

The Global Food Price Crisis and China-World Rice Market Integration: A Spatial-Temporal Rational Expectations Equilibrium Model

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The question

How would China affect the international rice market if it liberalized its trade in rice?

- China is the world' largest producer and consumer;
- Only about 5% of rice is traded internationally.

In a nutshell

The question

How would China affect the international rice market if it liberalized its trade in rice?

- China is the world' largest producer and consumer;
- Only about 5% of rice is traded internationally.

The answer

It will substantially reduce and stabilize the world rice price:

- reducing risk faced by major importers;
- particularly price spikes caused by export restrictions.

The model

Spatial-temporal rational expectations:

- four interdependent markets;
- storage by speculative storers and government.

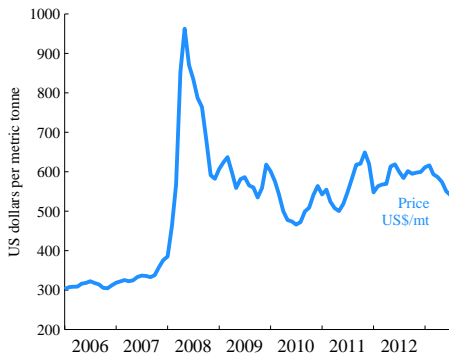
Outline

- 1 Introduction
- 2 The Model
- 3 Results
- 4 Conclusions

The Problem

Export Prices for Thai Rice

2006-1013



- Rice is one of the world's main staples.
- The poor spend around 40% of their income on staples.
- The sudden price increase particularly hurt the poor in developing countries.

Data source: [FAO](#): Thailand, 100% B, 2nd grade, White rice broken, Bangkok, f.o.b.

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The spatial dimension

China

- * China

World Market

- * Bangladesh
- * Philippines
- * Indonesia
- * United States
- * Malaysia

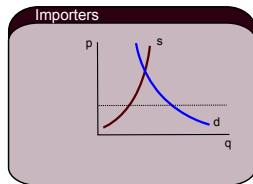
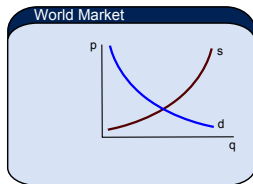
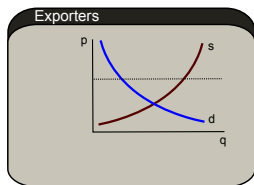
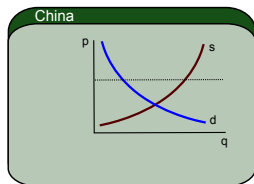
Importers

- * Cote d'Ivoire
- * Nigeria
- * Iran
- * Saudi Arabia
- * Iraq
- * Senegal

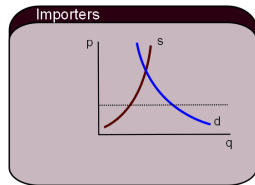
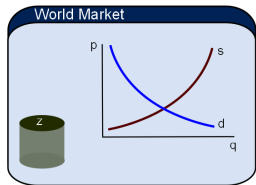
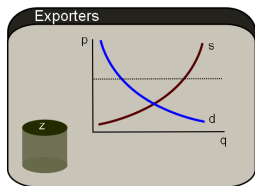
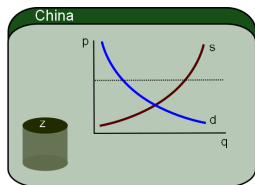
Exporters

