

# Trade policy coordination and food price volatility

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## Countercyclical trade policies contribute to world price volatility

- ▶ The rise of rice price in 2007/08 attributed to the export bans of many key countries.
- ▶ Anderson & Nelgen (2012): back-of-the-envelope calculation to assess a contribution of trade policy to price rises in Wheat in 1972/74 and 2006/08 of 23 and 19%.
- ▶ Not limited to price spikes: in period of low world prices, countries raise tariffs or use export subsidies decreasing world price further.

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Even if disciplining export restrictions would bring us closer to the first best, is it possible to achieve an international agreement on this issue?

Would it satisfy the participation constraints of every countries?

# Possibility of a self-enforcing trade agreement?

This work tries to assess the possibility of a self-enforcing trade agreement related to countercyclical trade policies.

Self-enforcement implies

- ▶ There is some internal punishment mechanism to enforce the agreement.
- ▶ It must satisfy the participation constraints of each country.
- ▶ To satisfy participation constraints in every state of the world, some deviations from first best may be authorized (e.g., sensitive products or safeguard measures).

## Our approach

- ▶ The model draws heavily on Bagwell & Staiger (1990).
- ▶ A small linear-quadratic trade model in which countries individually implement countercyclical trade policies (restricted to be taxes).
- ▶ The static Nash equilibrium is Pareto inferior to first best (i.e., free trade).
- ▶ Through repeated interactions, countries may be able to coordinate on a more cooperative policy and we study here the most cooperative equilibrium that is self-enforcing and subgame perfect.

# A simple linear trade model

2 countries (Home exports) – Linear demand functions – Inelastic stochastic supply

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2 state variables:

- ▶  $\epsilon$  and  $\epsilon^*$ ,
- ▶ or equivalently **free-trade world price** (i.e., **aggregate risk**,  $P^f$ ) and **trade volume** (i.e., **idiosyncratic risk**,  $V^f = (\epsilon - \epsilon^*)/2$ ).

# Social welfare function

Quadratic social welfare:

$$W = \underbrace{\int_P^{a/b} D(p) dp}_{\text{Consumers' surplus}} + \overbrace{P\epsilon}^{\text{PS}} - \underbrace{(P - P^w) [\epsilon - D(P)]}_{\text{Government income}} - K \frac{(P - \bar{P})^2}{2}.$$

- ▶  $K$  parameterizes the **country's preference for price stability**.
- ▶  $\bar{P}$  is a **target price** around which policy-makers wish prices to be stabilized (to avoid introducing any policy in the absence of price uncertainty, it is taken to be the steady-state price).

## Trade policies function of world price

- ▶ To account for the fact that trade subsidies are fiscally costly and countries are unlikely to use subsidies as extensively as taxes, trade policies are restricted to be taxes.
- ▶ Maximizing the social welfare function over trade policy leads to the following expression:

$$\tau = \min \left[ 0, \frac{\overbrace{K(\bar{P} - P^w)}^{\text{Smoothing}} - \overbrace{(\epsilon - a + bP^w)}^{\text{Market power}}}{K + 2b} \right],$$

# Interior Nash equilibrium I

$$\tau_N(P^f, V^f) = \begin{cases} 0 & \text{if } P^f \leq \bar{P} - \frac{bV^f}{K(K+2b)}, \\ \frac{K(\bar{P}-P^f)}{b} - \frac{V^f}{K+2b} & \text{if } |\bar{P} - P^f| \leq \frac{bV^f}{K(K+2b)}, \\ 2\frac{K(\bar{P}-P^f)-V^f}{K+3b} & \text{if } P^f \geq \bar{P} + \frac{bV^f}{K(K+2b)}, \end{cases}$$

$P^f$  and  $V^f$  correspond to 2 types of risk: **aggregate and idiosyncratic risks**.

Terms-of-trade (ToT) motivation for intervention changes with idiosyncratic risk, while smoothing motivation adjusts with aggregate risk.

# Interior Nash equilibrium II

## ToT motivation

- ▶ If  $K = 0$  trade policy interventions do not affect world price because
  - ▶ Importer taxes imports decreasing world price,
  - ▶ Exporter taxes exports at the same level increasing world price.
- ▶ This trade policy intervention reduces trade level.

