Trade Openness and Global Crop Supply: Implications for Global Value Chains

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Selected presentation for the International Agricultural Trade Research Consortium's (IATRC's) 2022 Annual Meeting: Transforming Global Value Chains, December 11-13, 2022, Clearwater Beach, FL.

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December 13, 2022
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Selected paper prepared for presentation at the 2022 International Agricultural Trade Research Consortium Annual Meeting in Clearwater Beach, Florida December 11-13, 2022

Disclaimer: The findings and conclusions in this presentation are those of the author(s) and should not be construed to represent any official USDA or U.S. Government determination or policy. This research was supported in part by the U.S. Department of Agriculture, ERS.

Outline of Today's Presentation

- Introduction and Motivation
- Research Problem and Objectives
- Data and Methodology
- Results and Discussion
- Conclusion
- Q and A

Introduction

- Food insecurity is a persistent challenge for millions of people around the world.
- Food security is ensured when all people, at all times, have physical, social, and economic access to sufficient, safe, and nutritious food that meets their dietary needs and food preferences for an active and healthy life (FAO, 1996).
- Food security has four pillars:
  - availability,
  - access,
  - Utilization, and
  - stability.

Motivation

- Trade affects all pillars of food security (e.g., Martin and Laborde, 2018; Díaz-Bonilla et al., 2016; Bellemare et al., 2018; Wacziarg and Welch, 2008).
- Trade openness
  - opens **opportunities for specialization** in production
  - effect on **better prices** for farmers
  - allows **access to larger markets**
  - **efficiency gains** from factors such as economies of scale, technology transfers and knowledge spillovers and thus enhances the possibilities for generating export revenues
  - stabilizes national food supplies and reduces **price fluctuations by smoothing out excess demand or excess supply situations in domestic markets**

Research Problem

- Many food deficit countries are net food importers.
- Trade plays an important role in alleviating food deficits as well as filling the consumption gaps that could not be met through domestic productions.
- However, excessive dependence on food imports could expose many countries to external shocks.
- E.g., supply chain disruptions, shipping bottlenecks, export restrictions, and conflict have aggravated recent food and feed price increases globally.

Research Objective

- Supply responses (area, yield, and production) to international prices are likely to be affected by the extent of domestic market integration.
  - International and domestic prices are linked through trade costs (domestic and international) and trade policies (e.g. tariffs)
- This paper aims to examine the role that **the level of domestic market integration to international markets plays in global crop supply responses**.
- No previous study on global crop supply response to price signals, after accounting for the impacts of trade.

Data and Methodology

- Panel data from 1970 to 2020 on Barley, Maize, Rice, Sorghum, and Wheat

Variables (units)	**Source**
Harvested area (ha) Yield (mt/ha) Production (mt)	Two sources: - USDA's Production Supply and Distribution (PSD) with 151 countries - FAO with 186 countries *Countries differ from others
Trade openness = $\frac{Imports+Exports\ (\$)}{Total\ GDP\ (\$)}$	FAO
International spot market price ($/mt)	World Banks' commodity price database
Fertilizer price indices (2010=100)	
Crop calendar information	FAO-GIEWS
Annual average temperature (°C) and precipitation (mm)	Climate Research Unit at the University of East Anglia, Norwich, England.
Total Factor Productivity (TFP) indices (2015=100)	USDA

Data and Methodology

- For our dynamic econometric specifications, we rely on two recent applications that adopt **system GMM approach** (Arellano and Bover, 1995; Blundell and Bond, 1998).
  - Dithmer and Abdulai (2017):
    used trade openness, among others, and found positive and significant impact on dietary energy consumption.
  - Haile et al.(2016):
    estimated a worldwide aggregate supply response for key agricultural commodities.
- Use a system GMM estimator given the dynamic panel nature of this model.
  - Resolves a dynamic panel bias in OLS and FE due to the correlation of the lagged dependent variable with the country fixed effects.

