Discussion of "The Aggregate Importance of Intermediate Input Substitutability"

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*The views expressed herein do not necessarily represent the position of the Federal Reserve Bank of Philadelphia, the Federal Reserve System, or the Federal Reserve Board of Governors.

This paper estimates (long-run) substitution across material inputs

- Compare two firms, i and i': Both use Chemicals as an input

  i uses complex fertilizers: 22.5% tariff in 1989 → 5% in 1996

  i' uses sulfuric acid: 100% tariff in 1989 → 40% in 1996

  price of complex fertilizers, relative to sulfuric acid, increases by 70%

- Main question of the paper: Does the chemicals cost share (within material inputs) of firm i increase more than that of i'?
  - If so, cost shares are positively correlated with relative prices (instrumented by tariffs) → $\theta < 1$. If not, $\theta > 1$.

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- Paper is much more general:
  - More flexible regression: Firms may use many inputs within 1-digit industry; regression compares across potentially many 1-digit industries
  - Industry or firm data.
  - Idea extended to elasticity of materials (relative to services and energy); intermediate inputs (relative to capital and labor)

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  - Looks at both industry- and firm-level data
  - Regression specification extended to elasticity of materials (relative to services and energy); intermediate inputs (relative to capital and labor)

Estimates of longer-run elasticities are relatively scarce

- Many estimates of short-run (<1 year) elasticity of substitution:
  - Barrot and Sauvagnat (2016): Use disasters at different input suppliers to estimate elasticity of substitution among different supplier firms.
  - Atalay (2017): use government spending shocks to identify industry elasticity of substitution across intermediate inputs.
  - Boehm, Flaaen, Pandalai-Nayar (2019): Use 2011 Japanese earthquake to identify how easily US multinationals substitute across inputs sourced in Japan vs. US.
  - Others in the literature: Miranda-Pinto and Young (2020), Fujiy, Ghose, Khanna (2022)

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  - Others in the literature: Miranda-Pinto and Young (2020), Fujiy, Ghose, Khanna (2022)
- Estimates of industry-level or firm-level elasticates at medium or longer horizons are critical:
  - Medium run: Macroeconomic impacts of Russian oil/gas embargo? (Bachman et al., 2022)
  - Longer run: Impacts of carbon taxes? (Melek and Orak, 2022)

Outline

- Paper provides credible estimates of elasticity of substitution across material inputs.
- Novel contribution to already large literature on estimation of elasticities of substitution.
- Three suggestions
  - Possible to estimate elasticity among different energy inputs?
  - Incorporate Boehm, Levchenko, Pandalai-Nayar (2022) local projections method
  - Provide rough sense of elasticity in a single nest case

Long differences don't generate estimates of long-run elasticities …

- Boehm, Levchenko, Pandalai-Nayar (2022): "A 5-year tariff change of a given magnitude could be due to shocks at the beginning or end of the 5-year period. As a result, a 5-year difference specification will estimate a conflation of horizon-0 to horizon-5 trade elasticities."

