Global Networks, Risks and the U.S. Economy

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Unique Framework for Shocks and Supply Networks

An **Enormous** body of work answering just the right questions

- Global supply chains have played a leading role in most economic story-lines of the past decade
- Offers a realistic production networks structure: multi-sector, multi-country models
- Factor shocks approximate what reality gives us (operating off equilibrium –interior of production possibility frontier)

Today: Three thoughts on extending/interpreting this model in additional useful directions for policymakers

Risk and Rare Earths

Direction Flows and Data

Capacity and Constraints

Risk in Global Supply Chains

Timely Question: What would be the macroeconomic effects of global export restrictions on Chinese-sourced rare earths?

Hulten (1978): The macroeconomic impact of a sectoral shock is given by the aggregate sales share (Domar weight) λ_i

Baqaee and Farhi (2019): Impact is also governed through inputs

$$\approx \lambda_i \sum_{j \neq i} \frac{-\lambda_j}{\xi_{ji}}$$

Rare Earths captures essence of **Risk** in that:

$$\lambda_{RE} \approx 0 \qquad \qquad \xi_{j,RE} \approx 0$$

Unique Challenges with Highly Micro/Idiosyncratic Risk?

1. How to capture risk when there is uncertainty surrounding estimates of $\xi_{RE,j}$ *AND* they are likely close to zero?
   - When both λ_{RE} and $\xi_{RE,j}$ are very close to zero, "small" errors can have big impact

2. What aggregation biases might exist when available input-output data are much more aggregate than source of risk?
   - ICIO data: 3-digit NAICS (i.e. 332: Fabricated Metals)
   - Rare earths: NAPCS 67113010109 (contains ALL RE metals)

One Promising Resource:

USGS: Mineral commodity consumption by application and associated industry

Mineral commodity	Application category	Data sources and notes regarding applications	Associated BEA industry [code]	Estimated percent of BEA industry's output that used this mineral commodity	Basis for assessment for percent of BEA industry's output that used this mineral commodity
		applications were split equally between medical, guided missiles, and search, detection, and navigation instruments. Rare earth element consumption in samarium-cobalt magnets was between different four sub-applications based on their allocated revenues shares. Rare earth element consumption in ceramics was split 80%-20% between thermal barrier coatings for aerospace turbine blades and			magnets [2034200000] in 2021 by this industry relative to its total output.
	Magnets, neodymium-iron-boron: power steering		Motor vehicle steering, suspension component (except spring), and brake systems manufacturing [3363A0]	11.9	Assessment was based on the value of shipments of the following NAPCS code: Manufacturing of other motor vehicle steering and suspension components, including motor vehicle ball joints [2042675000] in 2021 by this industry relative to its total output. The result was then multiplied by a factor of 55%. This factor represents the approximate share of motor vehicle steering that use rare earth permanent magnets (Stanford Magnets, 2024).
	Magnets, neodymium-iron-boron: automotive electronics		Audio and video equipment manufacturing [334300]	4.3	Assessment was based on the value of shipments of the following NAPCS code: Manufacturing of speakers for automobiles [2032400000] in 2021 by this industry relative to its total output.
	Magnets, neodymium-iron-boron: consumer electronics, hard disk drives		Computer storage device manufacturing [334112]	17.9	Assessment was based on the value of shipments of the following NAPCS codes: Manufacturing of disk subsystems and disk arrays for multiuser computer systems [2011625003] and Manufacturing of disk drives (all sizes) [2011625006] in 2017 by this industry relative to its total output.
	Magnets, neodymium-iron-boron: consumer		Audio and video equipment	39.8	Assessment was based on the value of shipments of the following NAPCS codes: Manufacturing of

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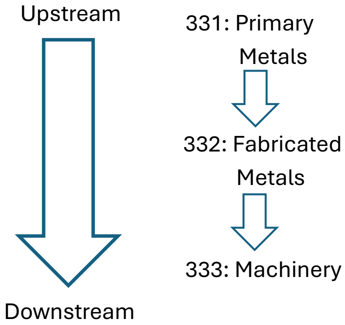
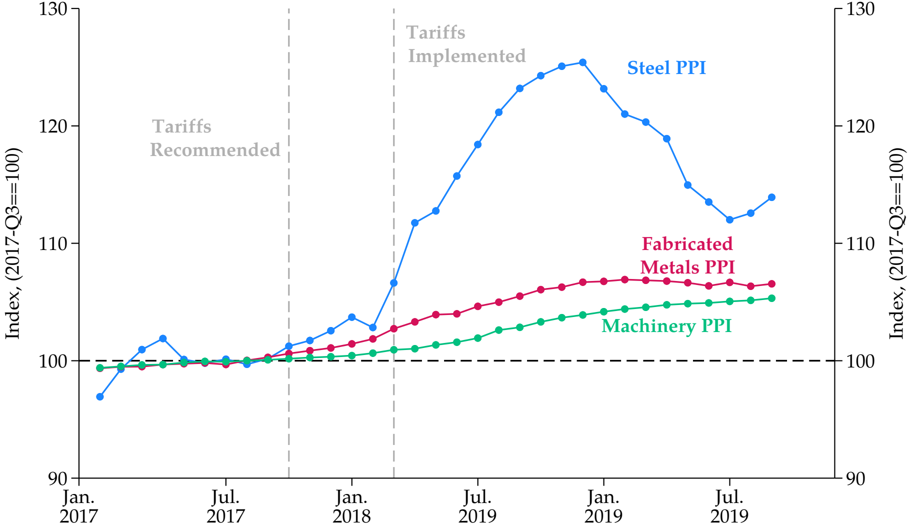
Direction Flows in Networks