Results and Discussion

Table 1. Descriptive statistics for main output variables

	Barley	Maize	Rice	Sorghum	Wheat
Production	1,318,364	3,715,247	3,257,970	946,606	3,493,547
	(53,777)	(255,432)	(194,875)	(45,285)	(170,765)
N	3089	5682	5570	3184	5749
Area	677,885	1,215,380	1,361,783	685,907	1,593,960
	(26,565)	(53,970)	(70,598)	(33,671)	(63,206)
N	3089	5682	5570	3184	5749
Yield	1.966	2.344	2.452	1.358	1.458
	(0.025)	(0.029)	(0.027)	(0.020)	(0.021)
N	3089	5682	5570	3184	5749

- Relatively lower global production/productivity in sorghum
- Highest area/acreage allocated to wheat and rice globally
- Productivity way below potential productivity in all crops

Results and Discussion

Table 2. Descriptive statistics for international spot prices

	Price volatility					Price level				
	Barley	Maize	Rice	Sorghum	Wheat	Barley	Maize	Rice	Sorghum	Wheat
1970-1979	0.132	0.176	0.211	0.183	0.198	127	251	690	236	309
	(0.004)	(0.003)	(0.005)	(0.004)	(0.005)	(0.690)	(1.486)	(7.881)	(1.366)	(2.530)
N	484	899	993	530	954	1176	1176	1176	1176	1176
1980-1989	0.322	0.192	0.151	0.206	0.125	100	168	413	160	222
	(0.003)	(0.002)	(0.002)	(0.003)	(0.001)	(0.554)	(1.145)	(3.738)	(1.071)	(1.166)
N	562	1049	993	593	1073	1259	1259	1259	1259	1259
1990-1999	0.177	0.162	0.211	0.151	0.180	101	133	336	127	175
	(0.001)	(0.002)	(0.003)	(0.002)	(0.001)	(0.375)	(0.492)	(0.799)	(0.400)	(0.640)
N	707	1202	1131	604	1242	1427	1427	1427	1427	1427
2000-2009	0.191	0.204	0.160	0.225	0.198	136	143	348	141	208
	(0.004)	(0.002)	(0.004)	(0.003)	(0.002)	(0.797)	(0.874)	(3.683)	(0.740)	(1.357)
N	624	1135	1087	683	1144	1334	1334	1334	1334	1334
2010-2020	0.193	0.187	0.142	0.190	0.211	143	194	446	192	232
	(0.004)	(0.001)	(0.001)	(0.002)	(0.002)	(0.966)	(1.025)	(1.118)	(0.799)	(1.022)
N	712	1295	1213	774	1336	1500	1500	1500	1500	1500
Total	0.203	0.184	0.174	0.192	0.183	122	176	440	169	226
	(0.002)	(0.001)	(0.001)	(0.001)	(0.001)	(0.389)	(0.678)	(2.302)	(0.613)	(0.815)
N	3089	5580	5417	3184	5749	6696	6696	6696	6696	6696

- The volatility of world prices was higher in the recent decade for barley and wheat

Results and Discussion

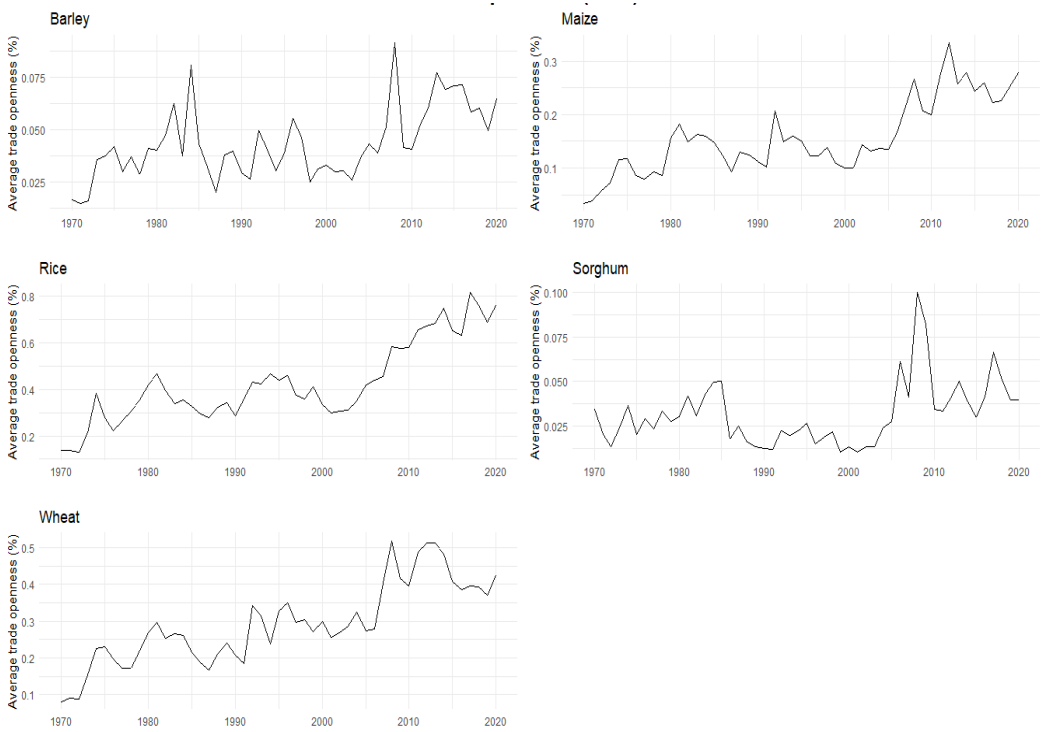
Table 3. Descriptive statistics for trade openness (%)

