U.S. Ethanol Demand and World Hunger: Is there any Connection?

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http://www.cbsnews.com/news/
biofuel-goals-could-require-all-the-worlds-crops/

Bank of Canada and the International Energy Forum, April 2016

Question:

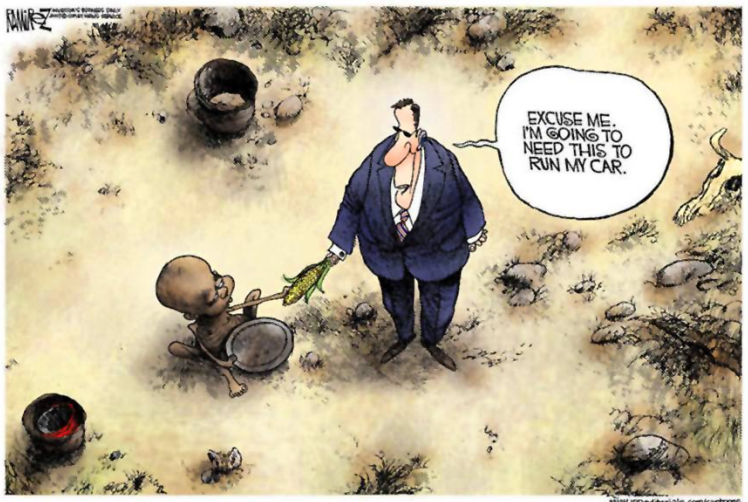
Are U.S. government ethanol-fuel incentive mechanisms leading to greater developing-country food insecurity?

- **Higher commodity prices and inelastic demand.**
- **Majority of developing countries with a high proportion of the world's food-deficit population are net food importers.**

International markets are a major destination of U.S. agricultural commodities.

- **U.S. maize exports comprise 1/3 of world maize trade.**
- **Maize net-import countries comprise most of the developing world.**

With increased maize-ethanol production potentially crowding out export, U.S. ethanol could be a driver of increased global food price volatility.



http://www.rockyhigh66.org/stuff/biofuels-cartoon.jpg

But wait. Not every country is experiencing the same maize-price increase with U.S. ethanol expansion.

Nicaragua: maize-price declined.

For effective policy mechanisms to mitigate price volatility, country-specific effects should be understood.

Limited empirical evidence:

- **Food importation.**
- **U.S. trade effects.**
- **Geographically diverse countries.**

https://en.wikipedia.org/wiki/Flag_of_Nicaragua

The underlying hypothesis is: U.S. ethanol production has differential impacts on maize prices in developing countries.

To explore this hypothesis, a recently developed panel structural vector autoregression (SVAR) approach is utilized.

Model is populated with:

- **U.S. ethanol production.**
- **U.S. maize prices.**
- **Maize prices in 38 developing countries.**

Two key features:

1. **Market interdependencies**
   - **Countries are linked cross sectionally with common global and regional shocks.**

2. **Responses are both dynamic and heterogeneous across developing countries.**

Panel time-series methods.

Why not a standard time series analysis?

1. **Many countries exhibit short time series data.**

2. **Data from many countries are noisy.**

These empirical challenges are addressed by expanding the panel dimension of the data to increase the reliability of the inferences.

Why not ignore cross-country heterogeneity?

1. **Inconsistent estimation of coefficients**

2. **Precludes studying the pattern of heterogeneous responses.**

Why not ignore the interdependencies among countries?

1. **Does not address the dynamics of a single large economy (United States)**

2. **Risks drawing inconsistent inferences concerning intercountry relationships.**

A special case:

- **Common shocks originating from the U.S.**
- **Developing countries are impacted by U.S. shocks, but are too small to affect the U.S.**

Rather than using cross-sectional averages of the panel of countries to infer the common shocks, the U.S. data are employed to infer the common shocks.

This allows examining the developing country-specific responses.

Panel SVAR Model

Q: U.S. ethanol production.

P: first differenced log transformed of U.S. real maize price.

