

Global Production Networks with Global Uncertainty

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Adding Uncertainty to Trade Models

- Adding uncertainty to quantitative trade models is a demanding task
- More macro-ish route: quantitative trade models \Rightarrow dynamics \Rightarrow uncertainty
 - Caliendo, Kortum, and Parro (2025): complete asset markets, endogenous trade imbalances, and exact hat algebra
 - Fitzgerald (2025): exogenous productivity uncertainty, complete markets versus balanced trade
- More trade-ish route: quantitative trade models \Rightarrow uncertainty
 - Kleinman, Liu, Redding, and Xu (2025): endogenous ex ante investments in import and export capacity
 - **Fan and Luo (2025)**: endogenous uncertainty and ex-ante extensive-margin supplier/sourcing choice

Setup

- Illustrate the core mechanism with a partial equilibrium sourcing model
- Each variety $\nu \in [0, 1]$ can be sourced from one of the N countries with cost $c_i/z_i(\nu)$
 - c_i : aggregate stochastic component, capturing either productivity or tariff shock
 - $z_i(\nu)$: idiosyncratic efficiency drawn from Fréchet distribution as in Eaton and Kortum (2002)
- Timing assumption about sourcing decision: sourcing location for each variety determined ex ante, quantity of each variety adjusted ex post
- Optimal sourcing rule: assign each variety ν to origin i that provides largest contribution to expected utility

Contributions

- Mass of varieties sourced from country i is characterized by

$$s_i = \frac{T_i [\lambda_i]^{\frac{\theta}{\sigma-1}}}{\sum_m T_m [\lambda_m]^{\frac{\theta}{\sigma-1}}},$$

- λ_i is the ex-ante marginal value of increasing varieties sourced from country i that solves a fixed-point problem
- Long-term elasticity θ (Fréchet dispersion) versus short-term elasticity σ (elasticity of substitution)

Contributions

- Extend to one-sector general equilibrium model
 - Provide a closed-form perturbation solution for the ex-ante sourcing decision around deterministic equilibrium
- Further extend the model to include input-output linkages à la Caliendo and Parro (2015) and incorporate two types of uncertainty in the quantitative exercise
 - “Reciprocal Tariffs”: enumerate all $2^{11} = 2048$ negotiation-outcome scenarios
 - Country–industry-specific productivity shocks: local solution using automatic differentiation to compute Jacobian- and Hessian-vector products

Comment 1: Extensive Margin

- Key assumption: ex ante extensive-margin sourcing decision
 - In EK framework, extensive margin is latent and varieties are aggregated to country or country-sector level in quantitative exercises
- Consider the following partial equilibrium, single-sector Melitz-style model
 - Mass M_i firms draw productivity φ from Pareto distribution $G_i(\varphi) = 1 - \left(\frac{\varphi_{0i}}{\varphi}\right)^k$, $\varphi \geq \varphi_{0i}$
 - Ex-ante exporting decision after observing φ with sunk fixed cost F_i
 \Rightarrow optimality condition: $\lambda_i \varphi^{\sigma-1} \geq F_i$
 - Exporting quantity determined ex post
 - All other assumptions remain the same as Section 2

Comment 1: Extensive Margin

- The solution of this partial equilibrium Melitz model is characterized by:
 - The optimal active set: $\Phi_i = [\varphi_i^*, \infty)$, $\varphi_i^* = \left(\frac{F_i}{\lambda_i}\right)^{\frac{1}{\sigma-1}}$
 - Risk-adjusted attractiveness $\lambda_i = E \left[I^{1-\gamma} P^{\gamma+\sigma-2} \frac{(\mu c_i)^{1-\sigma}}{\sigma-1} \right]$, where $P = \left[\sum_m (\mu c_m)^{1-\sigma} Z_m \right]^{\frac{1}{1-\sigma}}$
 - Effective productivity mass is: $Z_m = M_m \frac{k}{k-(\sigma-1)} \varphi_{0m}^k \left(\frac{\lambda_m}{F_m}\right)^{\frac{k-(\sigma-1)}{\sigma-1}}$
 - Define $T_i^M \equiv M_i \varphi_{0i}^k F_i^{-k/(\sigma-1)}$. Then share of active exporters in the destination that come from origin i :

$$s_i^M = \frac{T_i^M \lambda_i^{k/(\sigma-1)}}{\sum_m T_m^M \lambda_m^{k/(\sigma-1)}}$$

Comment 2: Hybrid Solution Method in Quantitative Exercise

- The quantitative exercise combines two solution methods:
 - local perturbation for high-dimensional productivity uncertainty
 - global enumeration for large discrete tariff uncertainty
- This hybrid approach is elegant and computationally necessary, but the key quantitative results rely on the interaction between these two sources of uncertainty
- A useful validation exercise: solve a smaller version of the model by brute-force simulation over both productivity and tariff shocks, and compare the results with the hybrid method

Minor Comments

- Existence and uniqueness of the one-sector general equilibrium model
 - Alvarez and Lucas (2007) arguments probably apply to the ex-post equilibrium. What about the ex ante equilibrium?
- Express the equilibrium in exact hat algebra?
 - Natural to express ex post equilibrium as changes to ex ante/deterministic equilibrium. What about the ex ante equilibrium?
- Trump-style tariff uncertainty may have a common U.S. policy-regime component
 - Allow cross-country correlation of tariff outcomes as a robustness check?
- Notational confusion: the Fréchet price-index constant γ_θ may be confused with the CRRA parameter γ

Thank you