Worker Protectionism with Third Country Responses

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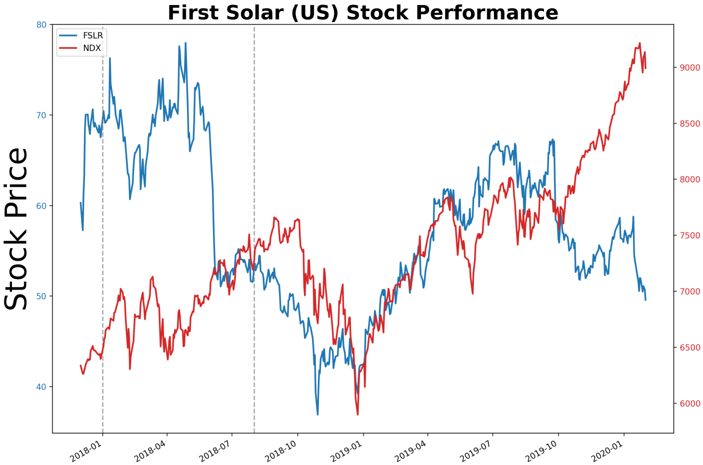
Motivation

- It is generally accepted that tariffs involve a tradeoff between domestic jobs and aggregate prices
- To quantify this tradeoff, it is essential that models accurately capture production relocation
- Ex: If tariffs on F lead to production fully relocating to F', there is no upside
- Standard models impose restrictive assumptions on the effect of $H \to F$ tariffs on F'
- This paper: Evaluate protectionist tariffs in a framework that accurately captures third country effects

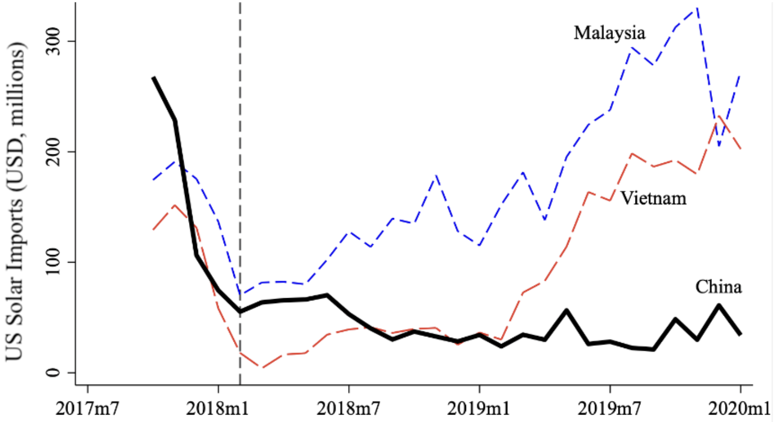
Outline

- Third Country Effects: Data and Models
- Latent Factor Approach
- Model Description
- Solution Method

Third Country Effects: Data



Third Country Effects: Data



Third Country Effects: Data

- Flaaen et al. (2020): washing machines
  - Tariffs on Mexico and South Korea $\rightarrow$ Production relocates to China
  - Tariffs on China $\rightarrow$ Production relocates to Thailand and Vietnam
  - Production finally returns to the US after global tariffs... at a cost
  - The estimated annual consumer cost per job was $815,000

Third Country Effects in EK

- Quantitative analyses of tariffs typically use the Eaton-Kortum (EK) framework
- Continuum of varieties, discrete choice for origin of each variety
- Like many discrete choice models, the EK framework exhibits **Independence of Irrelevant Alternatives (IIA)**

IIA

- Classic example from IO: Blue and Red Buses
- Consider a discrete choice between a blue bus and a train
- For simplicity assume that the current market share is 50-50
- How will market shares change if a new bus is introduced that is a different color (e.g. red)?
- Intuitive answer: 50% remains with trains, 50% split between red and blue bus
- Standard model (e.g. logit) answer: x% goes to red bus, $\frac{1-x}{2}$% goes to blue bus, $\frac{1-x}{2}$% goes to train
- Why? If the blue bus and train were equally attractive before, they should remain so afterwards

Third Country Effects in EK

Let π_{ni} denote the trade share of n in country i and consider a 3 country EK model:

$$\pi_{CH,US} = \frac{T_{CH}(x_{CH,US})^{-\theta}}{D}$$

$$\pi_{VN,US} = \frac{T_{VN}(x_{VN,US})^{-\theta}}{D}$$

$$\pi_{US,US} = \frac{T_{US}(x_{US,US})^{-\theta}}{D}$$

Where T_i is TFP, x_{ni} is the cost of buying from country n in country i, θ is the trade elasticity, and $D = \sum_{i \in US,CH,VN} T_i(x_{i,US})^{-\theta}$