PC: first differenced log transformed real maize price in a developing country.

$$\begin{bmatrix} Q_t \\ P_t \\ PC_t \end{bmatrix} = A(1) \begin{bmatrix} \varepsilon_{1t} \\ \varepsilon_{2t} \\ \varepsilon_{3t} \end{bmatrix}$$

ε_{1t}: an unexpected ethanol supply shock to the U.S. ethanol market (renewable fuel-ethanol mandate).

ε_{2t}: an unexpected ethanol demand shock to the U.S. maize market (increase in E85 fuel stations).

ε_{3t}: an unexpected developing country-specific shock (abnormal weather).

A(1) is 3×3 matrix containing the long-run impulse responses, with zero upper diagonal elements.

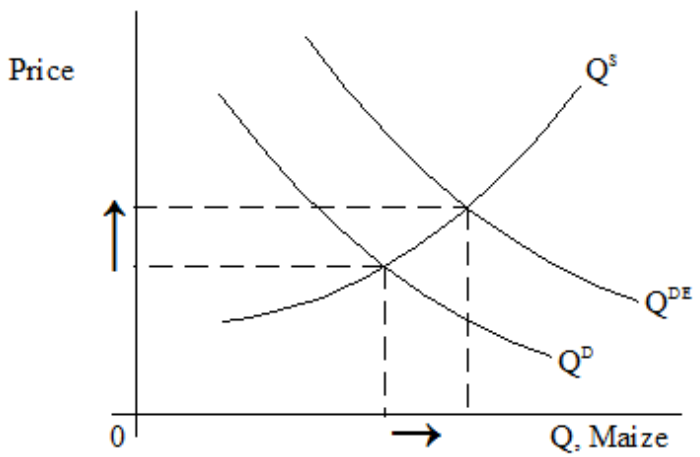
Q is only affected by its own innovations.

P is affected by its own and Q's innovations.

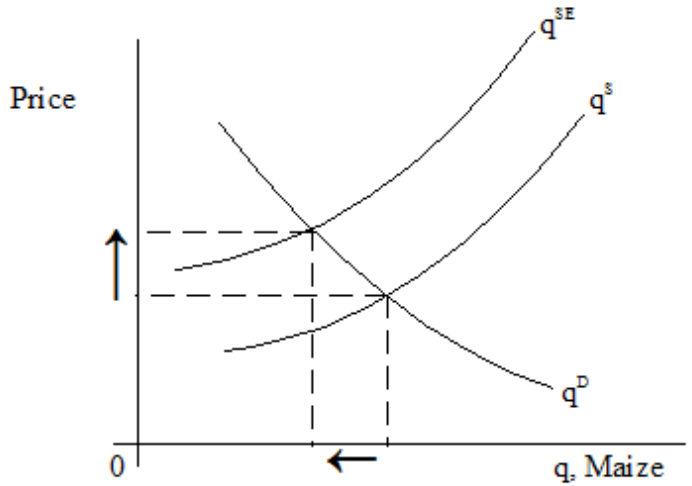
PC is affected by all the three's innovations.