- * Brazil
- * Pakistan
- * Egypt
- * Thailand
- * India
- * Vietnam

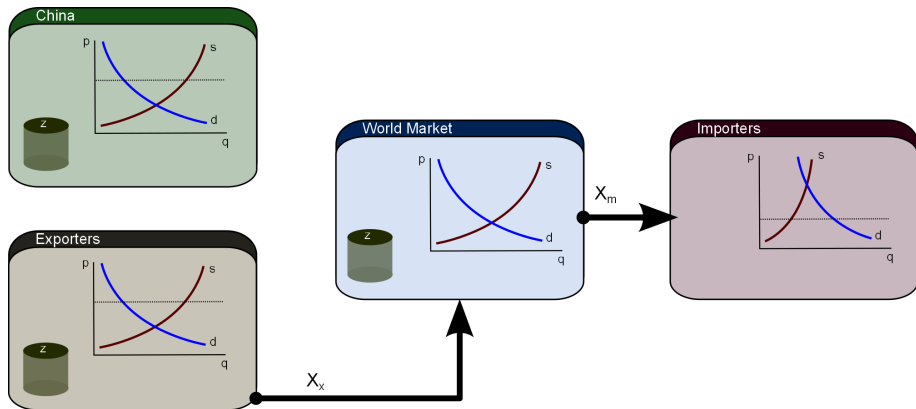
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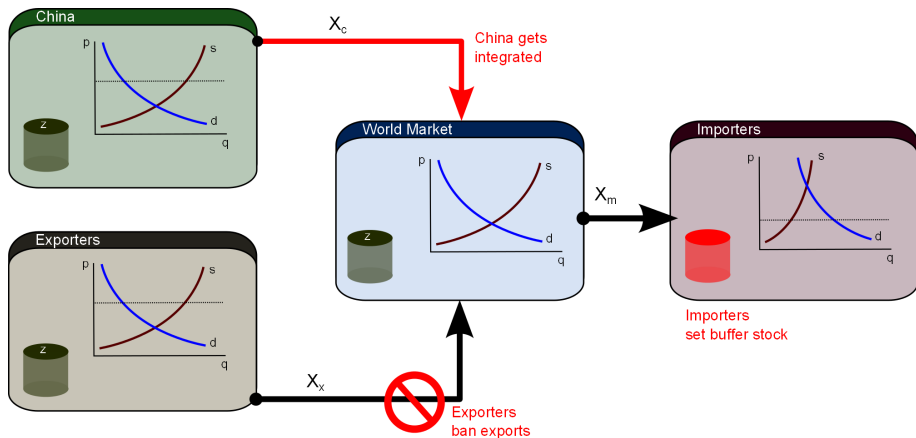
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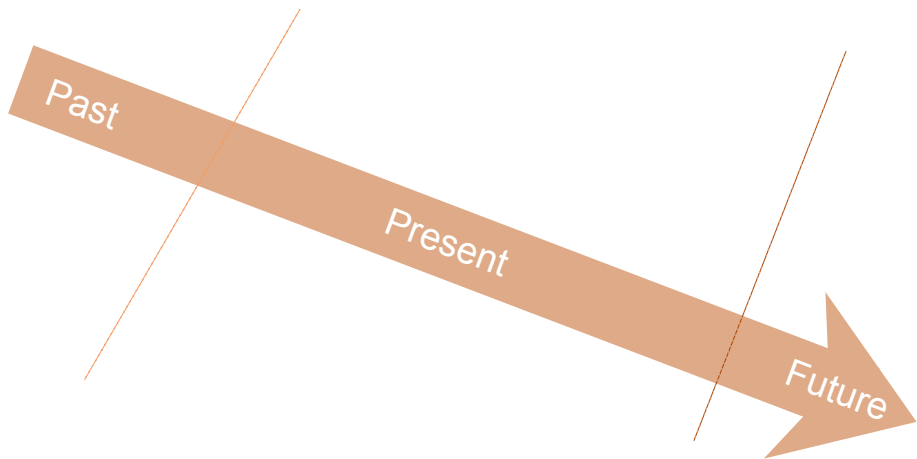
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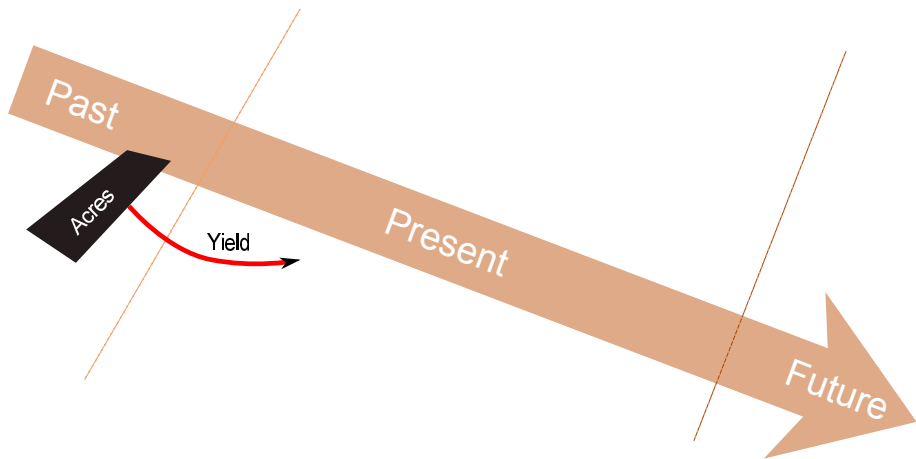
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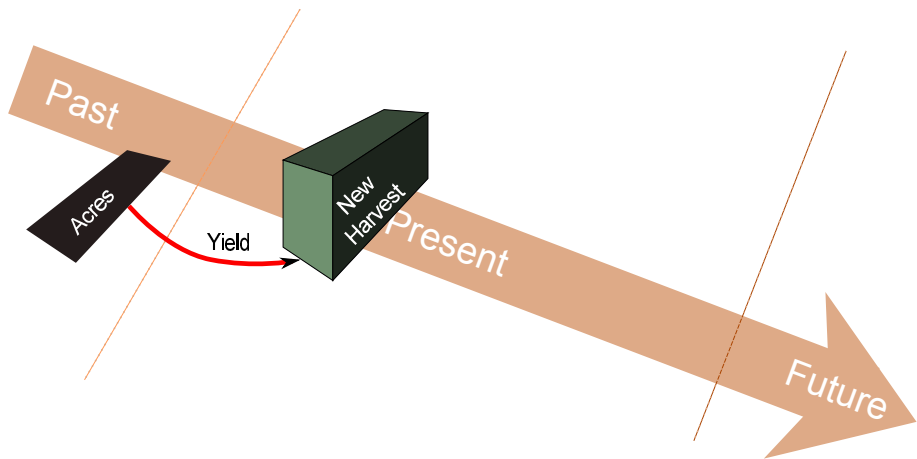
The temporal dimensions