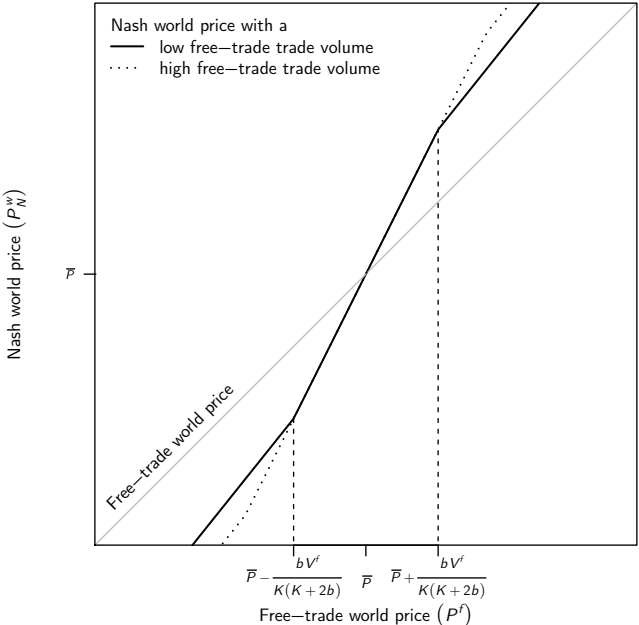
# Interior Nash equilibrium III

## Smoothing motivation

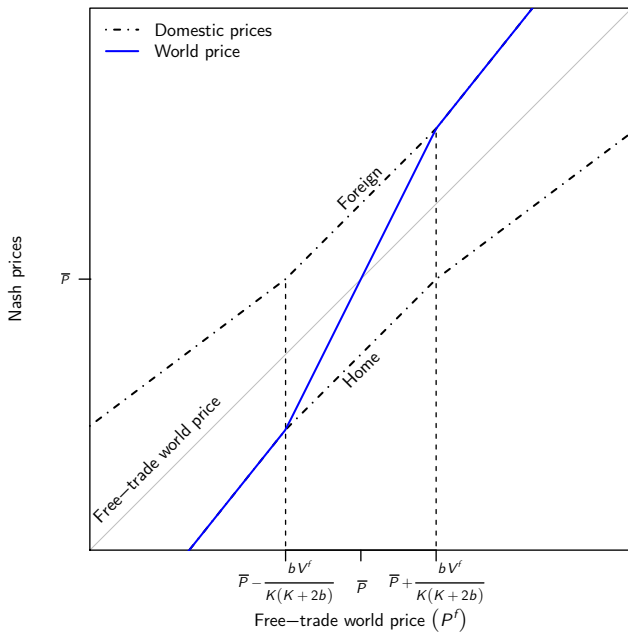
Neglecting the component related to terms of trade, the smoothing motivation in trade policies

- ▶ Increases world price volatility,
- ▶ When policies are active in both countries, they offset each other and domestic prices are the same as in free trade:
  - ▶ Analogy in Martin & Anderson (2012) with a crowd standing up in a stadium to get a better view: this is self-defeating.

# Nash prices



# Nash prices





# Design of a self-enforcing trade agreement

Countries' repeated interactions allow coordination on more cooperative policies:

- ▶ Coordination on protection levels lower than in the static game,
- ▶ but if one country deviates from the cooperative policy, they forever revert to the interior Nash equilibrium.

Trade-off between

- ▶ short-run gains from deviation,
- ▶ long-run losses from returning to the Nash.

# Participation constraint

Trade-off summarized by this participation constraint (PC):

$$E_t \sum_{i=0}^{\infty} \beta^i W(\tau_{t+i}, \tau_{t+i}^*) \geq W(\tau_R(\tau_t^*), \tau_t^*) + \frac{\beta}{1-\beta} E W_N,$$

with  $E W_N$  the unconditional expected welfare on the Nash equilibrium.

PC ensures that the country will **respect the agreement in all states of nature.**

# Optimization problem

The most cooperative subgame perfect Nash equilibrium is given by

$$\max_{\tau_t \leq 0, \tau_t^* \geq 0} E_t \sum_{i=0}^{\infty} \beta^i [W(\tau_{t+i}, \tau_{t+i}^*) + W^*(\tau_{t+i}, \tau_{t+i}^*)]$$

subject to PCs of both countries (to which are associated the positive Lagrange multipliers  $\mu_t$  and  $\mu_t^*$ )