Positive Demand Shock

United States

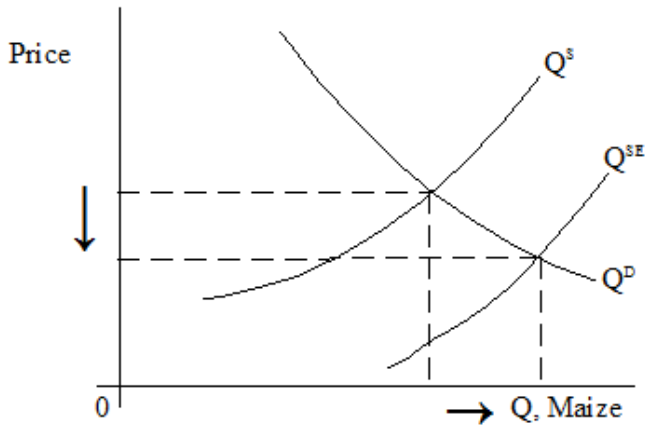


Developing Country

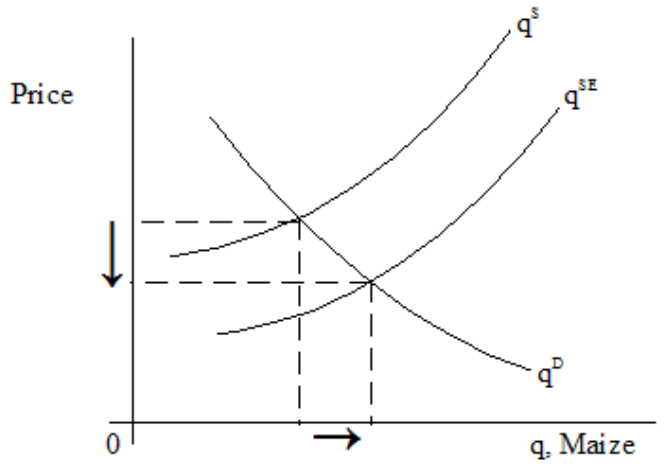


Positive Supply Shock

United States



Developing Country



Hypotheses:

Maize prices in a developing country will respond positively (negatively) to a U.S. maize demand (supply) shock.

How to test the hypotheses?

- **Impulse response functions: Measure the change in a developing country prices in response to a U.S. demand or supply shock.**

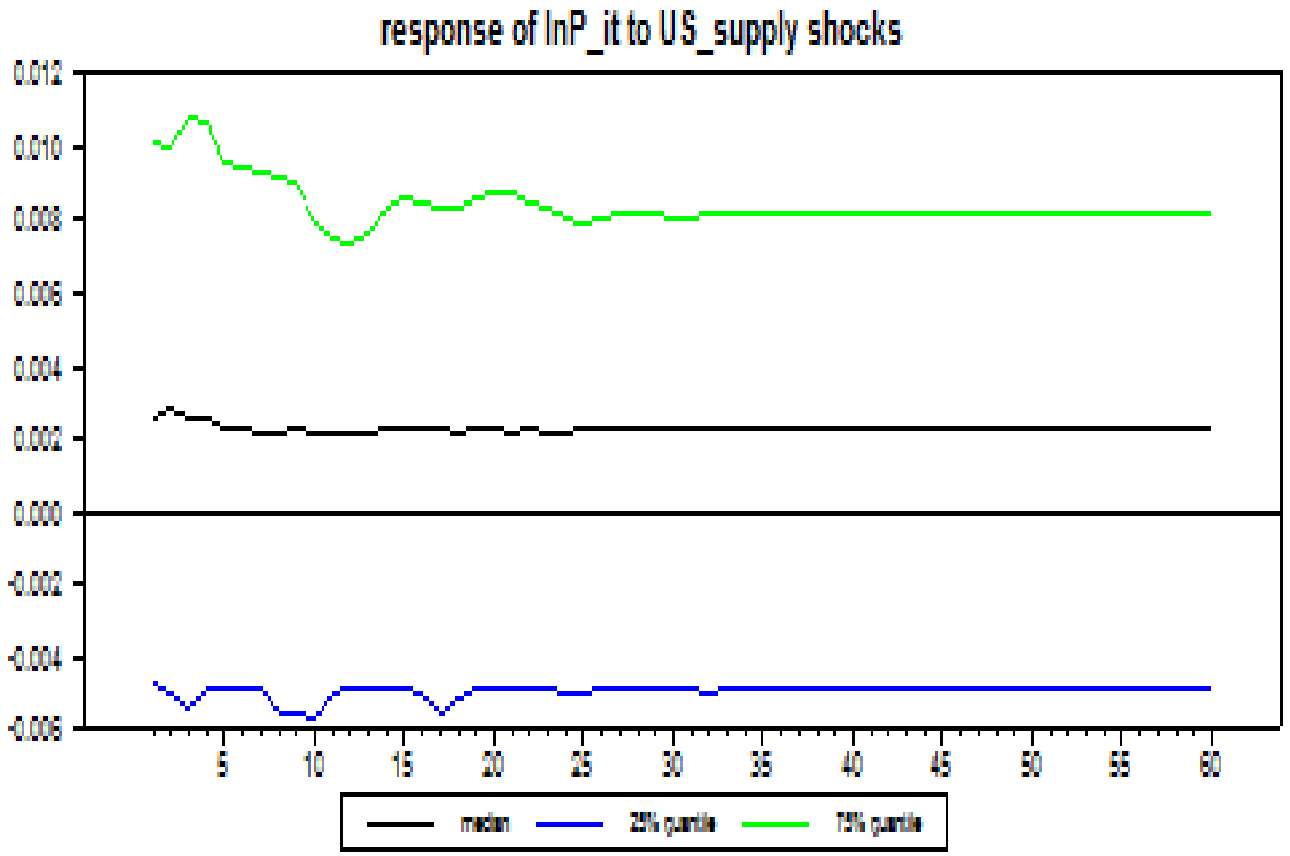
- **Variance decompositions: Measure the forecast error variance explained by a U.S. demand or supply shock.**