Third Country Effects in EK

Consider a 10% increase in the US tariff on China

$$\hat{\pi}_{CH,US} = \widehat{D}^{-1}(1.1)^{-\theta}$$
$$\hat{\pi}_{VN,US} = \widehat{D}^{-1}$$
$$\hat{\pi}_{US,US} = \widehat{D}^{-1}$$

Built into the EK model is the impossibility of Vietnam gaining more (proportionally) from China than the US (IIA).

Breaking IIA

- A well known departure from IIA is to apply discrete choice within "nests"
- Bus-train example: Outer nest (bus vs train) and inner nest (red vs blue)
- How to choose the nests in the context of trade?
- Previous models: Observables such as sector or geography
- Lind and Ramondo (AER, 2023): Latent Factor Estimation

Latent Factor Approach

- Key idea: What matters is the correlation of productivity draws between ji and $j'i$, more than observable labels
- Many factors are likely to govern this correlation, and not all of them are observable or easily modeled
  - Institutional knowledge
  - Brand penetration
  - Cultural awareness
  - Specific labor
  - ...
- Latent factor approach: Nested discrete choice, where nests are unobserved (latent)
- Allows for **product-level** heterogeneity in third country effects

Model

Households

- Recall that tariffs are a tradeoff between higher wages (for some) and higher prices (for all)
- To distinguish between winners and losers, need heterogeneous households
- Follow Caliendo, Dvorkin, and Parro (ECMA, 2019): Households make a discrete choice over industry, with preference shocks and switching costs
    - $\Rightarrow$ heterogeneous wages, heterogeneous effects of tariffs

Households

- N countries and J industries
- Each country-industry pair (n, j) contains a representative household of endogenous size L_{nj}
- Log preferences over consumption of a final good C
- An employed household in (n, j) receives wage w_{nj} and purchases the final good at price P_n
- A nonemployed household, i.e. a household $(n, 0)$, receives consumption b^n

Industry Choice

- Households pay time invariant, additive utility costs $\tau_n^{j,j'}$ to relocate from (j) to (j')
- In each period, households draw preference shocks for each industry $\epsilon_n^{j'}$
- The only decision households make in each period is where to relocate for next period
- In particular, the value of being in (n, j) at time t is

$$v_t^{nj} = \log\left(C_t^{nj}\right) + \max_{j'}\left\{\beta\mathbb{E}\left[v_{t+1}^{nj'}\right] - \tau_n^{jj'} + \nu\epsilon_n^{j'}\right\} \tag{1}$$

Where $C_t^{nj} = b^n$ if $j = 0$ and $\dfrac{w_t^{nj}}{P_t^n}$ otherwise

Job Flows

- Assuming type I extreme value shocks with 0 mean, we get:

$$V_t^{nj} \equiv \mathbb{E}\left[v_t^{nj}\right] = \log\left(C_t^{nj}\right) + \nu \log\left(\sum_{j'} \exp\left(\beta V_{t+1}^{nj'} - \tau_n^{jj'}\right)^{\frac{1}{\nu}}\right) \tag{2}$$

- It follows that

$$\mu_t^{nj,nj'} = \frac{\exp\left(\beta V_{t+1}^{nj'} - \tau_n^{jj'}\right)^{\frac{1}{\nu}}}{\sum_k \exp\left(\beta V_{t+1}^{nk} - \tau_n^{jk}\right)^{\frac{1}{\nu}}} \tag{3}$$

- The distribution of labor evolves according to

$$L_{t+1}^{nj'} = \sum_{j} \mu_t^{nj,nj'} L_t^{nj} \tag{4}$$

Production

- The final good in each i is produced according to

$$\left(\int_0^1 q_i(\varphi)^{\frac{\eta-1}{\eta}} d\varphi\right)^{\frac{\eta}{\eta-1}} \tag{5}$$

- For each φ, each (n,j) has a perfectly competitive firm that can produce φ and send it to i with linear productivity z_{nji} and observed tariffs t_{nji}

- Perfect competition implies

$$p_i(\varphi) = \min_{n,j}\left\{\frac{t_{nji} w_{nj}}{z_{nji}(\varphi)}\right\} \tag{6}$$