## First-order conditions

$$\begin{aligned}\tau_t : \tau_t \leq 0 \perp (1 + \mu_t) \frac{dW(t)}{d\tau_t} + (1 + \mu_t^*) \frac{dW^*(t)}{d\tau_t} &\geq \mu_t^* \frac{dW^*(\tau_t, \tau_R^*(\tau_t))}{d\tau_t}, \\ \tau_t^* : \tau_t^* \geq 0 \perp (1 + \mu_t^*) \frac{dW^*(t)}{d\tau_t^*} + (1 + \mu_t) \frac{dW(t)}{d\tau_t^*} &\leq \mu_t \frac{dW(\tau_R(\tau_t^*), \tau_t^*)}{d\tau_t^*}.\end{aligned}$$

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Efficient policies would be determined by

$$\frac{dW(t)}{d\tau_t} + \frac{dW^*(t)}{d\tau_t} = 0,$$

so Lagrange multipliers play the role of the relative weighting of countries in world welfare. When one PC is binding, the corresponding welfare weight becomes positive, justifying a deviation from free trade.

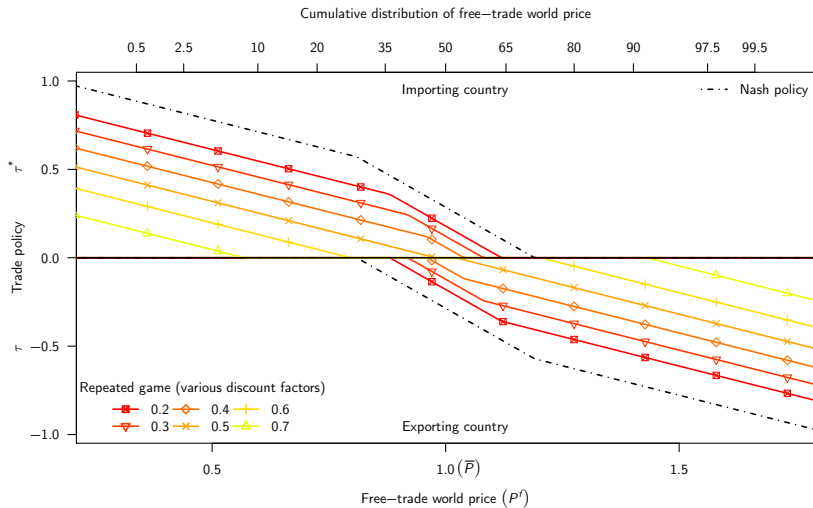
## Numerical illustration

Because of the numerous binding constraints, it is not possible to characterize analytically the solution.

Numerical illustration with the case of a **pure aggregate risk**:

- ▶ Steady-state price: 1.
- ▶ Coefficient of variation of world price: 30%.
- ▶ Steady-state demand: 1.
- ▶ Steady-state trade level: 0.2.
- ▶ Supply shocks follow a beta distribution with parameters  $\{X, 3\}$ ,  $X$  varying from 3 to 30.
- ▶  $K = 0.3$ , calibrated using the formula from Turnovsky et al. (1980) assuming a budget share of 15% and a risk aversion of 2.

# Symmetric price distribution

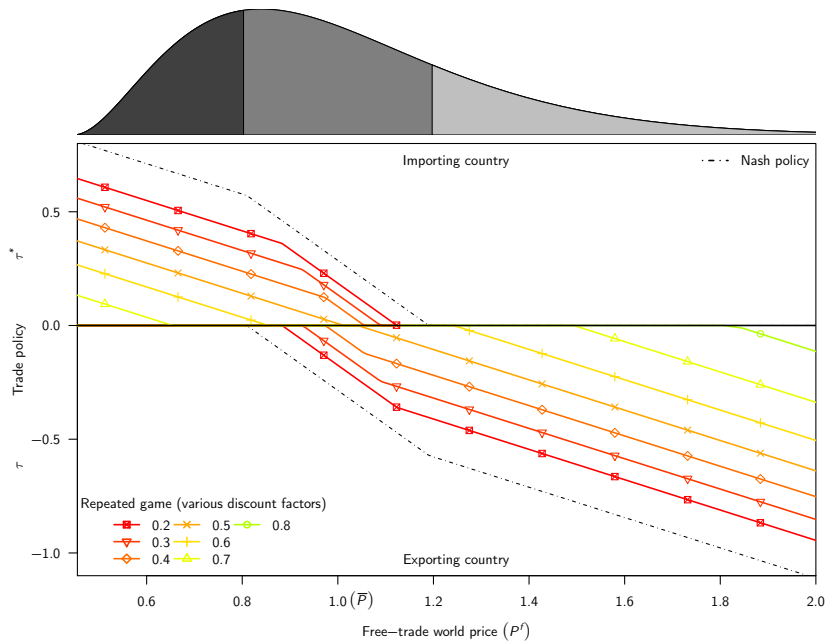


## Positively skewed price distribution

- ▶ In reality, food prices are not distributed symmetrically.
- ▶ Staple food Prices have a positively skewed price distribution (Deaton & Laroque, 1992).
- ▶ Matters for the cooperative equilibrium because affects the distribution of welfare between countries.
- ▶ How to skew prices?
  - ▶ A feature related to competitive storage (too complicated for here).
  - ▶ With negatively skewed supply shocks.