Data: 2006-2015, monthly.

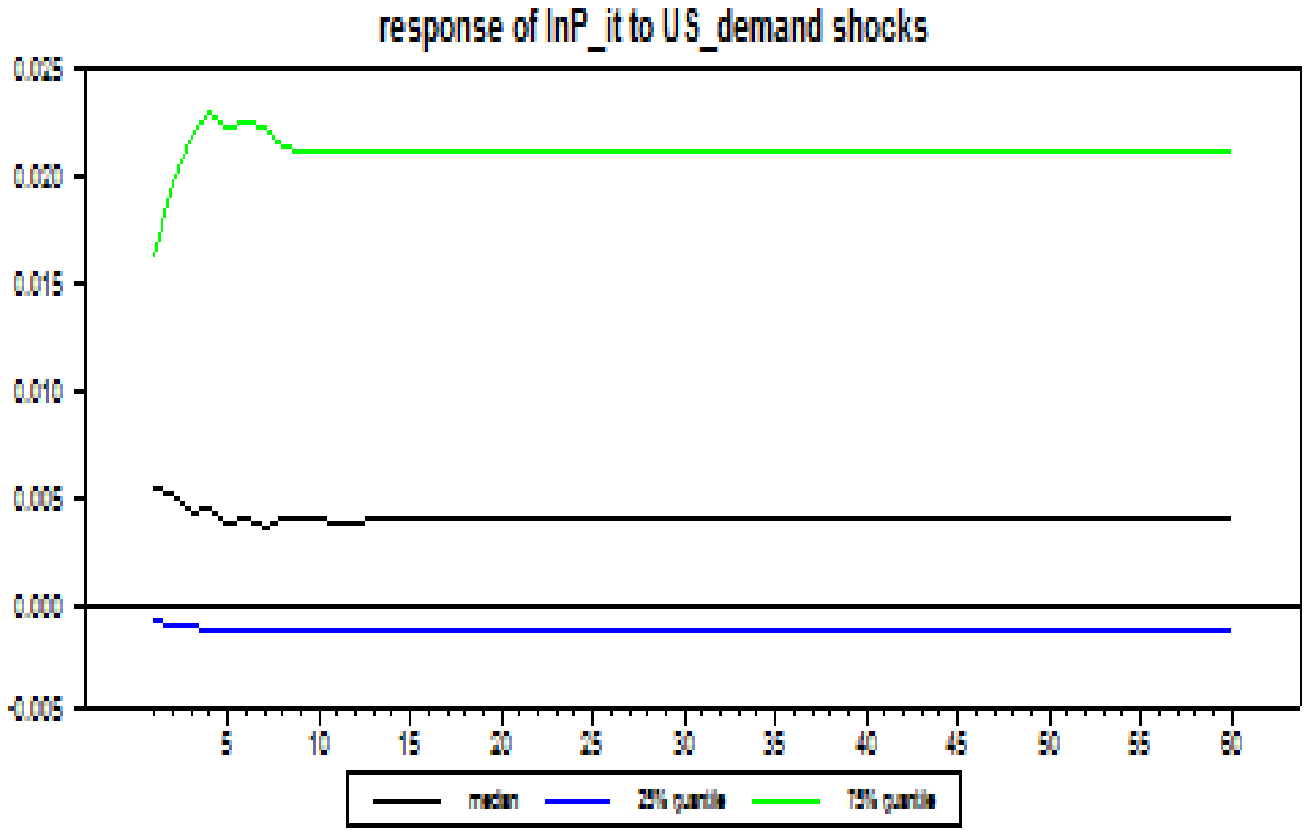
- **38 developing country maize prices.**
- **U.S. maize prices and ethanol production levels.**
- **Sources: EIA, FAO, USDA.**