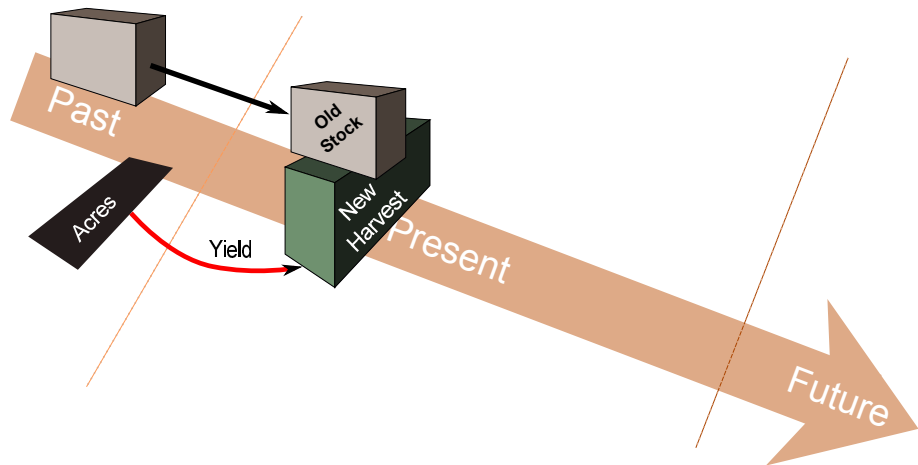
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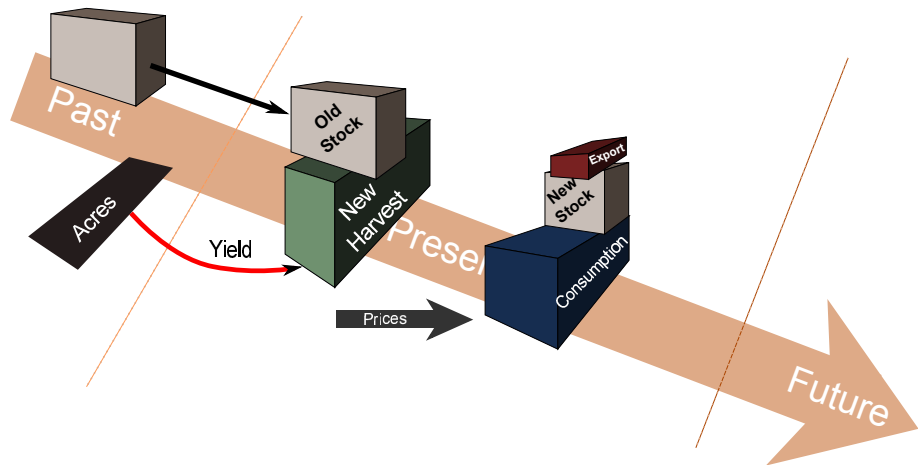
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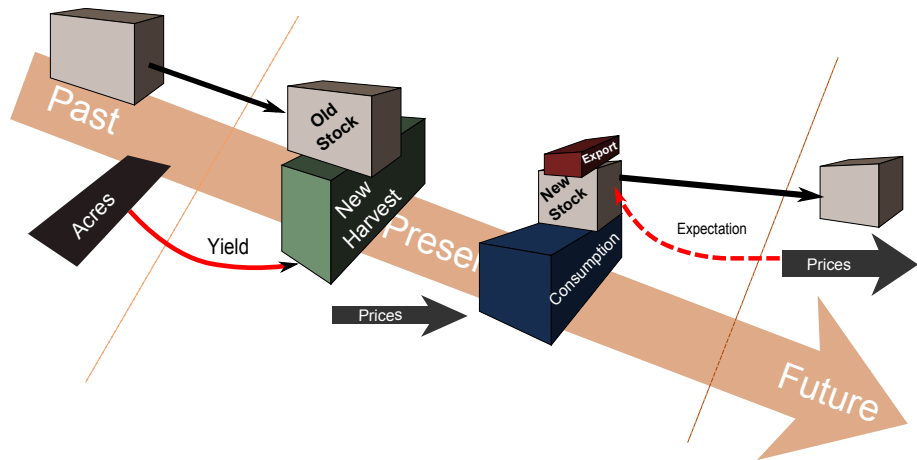
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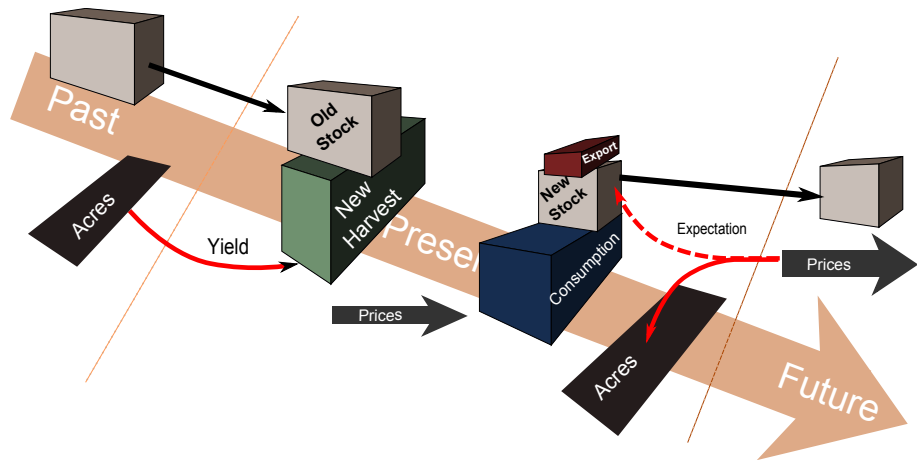
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Solving the model

