Do the Trade Winds Alter the Trade Flow? Assessing Impacts of ENSO Shocks on World Cereal Supply

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Motivation

- Unfavorable weather conditions associated with the phenomenon known as El Niño Southern Oscillation (ENSO) have considerable socio-economic implications around the globe.
- ENSO can amplify extreme weather conditions and directly impact the agricultural sector, particularly, field crops.
- The most recent co-occurrence of the record-setting Australian heat, and the U.S. drought of historical magnitudes suggested that extreme events can coincide in different regions of the world.

Hypothesis of Synchrony

The ENSO-related weather events result in economically meaningful correlation in agricultural production across the countries.

- Such a synchronization challenges the common assumption of idiosyncrasy of supply shocks across countries, with implications for trade and spatial price stabilization.

Data & Methods

- For the period 1961-2009, we estimate country-specific equations relating the percentage changes in the maize, wheat, sorghum, and rice production (FAOSTAT) to changes in sea surface temperature anomalies (SSTA) measured in the *Niño 3.4* region (NOAA).
- The ENSO variable represents SSTAs averaged over the November-December-January period preceding or coinciding with the harvest month in each country.
- We assume stochastic trend and apply threshold regressions to account for possible asymmetries in production response to La Niña and El Niño shocks.

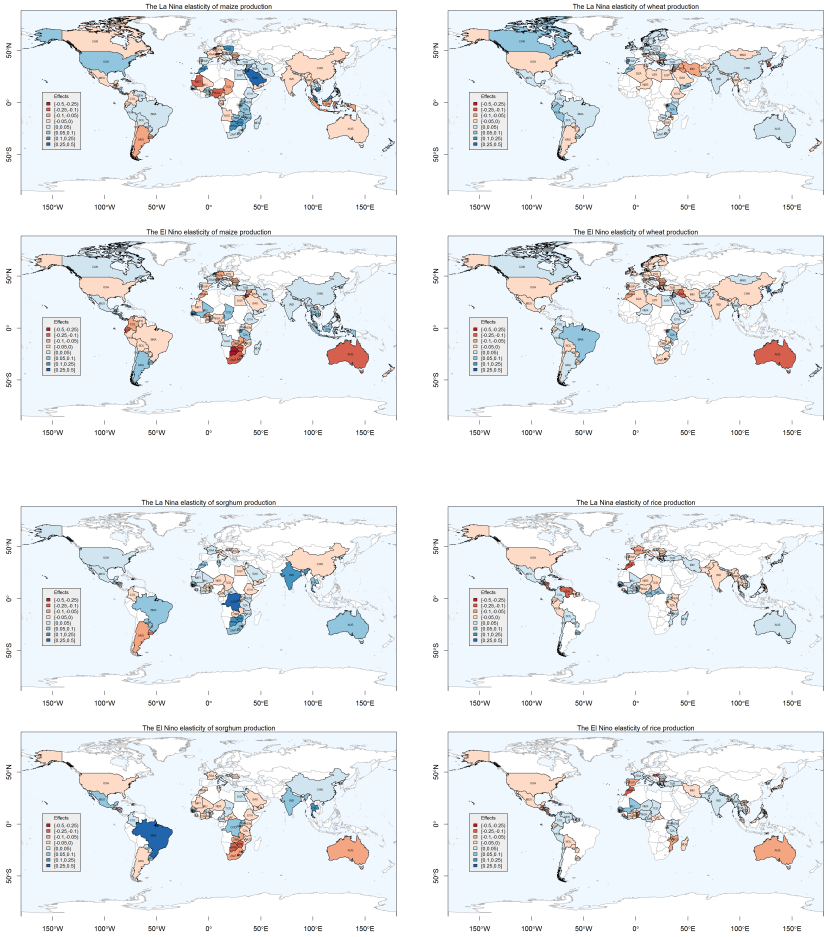
To illustrate, the two-threshold (i.e. three-regime) regression is represented as follows:

$$y_{i,t} = \begin{cases} \mu_i + \beta_i y_{i,t-1} + \theta_0 s_t + \nu_{i,t} & \text{if } s_t < \lambda_1 \\ \mu_i + \beta_i y_{i,t-1} + \theta_1 s_t + \nu_{i,t} & \text{if } \lambda_1 < s_t < \lambda_2 \\ \mu_i + \beta_i y_{i,t-1} + \theta_2 s_t + \nu_{i,t} & \text{if } s_t > \lambda_2 \end{cases}$$

where $y_{i,t}$ is the log of production in country i during the period t; s_t is the ENSO variable; θ_1 and θ_2 are thresholds; and μ_i, β_i, θ_0, θ_1, and θ_2 are the parameters to be estimated; finally, $\nu_{i,t} \sim \textit{iid}\,(0, \sigma_\nu)$.

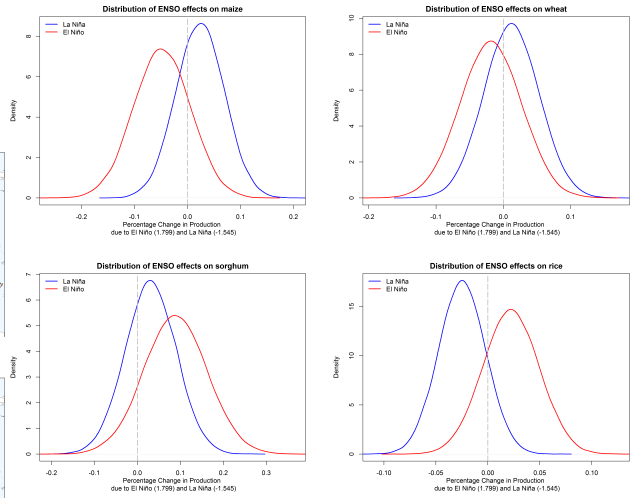
Results & Discussion

- We estimate 88 country-level regressions for maize, 73 for rice, 54 for sorghum, and 70 for wheat.
- We find evidence of a statistically significant relationship (at a $\alpha = \mathbf{0.1}$ level) between ENSO and the individual production response of countries comprising 71% of global maize production (41/88 countries); 32% of global rice production (28/73 countries); 43% of global sorghum production (21/54 countries); and 33% of global wheat production (25/70 countries).
- The geography of ENSO effects are illustrated on the maps below:



Results & Discussion

- The distribution of the aggregate effects of ENSO shocks (i.e. the hypotheses of synchrony tests), are illustrated using density graphs below:



Main Findings & Conclusion

- We find some evidence of synchrony (most apparent in the case rice, almost absent in the case of wheat).
- We find evidence of asymmetric production responses to ENSO shocks in a wide range of countries, which, in turn, manifests in global production asymmetries.
- Based on the aforementioned, there is an evidence of the potential ENSO impact on bilateral trade patterns.

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