Country666	Geography
Angola	Coastal
Argentina	Coastal
Benin	Coastal
Bolivia	Isolated
Brazil	Coastal
Burundi	Isolated
Cabo Verde	Isolated
Cameroon	Coastal
Central African Republic	Isolated
Chad	Isolated
Chile	Coastal
Colombia	Coastal
Congo, Rep.	Isolated
Dominican Republic	Coastal
Ethiopia	Isolated
Ghana	Coastal
Guatemala	Coastal
Haiti	Coastal
Honduras	Coastal
Kenya	Coastal
Malawi	Isolated
Mexico	Coastal
Morocco	Coastal
Mozambique	Coastal
Namibia	Coastal
Nicaragua	Isolated
Niger	Coastal
Panama	Isolated
Paraguay	Coastal
Peru	Coastal
Philippines	Isolated
Rwanda	Isolated
South Africa	Coastal
Tanzania	Coastal
Thailand	Coastal
Togo	Coastal
Ukraine	Coastal
Zambia	Isolated

Impulse responses of a U.S. ethanol supply shock on maize prices in developing countries



Impulse responses of a U.S. demand shock on maize prices in developing countries



What is causing these heterogeneous price responses?

- **U.S. food aid.**
- **Food imports.**
- **Coastal/continental.**

http://keckjournal.com/2014/02/su

http://naega.org/?page_id=1131

http://davidbrobert.com/worldGuru/SouthAmerica/LandlockedSouthAmerica/

Results:

U. S. Food Aid
Food Import Dependency } → A U. S. supply shock on developing county′s maize price

Food Import Dependency } → A U. S. demand shock on developing county′s maize price

Coastal countries
↓
A U. S. demand shock on developing county′s maize price

Table 2. Regression results[a]

	First Month			
	Impulse Responses		Variance Decompositions	
	Supply	Demand	Supply	Demand
Food Import Dependency	0.0002	−0.0004**	0.0005*	−0.0014*
	(0.0001)	(0.0001)	(0.0002)	(0.0005)
U.S. Food Aid Dependency	0.0003*	0.0001	0.0003***	0.0005
	(0.0001)	(0.0001)	(0.0002)	(0.0004)
African	0.0047	−0.0006	−0.0050	−0.0148
	(0.0052)	(0.0056)	(0.008)	(0.0200)
Coastal	−0.0054	0.0175***	−0.0090	0.0822*
	(0.0068)	(0.0073)	(0.0110)	(0.0261)
F(4, 31)	5.68*	2.39***	5.14*	3.56**
R^2	0.4229	0.2355	0.3986	0.3149
Adjusted R^2	0.3484	0.1368	0.3210	0.2265

[a] Standard errors are in the parentheses with *, **, and *** denoting 1%, 5%, and 10% level of significance, respectively. Food import dependency is the average of yearly ratio of cereal import dependency ratio from FAO (FAO, 2015). U.S. food aid dependency is U.S. maize aid over domestic supply. Africa is a dummy variable with 1 equaling an Africa country and 0 otherwise, and Coast is a dummy variable with 1 equaling a coastal country and 0 otherwise. Missing data resulted in Cabo Verde and Burundi being excluded from the analysis.