- There are 31 variables in the model: 23 endogenous, 4 exogenous, and 4 predetermined.

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- Parameter calibration

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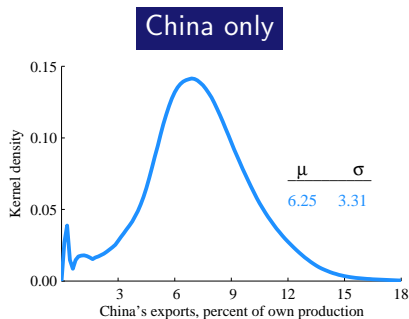
- Once solved, model is simulated to compare alternative scenarios
- Comparison based on stationary distribution of variables
- Model allows to analyze the dynamic adjustment to new stationary equilibrium, following a regime change

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How much rice would be traded?

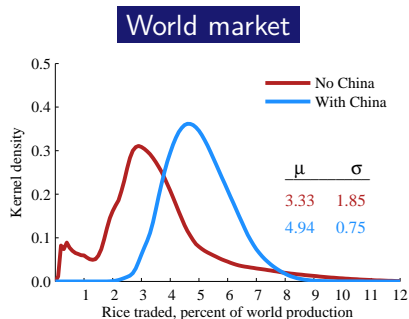
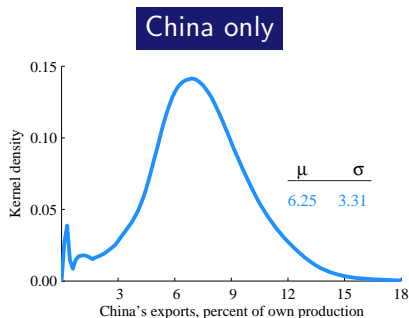
Over time, China would export on average 6.25% of its rice production.