Productivity

- In each i, the vector of productivities for potential sources (n, j) is drawn iid according to

$$Pr[z_{11i}(\varphi) \leq z_{11}, ..., z_{NJi}(\varphi) \leq z_{NJ}] = \exp\left[-G^i\left(T_{11i} z_{11i}^{-\theta}, ..., T_{NJi} z_{NJi}^{-\theta}\right)\right] \tag{7}$$

with

$$G^i(x_{11}, .., x_{NJ}) = \sum_k \left[\left(\sum_n \sum_j (\omega_{knji} x_{nj})^{\frac{1}{1-\rho_k}}\right)^{1-\rho_k}\right] \tag{8}$$

  - EK corresponds to $G(x_1, ..x_n) = \sum_j x_j$
  - k indexes nests, ρ_k governs correlation within nest
  - Every nji is in every nest, but weights differ

Trade Shares

From Proposition 2 in Lind and Ramondo (2023), we have:

$$\sum_k \underbrace{\frac{a_{knji}}{\sum_{n'} \sum_{j'} a_{kn'j'i}}}_{Within} \underbrace{\frac{\left(\sum_{n'} \sum_{j'} a_{kn'j'i}\right)^{1-\rho_k}}{\sum_{k'} \left(\sum_{n'} \sum_{j'} a_{kn'j'i}\right)^{1-\rho_k}}}_{Between} \tag{9}$$

Where

$$a_{knji} = \left(\omega_{knji} T_{nji} w_{nj}^{-\theta}\right)^{\frac{1}{1-\rho_k}} \tag{10}$$

Solution Method

Estimation

- Assume a fixed number of nests K
- Identification assumption: $T_{nji}\omega_{knji} = A_{kni}B_{jk}$
- $\{\rho_k, A_{kni}B_{jk}\} \to$ unique $\{\pi_{nji}\}$
- Estimate parameters to minimize distance between model and data trade shares
- Continue increasing K until fit does not improve (LR stop at $K = 7$)

Solution Method

- Employ hat-algebra method as in Caliendo et al. (2019)
- No need to estimate switching costs τ
- Economy need not be in steady state: Simply input initial conditions+shocks and iterate
- Two step procedure: Outer loop over labor flows, inner loop over trade shares

Static Hat Algebra

$$\hat{w}_{nj}\hat{L}_{nj}w_{nj}L_{nj} = \sum_i \hat{\pi}_{nji}\pi_{nji}\left[\left(\sum_j \hat{w}_{ij}\hat{L}_{ij}w_{ij}L_{ij}\right) - TB_i\right] \tag{11}$$

$$\hat{\pi}_{nji}\pi_{nji} = \frac{\hat{T}_{nji}\hat{t}_{nji}^{-\theta}\hat{w}_{nj}^{-\theta}\tilde{\pi}_{nji}G_{nj}^{i}\left(\hat{T}_{11i}\hat{t}_{11i}^{-\theta}\hat{w}_{11}^{-\theta}\tilde{\pi}_{11i},\ldots,\hat{T}_{NJi}\hat{t}_{NJi}^{-\theta}\hat{w}_{NJ}^{-\theta}\tilde{\pi}_{NJi}\right)}{G^{i}\left(\hat{T}_{11i}\hat{t}_{11i}^{-\theta}\hat{w}_{11}^{-\theta}\tilde{\pi}_{11i},\ldots,\hat{T}_{NJi}\hat{t}_{NJi}^{-\theta}\hat{w}_{NJ}^{-\theta}\tilde{\pi}_{NJi}\right)} \tag{12}$$

$$\hat{P}_i = G^{i}\left(\hat{T}_{11i}\hat{t}_{11i}^{-\theta}\hat{w}_{11}^{-\theta}\tilde{\pi}_{11i},\ldots,\hat{T}_{NJi}\hat{t}_{NJi}^{-\theta}\hat{w}_{NJ}^{-\theta}\tilde{\pi}_{NJi}\right)^{-\frac{1}{\theta}} \tag{13}$$