Conclusions:

- **Developing countries are not homogeneous in their response to market shocks.**
- **Global demand and supply shocks generate different impacts.**
- **Market interdependencies are far more complex than previous modeling efforts have considered.**

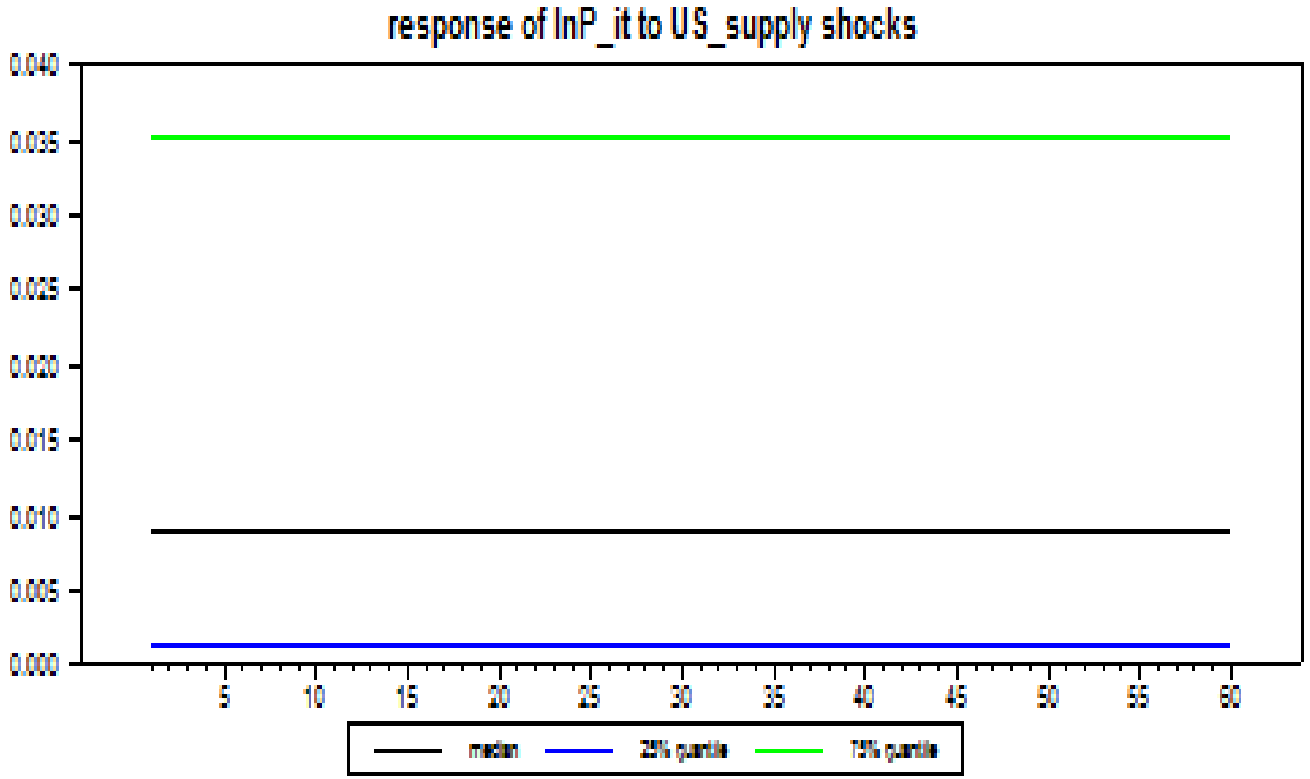
What about free trade?

