Extended Abstract

Paper/Poster Title	Food Production Shocks and Agricultural Supply Elasticities in Sub-Saharan Africa

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Abstract	***200 words max***
This paper estimates the food supply elasticity in Sub-Saharan Africa (SSA). Building up on commodity storage theory, we empirically estimate food supply functions for SSA. Our identifications strategy relies on exogenous weather shocks as instruments. This approach further allows to quantify the exposure of SSA food markets to weather events. We use data from FAO, USDA, WFP and public climate data to model 3 commodities in 173 food markets in 34 countries in SSA. Results suggest that (i) food supply in SSA is more elastic than global food supply, and (ii) prices are much more subject to exogenous weather events than global prices are. Moreover, we find substantial heterogeneity of food market responses to weather shocks and price developments by crops. These results are in line with commodity storage theory as in absence of opportunities to build inventories, producers will not shift supplies across time periods. Promoting storage activity - also through imports - and investing in storage facility can smoothen consumption, stabilize markets and reduce long term production uncertainty in the region.	

Keywords	Supply elasticities, Production shocks, Agriculture, Sub Saharan Africa
JEL Code	Q1, Q16, Q42, Q48 see: www.aeaweb.org/jel/guide/jel.php?class=Q)

Introduction	***100 – 250 words***

In spite of the long-term decline of world hunger, in Sub-Saharan Africa (SSA) food insecurity has been on the rise since 2014. This development is partly due to frequent and sudden supply-side shocks. Many of the most severe food price shocks that threaten food security originate from extraordinary local or regional crisis. For instance, the drought in Somalia in 2017 left more than 6 million people without sufficient access to food and spread into South-Sudan and Nigeria. A similar supply shock occurred in the aftermath of the tropical cyclone in Mozambique in 2019, leading to food price surges in Mozambique, Zimbabwe and Zambia. Most recently, within the realms of COVID-19, local droughts, conflicts, and the ongoing locust infestation, food prices have risen to record levels in many regions of SSA.

In many parts of the world, shocks on the food supply side are usually compensated by abundant levels of food stocks, international trade as well as market efficiency Wright (2011). In SSA grain reserves are low – often even non-existent – and many regions are not connected to international markets while market efficiency is generally low. Thus, food markets in SSA are notoriously more volatile and vulnerable to shocks. Moreover, as market prices are an important signal to producers to shift supply, unstable markets result in further misallocation of food production capacities of the next period – even in the absence of stocks. This interdependency over time can exacerbate market instabilities and weaken resilience against market shocks.

Nevertheless, food markets in SSA are also very heterogeneous and the response – as much as its degree – of producers to price signals, and markets to exogenous shocks varies vastly across the continent. While for global food markets, both supply and demand analysis over time as well as market responses have been studied intensively, such insights on SSA food markets are scarce. This gap in the literature is particularly striking since the majority the global food insecure live in SSA and a number of global policy efforts target the strengthening of food markets in SSA. Thus, understanding both the extent of market vulnerability to supply shocks as well as the supply elasticity in SSA food production are key for successful market development and resilience.		
Methodology		***100 – 250 words***
This paper identifies food supply functions and determines the effect of exogenous weather shocks on prices and supply, as well as the supply elasticity in SSA. We build up on the data compiled in Porteous (2019) that includes production data and agricultural commodity prices from FAO and USDA for major food crops in SSA from 2002-2013. We extend this dataset until 2020 to construct a panel on the regional level covering 205 food markets that trade six commodities in 39 SSA countries. Concerning model and identification, we specify a supply function following Ghanem & Smith (2020) for SSA and employ climate data as well as linear production shocks as instrumental variables to identify the parameters. Aside from identifying the supply elasticity of food production SSA, this dual approach additionally allows to identify both the effects of production shocks in general as well as climate related shocks on food markets. We estimate the IV model using country, market and crop specific fixed effects. Moreover, the fixed effects regime allows inference on the respective levels and thus describes specific factors that shape market functioning. Our innovations to the literature are twofold. First, with regards to the estimation strategy of food supply functions, we propose a causal dynamic empirical model using panel data as opposed to time series models. While related works have focused on global and food supply dynamics as aggregates across commodities, we investigate food supply functions in the context of SSA food markets that are crop specific. Second, following the theory of comparative storage (Wright, 2011), we provide novel empirical insights on markets where stock levels are low in contrast to existing studies that focus on markets where stocks are more abundant.		
Results		***100 – 250 words***