Baseline: NO exporter ban, YES importer stock.

How much rice would be traded?

That would increase the world volume of rice trade, while reducing its variability.

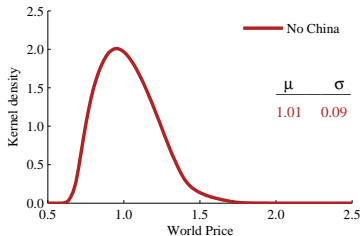


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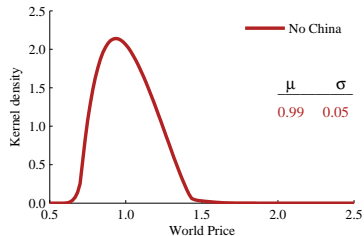
The effect of China's integration on world rice price

Normal trade

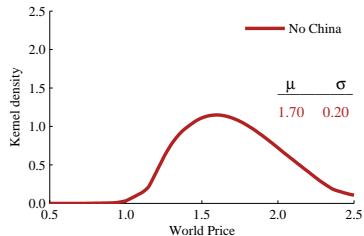
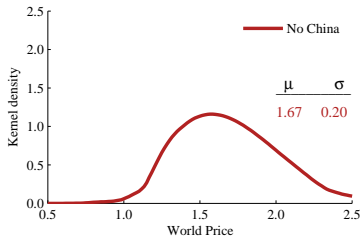
No stockpile in importers