- **Greater exposure to global agricultural commodity markets yields heightened susceptibility to price shocks from abroad.**

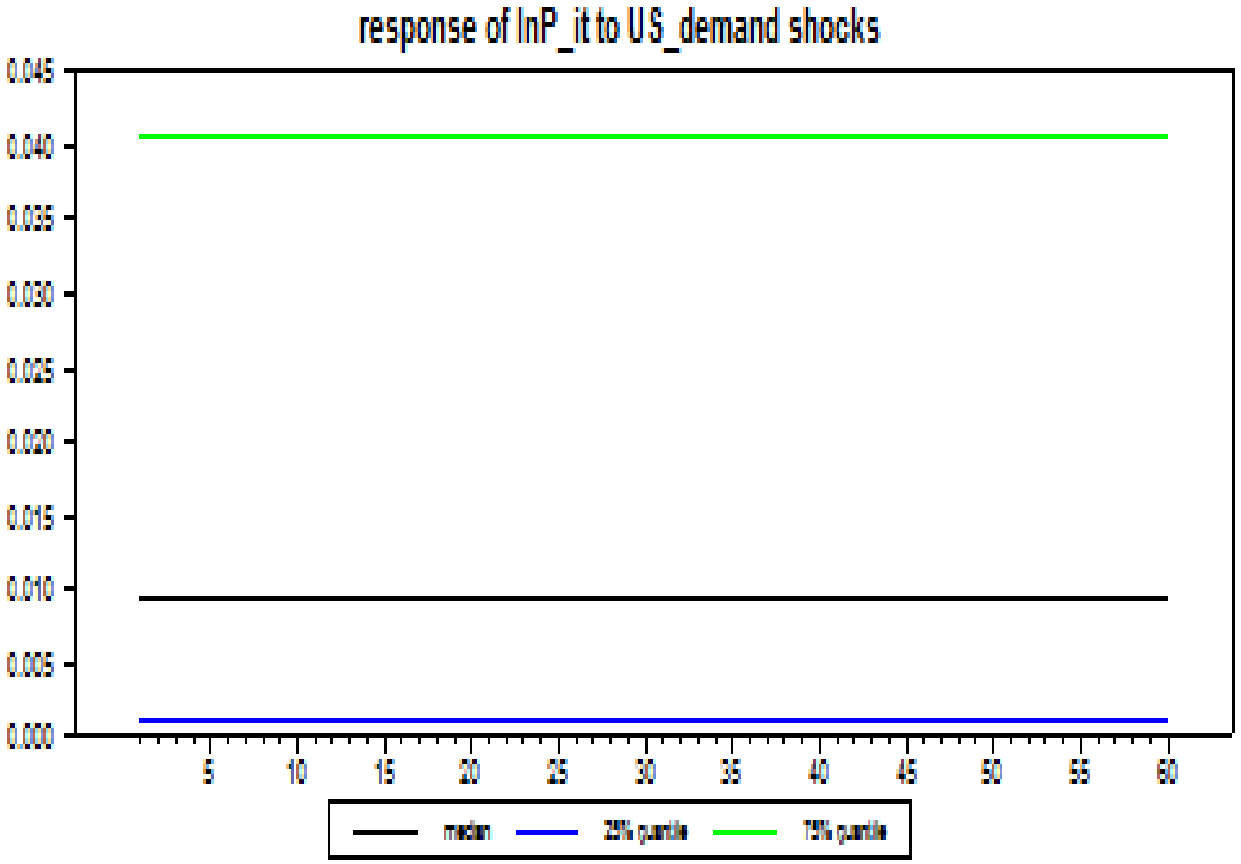
- **A country may want to consider mitigating this susceptibility.**

- **Diversify the agricultural sector with more country-specific traditional commodities.**

Variance decomposition of a U.S. supply shock on developing countries' maize prices



Variance decomposition of a U.S. demand shock on developing countries' maize



Results:

- **A U.S. ethanol demand shock increases maize prices in approximately 75% of the developing countries.**

  This increase is also persistent.

- **In contrast, an ethanol supply shock has mixed results. Slightly fewer than 50% of the countries experience no increase or a decline in their prices.**

- **Developing countries' price flexibility to U.S. supply shock is less responsive than to say a U.S. ethanol demand shock.**