International Macroeconomics with Global Supply Chains

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Global Supply Chains in International Macro

Most int'l macro analysis is done without global supply chains.

More ought to be done with global supply chains.

Supply chain thinking improves *empirical* answers to core questions:

- How does trade transmit shocks across countries?
- How do international relative prices influence 'competitiveness'?
- What is the size/distribution of the burden of external rebalancing?
- How do monetary shocks spill over across countries?

Plan for this talk:

1. The Macro-Mechanics of Input Linkages
2. The Research Frontier

Value-Added Models and Beyond

Canonical models ignore traded inputs – they are "value-added models."

Example: International RBC Model [Backus, Kehoe, and Kydland (1994)]

Problem 1: Mis-calibration of value-added models.

- Researchers mix gross and value-added data/parameters.
  - Openness: exports/GDP $\neq$ value-added exports/GDP.
  - Elasticities: gross trade elasticities $\neq$ value-added elasticities.
  - Bilateral linkages: CHN-US gross exports $>$ value-added exports.
- This is correctable. [Bems (2014), Johnson (2014a), Bems and Johnson (2015)]

  Structural transformation analog [Herrendorf, Rogerson, and Valentinyi (2013)].

Problem 2: Inputs introduce new channels for shock transmission.

- Value-added models focus exclusively on demand-side linkages, but GSCs link countries together on the supply side too.
- Needed: models with explicit cross-border input linkages ...

Bare Bones Model (IRBC + IO)

Static (no capital) model with N countries indexed by $i, j \in \{1, ..., N\}$.

Consumers: $U_i = \log(F_i) - \frac{\chi\epsilon}{1+\epsilon} L_i^{(1+\epsilon)/\epsilon}$

with $F_i = \left[\sum_{j=1}^{N} F_{ji}^{(\sigma-1)/\sigma}\right]^{\sigma/(\sigma-1)}$ and $w_i L_i = \sum_{j=1}^{N} p_j F_{ji}$.

Production: $Q_i = \left[\omega V_i^{(\gamma-1)/\gamma} + (1-\omega) X_i^{(\gamma-1)/\gamma}\right]^{\gamma/(\gamma-1)}$,

with $V_i = Z_i L_i$ and $X_i = \left[\sum_{j=1}^{N} X_{ji}^{(\rho-1)/\rho}\right]^{\rho/(\rho-1)}$

Output allocation: $Q_i = \sum_{j=1}^{N} [F_{ij} + X_{ij}]$.

Full IRBC + IO models: Ambler et al. (2002), Johnson (2014b).

Domestic and IO International Linkages

Large literature on domestic cross-sector linkages:

1. Sectoral comovement and aggregate fluctuations:
   Long and Plosser (1983), Horvath (2000), Conley and Dupor (2003), Foerster, Sarte, and Watson (2011), Acemoglu et al. (2012)
2. Weak links and misallocation:
   Jones (2011), Bartelme and Gorodnichenko (2015)

Parallel issues in international macro:

1. Explaining cross-country comovement and regional cycles.
2. Quantifying aggregate costs of border frictions.

Shock transmission is broadly similar in domestic and int'l context.
Key exception: labor is mobile across sectors, immobile across borders.

Application: Int'l Relative Prices and Competitiveness

Example: suppose Japanese Yen depreciates.

Does demand for value added (DfVA) from Asian trade partners rise/fall?

- Since Japan is upstream in 'factory Asia', then devaluation boosts competitiveness of downstream Asian partners (DfVA rises).
- But, there is expenditure switching toward Japanese inputs, reducing demand for inputs from downstream countries (DfVA falls).

Point 1: IO links + elasticities determine how DfVA changes.

Point 2: low input elasticity $\Rightarrow$ maximizes pro-competitive effect
$\Rightarrow$ yen depreciation raises DfVA from Asia.

Point 3: Broadly, input linkages reallocate beggar-thy-neighbor spillovers away from supply chain partners.

Formalizing the Role of IO linkages & Elasticities

Bems and Johnson (2015)

Focus on "demand side" of the IRBC + IO framework (demand for V_i). Linearize FOC's, production function, and market clearing conditions.