Table 1 reports the results from estimating the IV regression. The first stage regression reveals strong effects of the weather variables on prices. The period of t−1 describes the weather conditions before harvest in t−1 and we observe rather strong coefficient estimates, compared with the global estimates reported in Roberts & Schlenker (2013). In the second stage of the model, we estimate a supply estimate of 0.32, indicating that for every percentage increase of food prices, production will rise by 0.32% in the following period.

Table 1: Food Supply Elasticity in Sub-Sahara Africa

IV stages		p_t First (1)		q_t Second (2)	
p_t				0.32*	(0.16)
Temperature	T_{t-1}	742.5**	(279.5)		
Precipitation	P_{t-1}	0.32***	(0.10)		
Temperature	T_{t-1}^2	-16.8**	(6.3)		
Precipitation	P_{t-1}^2	0.003***	(0.001)		
t		0.14*	(0.08)		
Temperature	T_t	0.08	(0.07)	0.01	(0.01)
Precipitation	P_t	-29.8	(26.8)	-31.3***	(9.7)
Temperature	T_t^2	-0.0004	(0.001)	-8×10^{-5}	(8.2×10^{-5})
Precipitation	P_t^2	0.67	(0.61)	0.71***	(0.22)
Observations		1389		1389	
R2		0.75		0.92	

Notes: Standard errors are in parentheses. All models include country fixed effects, crop fixed effects and market fixed effects.

As a robustness check, and to shed more light on the elasticity of food supply in SSA at the commodity level, we estimate the model using a sample split by crop. The elasticity of supply is both statistically most significant as well as largest in terms of magnitude for ricecompared to maize and wheat. However, we find that temperature effects are driving a substantial higher variation in prices of maize while the food supply elasticity of maize production is smaller at 0.17 and statistically less significant. The wheat model exhibits no meaningful effects in terms of coefficient size and statistical power. One potential explanation is wheat is perhaps the least important staple food compared with the other two commodities under consideration and thus the number of observations of 65 in this model is rather small compared with the other models. Nevertheless, in all three models we observe substantial heterogeneity in sample size, statistical power and size of the coefficients of the supply elasticities.

Discussion and Conclusion

100 – 250 words

In this paper, we analyze the food supply elasticity in SSA. SSA exhibits comparably high volatility in food prices and production levels, resulting in a strong vulnerability to exogeneous weather shocks. At the same time the region also exhibits rising rates of food insecurity and particularly high poverty and prevalence of undernourishment. Building up on the theory of competitive storage, our analysis investigates food supply and prices over time in absence of storage activity that might be due to lack of storage technology or minimum requirements constraints. We compile a dataset of food production, food prices and climate data on a regional level of maize, rice and wheat of 173 markets in 34 countries in SSA. Using an IV model in which we use temperature and climate as instruments, we estimate and identify the food supply elasticity in SSA.

Our results suggest that (i) food supply in SSA is more elastic than global food supply, and (ii) prices are much more subject to exogenous weather events than global prices are.

Moreover, we find substantial heterogeneity of food market responses to weather shocks and price developments by crops. These results are in line with commodity storage theory as in absence of opportunities to build inventories, producers will not shift supplies across time periods. Thus, exogenous production shocks will translate fully to both supply and price levels, resulting on overall more volatile prices and production levels over time.

Given that markets are functioning in the sense that producers respond to price signals in the region, promoting stockpiling in SSA is thus a promising a policy avenue. Such measures include investment programs, training and outreach as well as public inventory agencies. Even in cases where low productivity or low levels of production remain the root-cause of food insecurity in SSA, food stocks are major opportunities to stabilize prices and supplies also by means of imports.

References

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