Extended Abstract
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Paper/Poster Title	The effect of increased weather volatility on agricultural trade

Abstract prepared for presentation at the 96th Annual Conference of the Agricultural Economics Society, K U Leuven, Belgium

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Abstract	***200 words max***

We use an econometric gravity model to estimate the effects of weather volatility on international trade flows. To account for variation in weather conditions, we include the standardised precipitation-evapotranspiration index (SPEI). We match this index with country-level information on product growing and harvesting seasons to capture extreme weather events in the growing season. We find that for smaller variation in weather has no impact on trade, but for more extreme events (i.e., more than two standard events from the mean), the trade impacts are substantial, ie, reduced by around 46%. Using the estimation results, we simulate the trade impacts of more widespread weather events. We find that the impact varies by crop, with the largest effect being for wheat and the smallest impact for soybeans.

Keywords	Agricultural trade, climate change
JEL Code	Q17, Q54 see: www.aeaweb.org/jel/guide/jel.php?class=Q)

Introduction	***100 – 250 words***

Climate change represents one of the largest threats to the future of food security. Rising temperatures and shifting precipitation patterns threaten agricultural yields in many key production regions. Adapting agriculture to these challenges is crucial to securing sufficient access to nutritious food and healthful diets globally. For domestic agricultural systems negatively affected by climate change, agricultural trade represents an important adaptive tool. However, agricultural trade is also likely to respond to projected climate change scenarios and these responses reveal the capacity for international agricultural trade to serve as a climate adaptation strategy. This paper examines the impact of extreme weather events on agricultural trade using an econometric gravity model for four products: soybean, rice, wheat, and corn. In particular, we estimate i) the current impact on weather events on monthly, bilateral trade flows and ii) simulate the impact of more widespread weather events on agricultural trade.

Methodology	***100 – 250 words***

This research uses an econometric gravity model to estimate the effects of weather volatility on international trade flows. The analysis is conducted in two parts:

(1) **Estimating the effect of weather events on trade:** We combine data on planting and harvesting months for rice, wheat, soybean, and corn with monthly trade flows for the years 2010-2019. To account for variation in weather conditions, we include the standardised precipitation-evapotranspiration index (SPEI). The SPEI index is used to determine the onset, duration and magnitude of drought conditions compared to normal years. We create dummy variables using this index for weather events in the growing seasons of the products (i.e., the months between planting and harvesting). These

weather dummies are then used to estimate the impact of weather events on trade in the trading season (i.e., the months following the harvest month). These weather and climate variables augment the standard gravity model of trade. Controls include fixed effects for country-pair-crop-month-of-year, to control for typical seasonal levels of trade, and crop-month-year, to control for global crop-specific shocks to trade. The gravity model is estimated using a Pseudo-Poisson Maximum Likelihood (PPML) Regression Model.

(2) **Simulate the impact of more widespread weather events on agricultural trade**: A potential effect of climate changes is weather that is more volatile. Accordingly, we use the results estimated in the first part of the analysis to simulate an increase in occurrence of weather events. In particular, we use a mean preserving spread simulation to simulate trade effects of various increases in the spread of the SPEI distribution.

Results

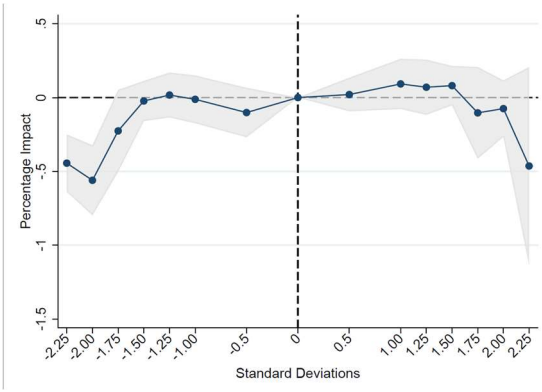
100 – 250 words

The results from the analysis are summarised as follow:

(1) Estimating the effect of weather events on trade: We examine the impact of various weather conditions on trade flows. Figure 1 summarises the results from the PPML estimations. The estimations were conducted using various cut-off for the SPEI. For instance, consider the trade effect of standard deviation at 1 and -1 in the Figure. The point estimate in the graph refer to the coefficient on the weather event dummy in the PPML estimation using the cut-off for a weather event in the growing season as one standard deviation lower (ie, -1) or higher (i.e., 1) than normal.

The Figure shows that trade flows are not affected for smaller variation in weather conditions (i.e, using cut-offs of less than 2 standard deviations for weather events). However, for greater variation in weather conditions during the growing season – i.e., if the SPEI is lower than -2 – it reduces trade by 46.7%.

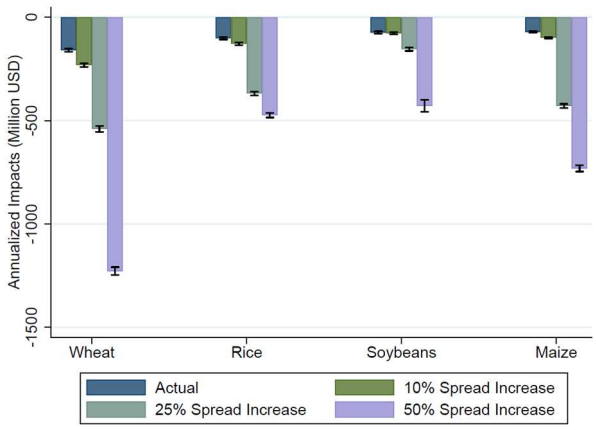
Figure 1 The effect of variation in the SPEI on trade flows



(2) Simulate the impact of more widespread weather events on agricultural trade: Figure 1 shows that trade is only affected for weather events that are more extreme. We use the cut-off of SPEI greater than 2 standard deviation from the mean, and simulate the effect of greater volatility of weather events (ie, "fatter" tail of the SPEI distribution) on trade. Figure 2 shows the trade impact of under various scenarios by

crop. As seen in the graph, we find that the impact varies by crop, with the largest effect being for wheat and the smallest impact for soybeans.

Figure 2 Trade impacts of increased variance of the SPEI distribution



Discussion and Conclusion

100 – 250 words

This research creates new knowledge about climatic change and the impact on international agricultural trade flows. It measures how international agricultural trade flows respond to changes weather events. Based on this assessment, predictions of trade responses to projected climate change scenarios reveals the capacity for international agricultural trade to serve as a climate adaptation strategy. Further, the scenario analyses assess how more widespread weather events may diminish international trade's ability to act as a buffer in mitigating climate impacts on food availability.