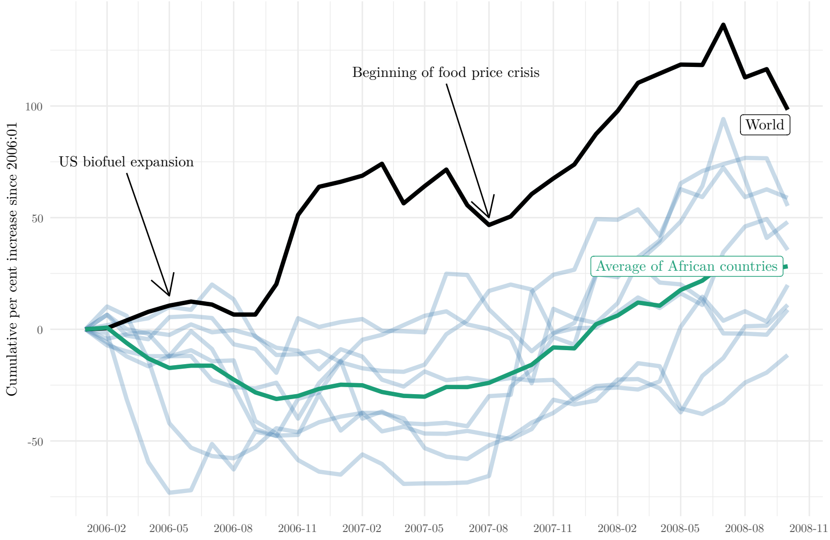
- Estimates food **supply elasticities in SSA**
- Identifies the supply equation using precipitation and temperature as **instrumental variables**
- Finds **stronger production responses to price shocks in SSA** than elsewhere
- Finds inherently **stronger price responses to climate shocks**
- Contribution: Model supply elasticity when **commodity storage** is low

Problem



Food insecurity in SSA is still high and on the rise

Food markets in SSA are different than world markets



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**
- $\rightarrow$ Stockpiling is competitive when prices are low
- At the aggregate level $\rightarrow$ 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)

Empirical model

Supply-side equations of the world food market model (Roberts & Schlenker, 2013, AER, Ghanem & Smith, 2020, AJAE; Hendricks, Janzen and Smith, 2015, AJAE)

$$\begin{aligned} q_t &= \alpha + \beta p_t + \gamma \omega_t + f_1(t) + u_t \\ p_t &= \delta + \mu_1 \omega_t + \mu_2 \omega_{t-1} + f_2(t) + \epsilon_t. \end{aligned} \tag{1}$$

- IV: Exogenous weather shocks (ω) are instruments to identify supply elasticity (β)
- Time trend $f(t)$
- q is production (excl. stocks)

Data

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 precitpitation and temperature data

Unbalanced panel of 1,389 obs over 11 years

Results

Supply elasticities (β):

Maize	0.17
Wheat	0.02
Rice	0.47*
Overall	0.32*

- **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
- **Hetergeneous effects** across crops (and countries)

Implications & conclusion

- 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