Three steps:

1. Demand for Gross Output: $\hat{\mathbf{Q}} = f(\hat{\mathbf{F}}, \hat{\mathbf{p}}; [\sigma, \gamma, \rho])$
2. Demand for Value Added: $\hat{\mathbf{V}} = g(\hat{\mathbf{Q}}, \hat{\mathbf{p}}; \gamma)$
3. Gross Output Prices: $\hat{\mathbf{p}} = h(\hat{\mathbf{p}}^v)$

Demand for Value Added

$$\hat{\mathbf{V}} = v(\hat{\mathbf{p}}^v, \hat{\mathbf{F}}; [\sigma, \gamma, \rho])$$

$$= -\left(\sigma \mathbf{T}_\sigma + \rho \mathbf{T}_\rho + \gamma \mathbf{T}_\gamma\right) \hat{\mathbf{p}}^v + w(\hat{\mathbf{F}})$$

The $\mathbf{T}$'s depend on input and final goods linkages across countries.

Demand for Value Added and Value-Added REERs

$$\hat{V}_i = -\tilde{\epsilon}_i(\sigma, \rho, \gamma)\ T^{ii}_{VA}\ \widehat{REER}_i + w(\hat{\mathbf{F}})$$

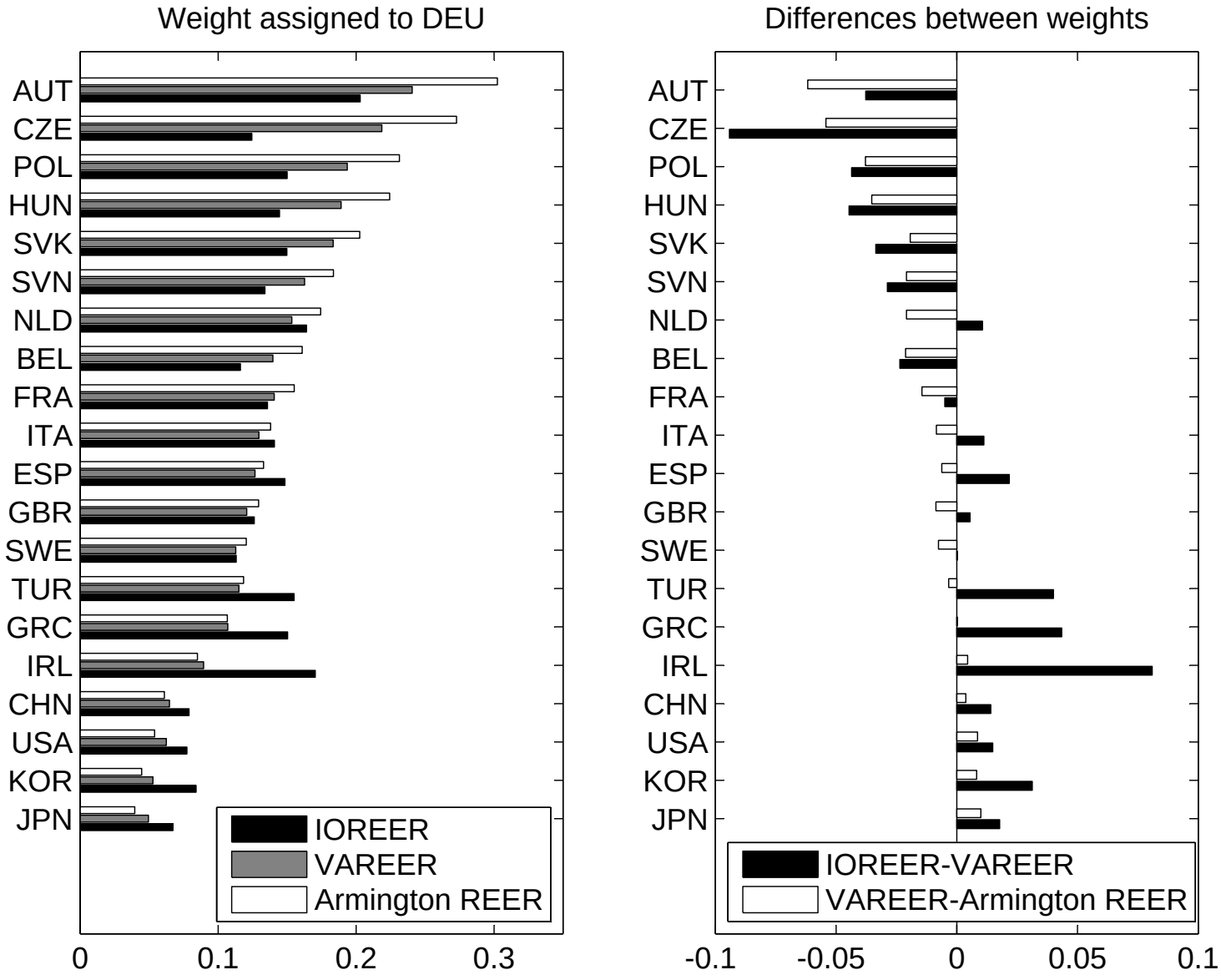
$$\widehat{REER}_i \equiv \sum_{j \neq i} \underbrace{\left[\frac{-(\sigma T^{ij}_{\sigma} + \rho T^{ij}_{\rho} + \gamma T^{ij}_{\gamma})}{\sigma T^{ii}_{\sigma} + \rho T^{ii}_{\rho} + \gamma T^{ii}_{\gamma}}\right]}_{\text{Typically } +\text{, not always. Sum to 1.}} \left(\hat{p}^v_i - \hat{p}^v_j\right)$$