Static Hat Algebra

$$\hat{w}_{nj}\hat{L}_{nj}w_{nj}L_{nj} = \sum_i \hat{\pi}_{nji}\pi_{nji}\left[\left(\sum_j \hat{w}_{ij}\hat{L}_{ij}w_{ij}L_{ij}\right) - TB_i\right] \tag{14}$$

$$\hat{\pi}_{nji}\pi_{nji} = \frac{\hat{T}_{nji}\hat{t}_{nji}^{-\theta}\hat{w}_{nj}^{-\theta}\tilde{\pi}_{nji}G^i_{nj}\left(\hat{T}_{11i}\hat{t}_{11i}^{-\theta}\hat{w}_{11}^{-\theta}\tilde{\pi}_{11i}, \ldots, \hat{T}_{NJi}\hat{t}_{NJi}^{-\theta}\hat{w}_{NJ}^{-\theta}\tilde{\pi}_{NJi}\right)}{G^i\left(\hat{T}_{11i}\hat{t}_{11i}^{-\theta}\hat{w}_{11}^{-\theta}\tilde{\pi}_{11i}, \ldots, \hat{T}_{NJi}\hat{t}_{NJi}^{-\theta}\hat{w}_{NJ}^{-\theta}\tilde{\pi}_{NJi}\right)} \tag{15}$$

$$\hat{P}_i = G^i\left(\hat{T}_{11i}\hat{t}_{11i}^{-\theta}\hat{w}_{11}^{-\theta}\tilde{\pi}_{11i}, \ldots, \hat{T}_{NJi}\hat{t}_{NJi}^{-\theta}\hat{w}_{NJ}^{-\theta}\tilde{\pi}_{NJi}\right)^{-\frac{1}{\theta}} \tag{16}$$

Input $w, L, \pi, G, \theta, TB, \hat{T}, \hat{t}, \hat{L}$; Output $\hat{w}, \hat{\pi}, \hat{P}$

Dynamic Hat Algebra

Define $u_t^{nj} \equiv \exp\left(V_t^{nj}\right)$

$$\mu_{t+1}^{nj,ik} = \frac{\mu_t^{nj,ik}\left(\hat{u}_{t+2}^{ik}\right)^{\beta/\nu}}{\sum_m \sum_h \mu_{t+1}^{nj,mh}\left(\hat{u}_{t+2}^{mh}\right)^{\beta/\nu}} \tag{17}$$

$$L_{t+1}^{nj} = \sum_i \sum_k \mu_t^{ik,nj} L_t^{ik} \tag{18}$$

$$\hat{u}_{t+1}^{nj} = \frac{\hat{w}_{nj}}{\hat{P}_n}\left(\sum_i \sum_k \mu^{nj,ik}\left(\hat{u}_{t+2}^{ik}\right)^{\beta/\nu}\right)^{\nu} \tag{19}$$

Dynamic Hat Algebra

Define $u_t^{nj} \equiv \exp\left(V_t^{nj}\right)$

$$\mu_{t+1}^{nj,ik} = \frac{\mu_t^{nj,ik}\left(\hat{u}_{t+2}^{ik}\right)^{\beta/\nu}}{\sum_m \sum_h \mu_{t+1}^{nj,mh}\left(\hat{u}_{t+2}^{mh}\right)^{\beta/\nu}} \tag{20}$$

$$L_{t+1}^{nj} = \sum_i \sum_k \mu_t^{ik,nj} L_t^{ik} \tag{21}$$

$$\hat{u}_{t+1}^{nj} = \frac{\hat{w}_{nj}}{\hat{P}_n}\left(\sum_i \sum_k \mu_t^{nj,ik}\left(\hat{u}_{t+2}^{ik}\right)^{\beta/\nu}\right)^{\nu} \tag{22}$$

Input $\beta, \nu, L, \hat{w}, \hat{P}$ Output $L', \mu, \hat{u}$

Algorithm

1. Estimate parameters of G to match static trade shares as in LR
2. Guess a path for $\left\{\hat{u}_t^{ik}\right\}$ that converges to 1
3. Use Equation 20 and initial migration flows to solve for the full migration path
4. Use Equation 21 to solve for the labor path
5. Compute the change in real wages using the static hat algebra equations
6. Use Equation 22 to compute the implied path for $\left\{\hat{u}_t^{ik}\right\}$
7. Iterate 2-6 until convergence

Conclusion

- Our framework synthesizes two frontier models:
  - Caliendo et al. (2019) for heterogenous workers
  - Lind and Ramondo (2023) for nested productivity
- As a result, the effect of tariffs is heterogeneous across workers **and** products
- Analyses:
  - To what extent can tariffs bring back domestic jobs?
  - To what extent to domestic workers in targeted industries benefit?
  - What is the cost to workers in other industries?