Importers have stockpile



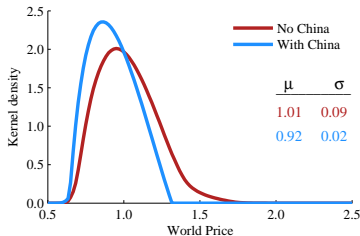
Export bans



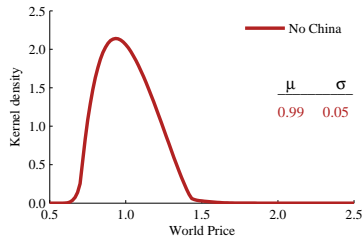
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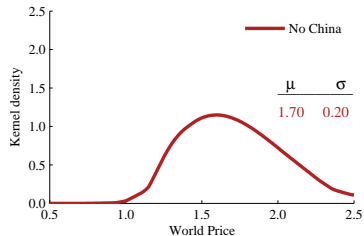
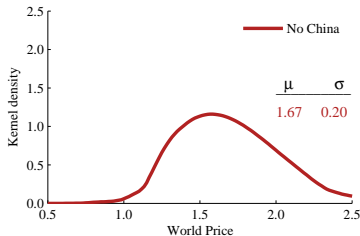
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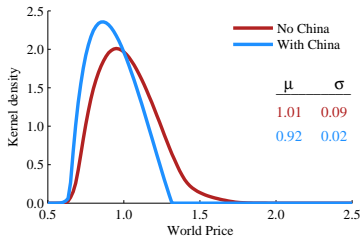
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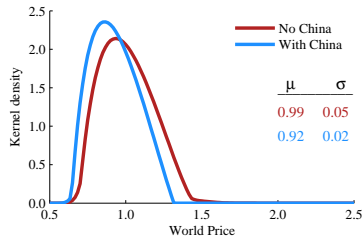
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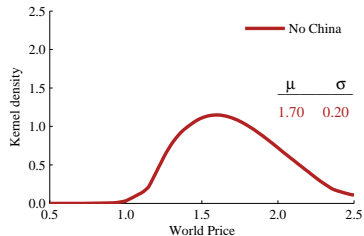
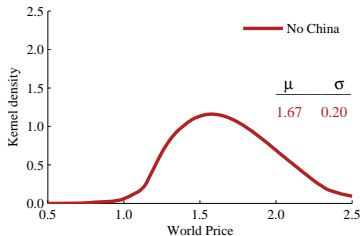
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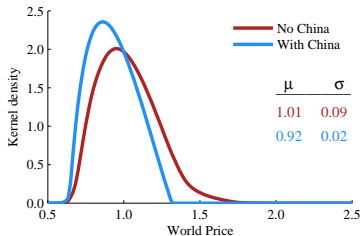
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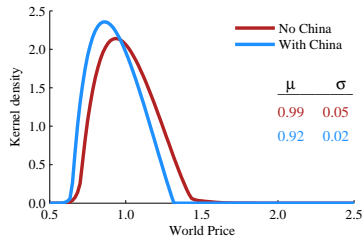
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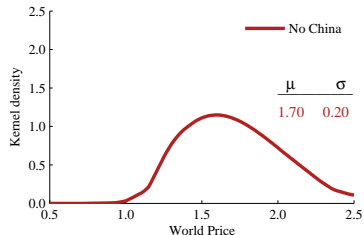
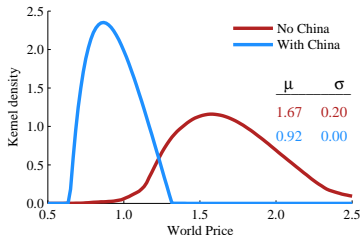
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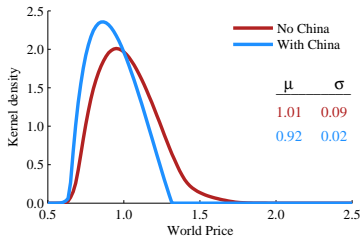
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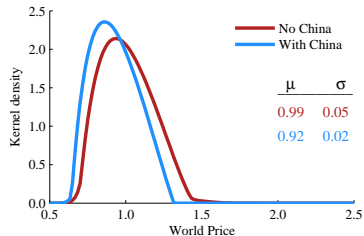
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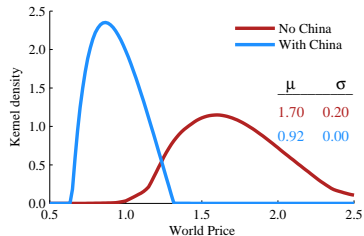
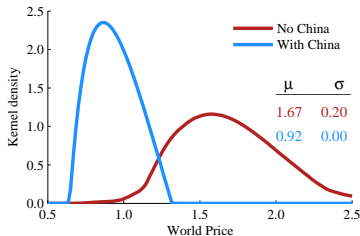
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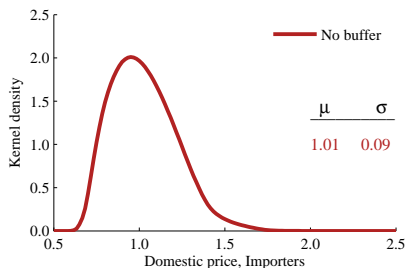
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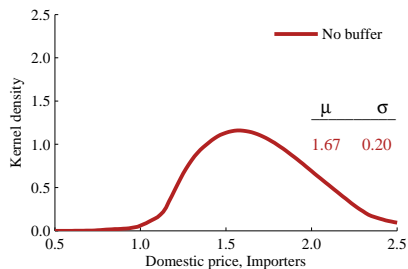
Can importers stabilize domestic price?

Without a buffer stock, local prices in importing countries increase in response to a ban on exports.

Normal trade



Export bans

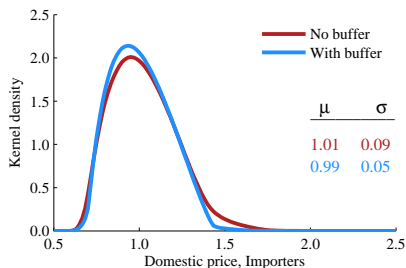


Baseline: China not integrated

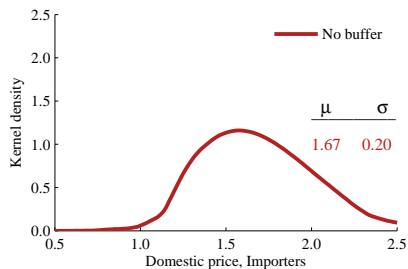
Can importers stabilize domestic price?

Having a stock provides minimal help during normal trade years...