	Barley	Maize	Rice	Sorghum	Wheat
1970-1979	0.030	0.079	0.243	0.027	0.164
1980-1989	0.044	0.142	0.354	0.032	0.236
1990-1999	0.038	0.138	0.401	0.018	0.285
2000-2009	0.042	0.160	0.408	0.039	0.333
2010-2020	0.061	0.257	0.695	0.042	0.433
Total	0.044	0.162	0.431	0.033	0.301
N	3023	5616	5454	3123	5645

- TO varies by crop and over time
- Sizable relative global trade in wheat, rice, and maize

Results and Discussion

Figure 1. Trade openness, 1970-2020



Source: FAO

- Increasing trade trend after 2000 in wheat, barley, rice, and maize
- Declining sorghum trade, especially after 1980s and remained low

Results and Discussion

Estimation results

- Trade openness measurements are lagged one year to remove problems of endogeneity (Shaik et al.; Hart et al. 2015)
- Several specification tests are used for each model
  - Arellano and Bond (1991) tests for higher order serial correlation.
  - Sargan (1958) and Hansen (1982) J-statistic to evaluate the validity of overidentifying restrictions.
- The necessary conditions for a correctly identified system GMM model include
  - a significant AR(1) test,
  - an insignificant AR(2) test, and
  - an insignificant Sargan-Hansen test

Results and Discussion

- **Own-price** is positively and significantly associated with yield and production for all the five commodities
  - Higher elasticity estimates for production relative to yield and area
- **Trade openness** has a statistically significant and negative correlation with **production** and **yield for all crops**
  - Access to external markets alone may discourage production or yield
- **Trade openness interacted with the own price** has a positive and significant relationship with production
  - Given access to external markets, producer have more incentive through own prices
  - Positive and significant relationship for maize and sorghum yield only
  - Positive and significant relationship for sorghum area only

Results and Discussion

- Some evidence of negative effects of **price volatility** on supply response similar to Haile et al. (2016)
  - Negative association for wheat yield
  - Positive association for maize yield
  - Positive association for barley area

- **Fertilizer prices** are negatively associated with all three outcome variables, although not significant
  - Positive correlation with wheat yield

Results and Discussion

- Strong evidence that **temperature** is negatively associated with yields for all five commodities
- Mixed evidence for **precipitation** on supply response
  - Associated with reduced area planted for sorghum and wheat
  - Increased yields for barley and sorghum
- No statistically significant effects of TFP growth
- Finally, lagged dependent variables significant and positively related in most cases
  - Production and area responses closer to 1
  - Yield responses smaller than area and production

Conclusion

- Trade effect on supply is strong for production and yield , although results vary by commodity
- Trade creates incentives for producers to response to international own price for most commodities
- Own price elasticity is positive and significant
- Input prices are negatively associated with yield

Thank you!
Questions?

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