# Trade policies under a skewed price distribution



## Disciplining export taxes with skewed prices

A positively skewed price distribution makes more difficult to disciplining export taxes than import tariffs. 2 possible effects:

- ▶ Occasional spikes  $\Rightarrow$  The exporting country will occasionally face very large incentive to deviate.
- ▶ Prices concentrated below and around mean  $\Rightarrow$  Frequent policies in Nash by the importing country.

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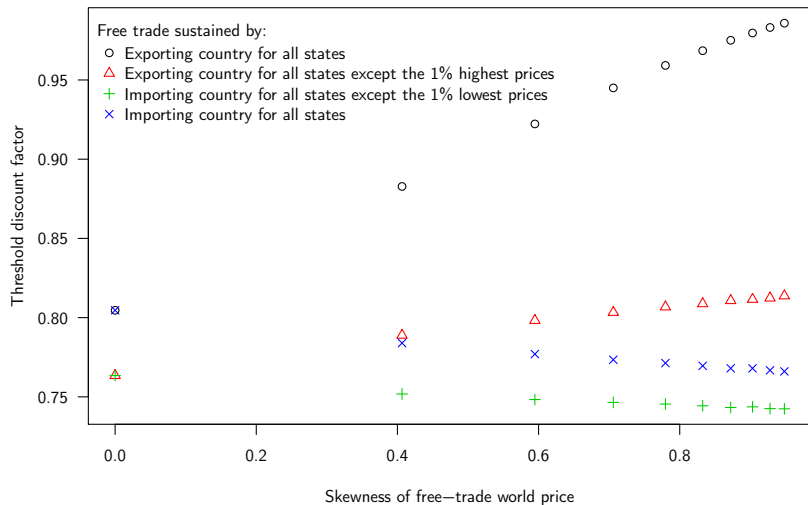
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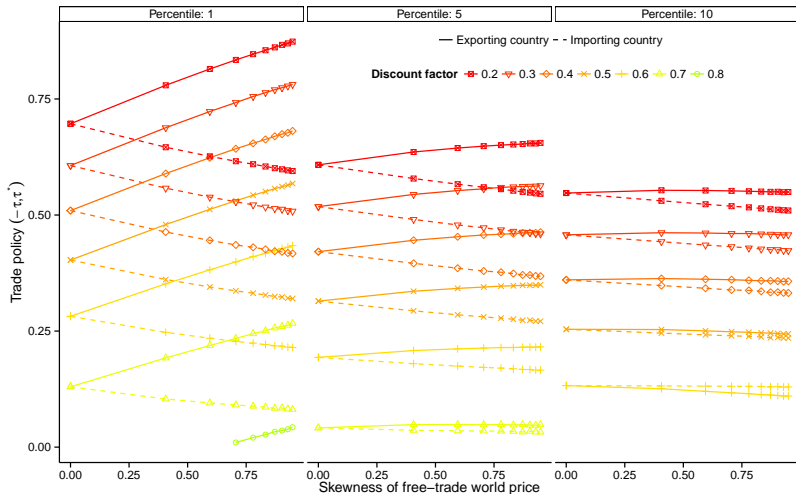
To show the overall effect of price skewness, analyze

- ▶ how the threshold discount factor evolves with skewness;
- ▶ how cooperative trade policies at high percentiles evolve with skewness.

# Threshold discount factor as a function skewness



# Cooperative trade policies as a function skewness



## Conclusion

- ▶ If countries care for domestic price volatility, even in a cooperative agreement it may not be possible to completely alleviate countercyclical trade policies.
- ▶ These deviations from first best differ from the literature based on ToT in that they are asymmetric: exporters deviate when world price is high and importers deviate when world price is low.
- ▶ Export restrictions do not play in this work a more important role than tariffs. The former are the policy used by exporters and the latter the policy used by importer, but both contribute to shift volatility to partners' markets.
- ▶ Export restrictions may be more difficult to avoid in cooperation than tariffs, because the positively skewed distribution of prices implies for the exporter a greater incentive than for the importer to deviate from free trade.

Thank you for your attention.