Normal trade



Export bans

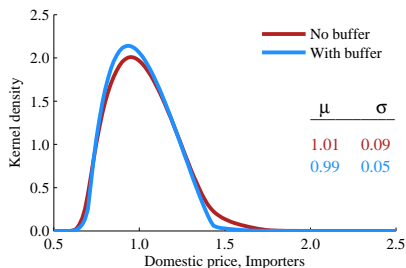


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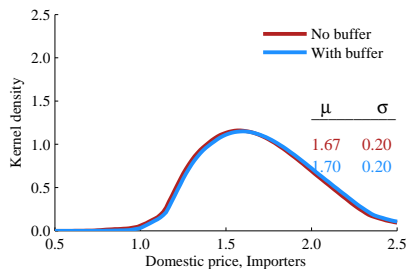
Can importers stabilize domestic price?

...yet it is definitely ineffective in a trade disruption.

Normal trade



Export bans

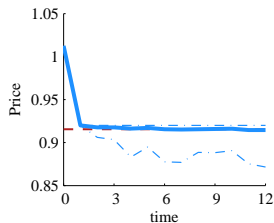


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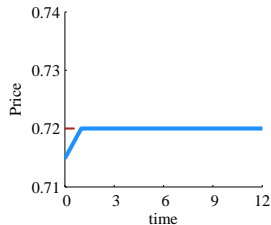
The dynamics of adjustment after China's integration

Prices

World



China

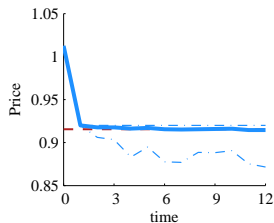


--- new steady-state — response to shock · - · - 90% interval

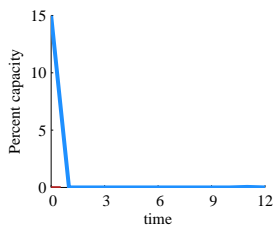
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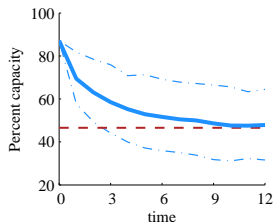
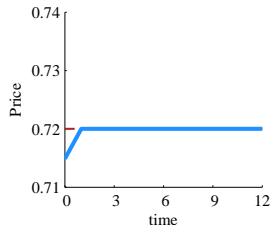
Prices



Stockpiles



China



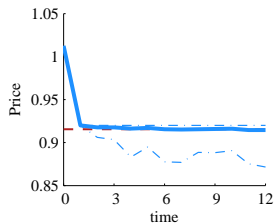
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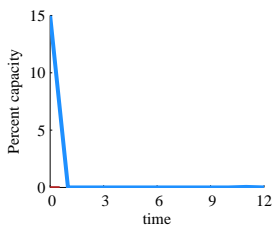
World

China

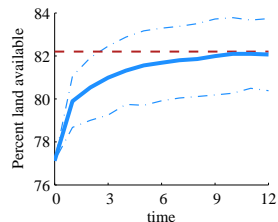
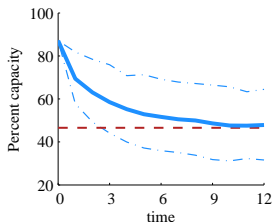
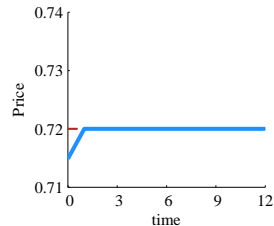
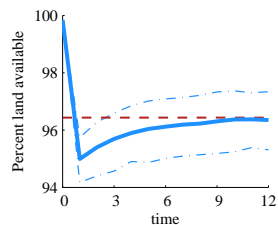
Prices



Stockpiles



Acreage



--- new steady-state — response to shock - · - 90% interval

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Summary of results

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- In all scenarios, China's integration to international rice market reduces both the mean and variance of the world price.
- Following China's integration, price and acreage will increase in China. Opposite result in world market.
- Prices would adjust fast, while acreage and China's stockpile would adjust slowly.