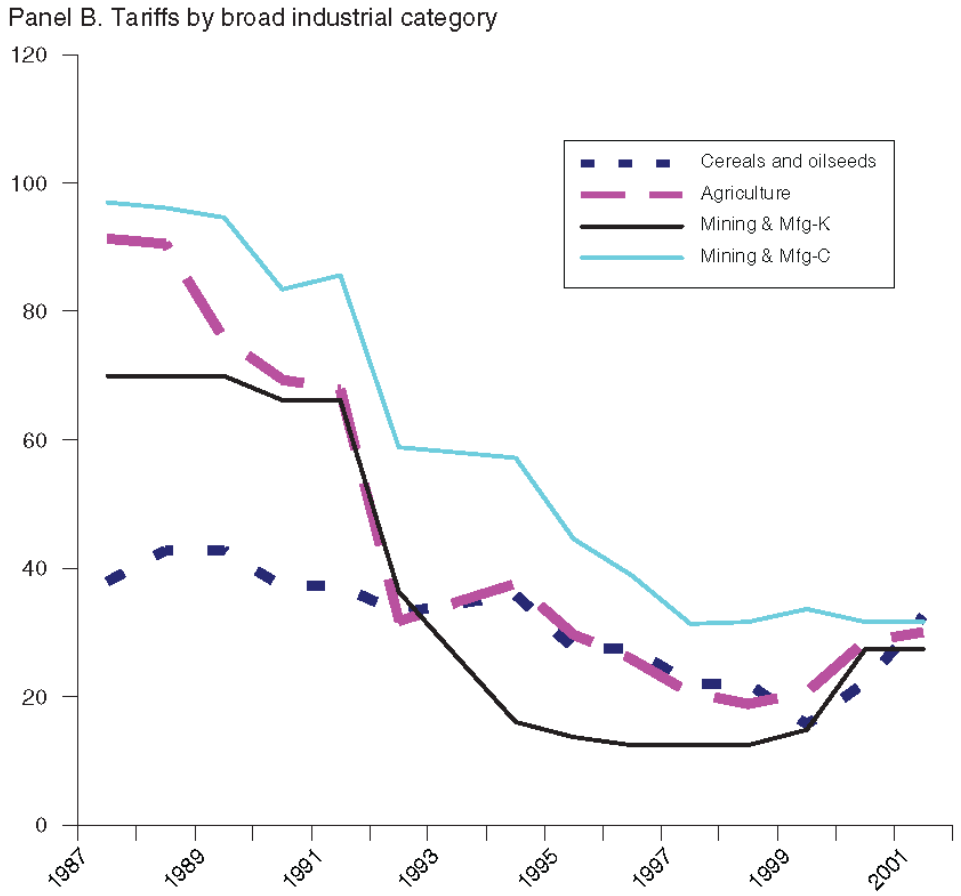

FIGURE 1. EVOLUTION OF INDIA'S TARIFF AND NTBS (*Continued*)

… but one can apply a local projections approach to retrieve long- and short-run elasticities jointly

- Boehm et al. approach:
- $\Delta_h \ln\left(\frac{PM_{ik,t}}{PM_{i,t}}\right) = \beta_h \Delta_h \ln\left(P_{ik,t}\right) + \lambda_{ik} + \lambda_{it} + \lambda_{kt} + \varepsilon_{ikt}$
  - Δ_h is the h-period difference from t-h to t
  - Instrument $\Delta_h \ln\left(P_{ik,t}\right)$ using "tariff shock" in period t.
- Approach yields β_h, h-horizon elasticities of substitution.
- Would likely require ASI data beyond 1996. Boehm et al. apply 24 years of data to estimate h up to 10.

Different papers have different nesting structures…

- This paper: Y_j=F_j(K−L, E−M−S).
  - E, M, and S are each composites of inputs from different 1-sector industries.
  - Elasticity of substitution within M, across 1-digit industries is θ=3.1
  - Elasticity of substitution across M, S, and E is θ^X=0.4
- Atalay (2017), Baqaee and Farhi (2019, Section 6; 2022, Section 4), Carvalho et al. (2021), Miranda-Pinto and Young (2022), Caliendo, Parro, Tsyvinski (2022), Y_j = F_j(K-L, X) or Y_j = F_j(L,X).
  - X is a composite of inputs (or firms) from different industries (or firms).

… possible to provide rough guide as to long-run elasticity in the single nest case?

- FOC comparing two materials purchases (k vs. l):

$$\Delta \ln\left(\frac{PM_{ik}}{PM_{il}}\right) = (1-\theta)\Delta \ln\left(\frac{P_{ik}}{P_{il}}\right) + \varepsilon_{i,kl}$$

- FOC comparing a material and a service (k vs. s):

$$\Delta \ln\left(\frac{PM_{ik}}{PS_{is}}\right) = (1-\theta)\Delta \ln\left(\frac{P_{ik}}{P_{is}}\right) + (\theta - \theta^X)\,\Delta \ln\left(\frac{P_i^m}{P_i^s}\right) + \varepsilon_{i,ks}$$

$$= \left(1-\tilde{\theta}_{i,ks}\right)\Delta \ln\left(\frac{P_{ik}}{P_{is}}\right) + \tilde{\varepsilon}_{i,ks}\text{ , where}$$

$\tilde{\theta}_{i,ks} = \theta(1-s_i) + \theta^X s_i,$

and s_i is the share of the material (or service) within its bundle.

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- If θ=3.1, θ^X=0.4, s_i=0.5, then $\tilde{\theta}_{i,ks}$=1.75