- Effects of industry shocks can differ depending on how upstream they are.
- Model has real IO linkages representing direction of production flows...
- ...would be useful to see examples of transmission flow from model
- Could timing be calibrated from data?

Direction in Data: 2018 Steel Tariffs and Effects



Risk and Rare Earths

Direction Flows and Data

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Post-Covid Supply Chain Disruptions:

Capacity Constraints: Another difficult feature of production chains to capture:

- Rapid demand shifts during COVID, firms cannot expand capacity quickly
- Subsequently, disruptions *cascade* as downstream firms experience materials constraints
- Can factor shocks reflect such constraints? And for endogenous triggering of upstream/downstream constraints?
- How much is captured (in reduced form) by elasticity of substitution?

Highlight an often overlooked empirical resource on this subject

Quarterly Survey of Plant Capacity

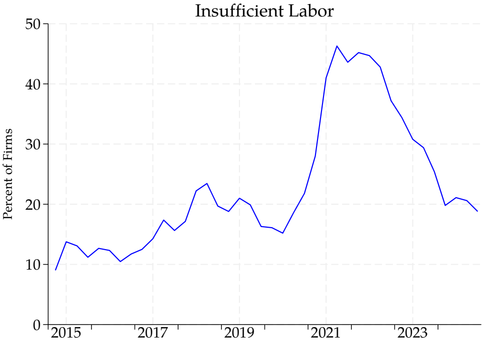
- Asks plants about full production capabilities AND current operating rates.
- Some plants report operating at capacity.
- If not, survey asks plants – why not?

B. ACTUAL OPERATIONS VS FULL PRODUCTION CAPABILITY

If this plant's **actual** production in the current quarter was **less** than **full production capability**, mark (X) the primary reasons.

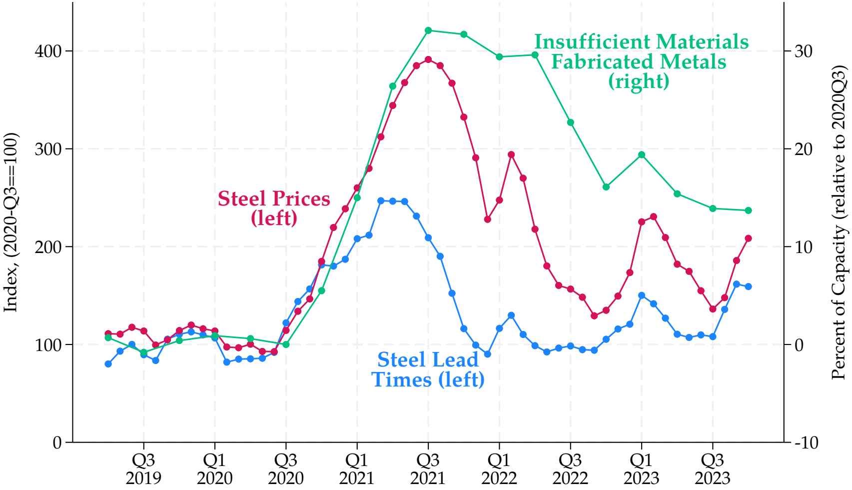
- ☐ Not most profitable to operate at full production capability
- ☐ Insufficient supply of materials
- ☐ Insufficient orders
- ☐ Insufficient supply of local labor force/skills
- ☐ Lack of sufficient fuel or electric energy
- ☐ Equipment limitations
- ☐ Storage limitations
- ☐ Logistics/transportation constraints
- ☐ Sufficient inventory of finished goods on hand
- ☐ Strike or work stoppage
- ☐ Seasonal operations
- ☐ Environmental restrictions
- ☐ Other – *Specify*

Quarterly Survey of Plant Capacity



Labor and Material constraints mattered a great deal in 2021-2022!

Steel Production Hits Constraints, Cascading Impacts



- Downstream sector (Fabricated Metals) experiences shortages

Conclusion

Policy-Relevant Research at its Finest

- Line of research answers a huge array of policy-relevant questions
- Right type of model to capture production network
- Data resources (especially for U.S.) need to catch up!