Additional material

Model equations:

- ▶ Consumption demand
- ▶ Prices: market clearing
- ▶ Storage conditions
- ▶ Production supply
- ▶ Trade: arbitrage
- ▶ Availabilities

High price volatility:

- ▶ Export restrictions and price

Consumption demand

$$\begin{aligned}0 \leq C_c \leq \infty & \quad \& \quad C_c = \alpha_c P_c^{-\beta_c} \\0 \leq C_x \leq \infty & \quad \& \quad C_x = \alpha_x P_x^{-\beta_x} \\0 \leq C_m \leq \infty & \quad \& \quad C_m = \alpha_m P_m^{-\beta_m} \\0 \leq C_w \leq \infty & \quad \& \quad C_w = \alpha_w P_w^{-\beta_w}\end{aligned}$$

Prices: Demand vs supply

$$\begin{aligned}
 0 \leq P_c \leq \infty & \perp C_c + Z_c - A_c + Y_c \\
 0 \leq P_x \leq \infty & \perp C_x + Z_x - A_x + Y_x \\
 0 \leq P_m \leq \infty & \perp C_m + Z_m - A_m - Y_m \\
 0 \leq P_w \leq \infty & \perp C_w + Z_w - A_w - Y_c - Y_x + Y_m
 \end{aligned}$$

Storage

$$\begin{aligned}
 0 \leq Z_c \leq \bar{Z}_c & \perp \bar{P}_c - P_c \\
 0 \leq Z_x \leq \bar{Z}_x & \perp \bar{P}_x - P_x \\
 0 \leq Z_m \leq \bar{Z}_m & \perp \bar{P}_m - P_m \\
 0 \leq Z_w \leq \bar{Z}_w & \perp \delta \mathbb{E} P_w - P_w - K
 \end{aligned}$$

Acreage and Production

Production

$$Q_c = \tilde{\epsilon}_c q_{c,-1}$$

$$Q_x = \tilde{\epsilon}_x q_{x,-1}$$

$$Q_m = \tilde{\epsilon}_m q_{m,-1}$$

$$Q_w = \tilde{\epsilon}_w q_{w,-1}$$

Acreage

$$\underline{q}_c \leq q_c \leq \bar{q}_c \quad \perp \quad \phi_c(\mathbb{E} P_c)^{\theta_c} - q_c$$

$$\underline{q}_x \leq q_x \leq \bar{q}_x \quad \perp \quad \phi_x(\mathbb{E} P_x)^{\theta_x} - q_x$$

$$\underline{q}_m \leq q_m \leq \bar{q}_m \quad \perp \quad \phi_m(\mathbb{E} P_m)^{\theta_m} - q_m$$

$$\underline{q}_w \leq q_w \leq \bar{q}_w \quad \perp \quad \phi_w(\mathbb{E} P_w)^{\theta_w} - q_w$$

Trade

$$\begin{aligned} 0 \leq Y_c \leq \bar{Y}_c & \perp P_w - P_c - \tau_c \\ 0 \leq Y_x \leq \bar{Y}_x & \perp P_w - P_x - \tau_x \\ 0 \leq Y_m \leq \bar{Y}_m & \perp P_m - P_w - \tau_m \end{aligned}$$

Availability

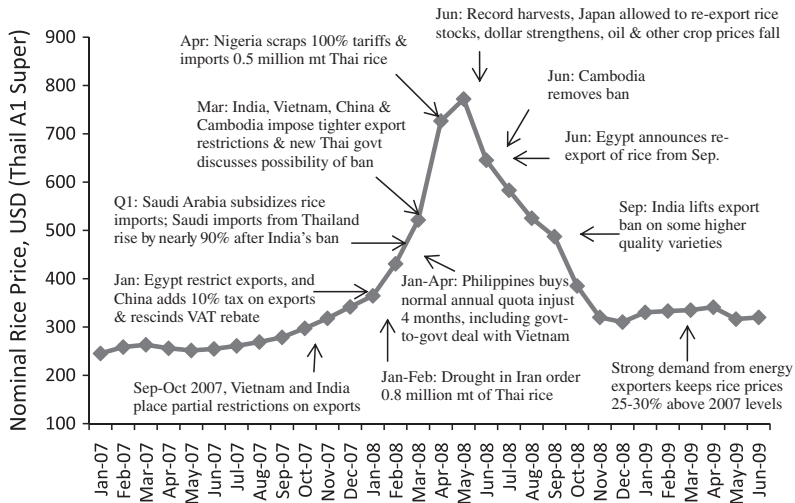
$$A_c = Q_c + Z_{c,-1}$$

$$A_x = Q_x + Z_{x,-1}$$

$$A_m = Q_m + Z_{m,-1}$$

$$A_w = Q_w + Z_{w,-1}$$

The effects of export restrictions on rice prices



Source: Headey 2011 *Rethinking the global food crisis: The role of trade shocks*

Romero-Aguilar, Liu, Chen, Miranda ()

The Global Food Price Crisis

2013 AAEA Meeting

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