$$\tilde{\epsilon}_i(\sigma, \rho, \gamma) \equiv \sigma \frac{T^{ii}_{\sigma}}{T^{ii}_{VA}} + \rho \frac{T^{ii}_{\rho}}{T^{ii}_{VA}} + \gamma \frac{T^{ii}_{\gamma}}{T^{ii}_{VA}}$$

$$T^{ii}_{VA} \equiv T^{ii}_{\sigma} + T^{ii}_{\rho} + T^{ii}_{\gamma}$$

Value-Added REERs

REER Weights Assigned to Germany, 2007



Frontiers I: Input Linkages in Int'l Macro Models

Contours of the literature

- IRBC & Trade-Comovement: Ambler et al. (2002), Johnson (2014b).
- External Rebalancing: Bems (2014).
- Import Demand & Trade Collapse: Bems, Johnson, and Yi (2010), Eaton et al. (2011), Bussière et al. (2013).
- REERs & Competitiveness: Bems and Johnson (2015), Patel et al. (2014).

GSCs, Exchange Rates, and Monetary Policy

- Obs. 1: Imported inputs can be natural exchange rate hedge.
  Recent micro pass-through evidence by Amiti, Itskhoki, and Konings (2014).
- Obs. 2: IO linkages $\Rightarrow$ pricing complementarities (real rigidity) – "act as multiplier for price stickiness" [Basu (1995)].

How do GSCs alter monetary shock transmission in NOEM models?

Frontiers II: Elasticities Matter. . . What are They?

Most credible elasticity estimates are at micro level (firms or sectors).

Challenge: aggregating micro-estimates to macro-relevant parameters.

Firm-level $\mapsto$ sector-level elasticities

- Example: Boehm et al. (2015) use 2011 Japan shock to estimate firm-level elasticities b/n F & H inputs, and inputs & factors.
- Agg. elasticity = within-firm substitution + cross-firm reallocation + exit-entry dynamics [Ramanarayanan (2013), Oberfield and Raval (2014)].

Sector-level $\mapsto$ aggregate elasticities

- Imbs and Mejean (2014) study elasticity heterogeneity and aggregation in multi-sector model without IO linkages.
- How does aggregation work with IO linkages?

Frontiers III: Cascades via Input Chains

Issue 1: Measuring exposure to GSC shocks

- Both first-order (direct) and higher order (indirect) linkages matter.
  - Across countries: e.g., Japanese inputs embodied in Korean semiconductors, which are exported to the US.
  - Across firms: e.g., firm that directly imports from Japan may supply inputs to downstream firms in the US.
- Holy grail: credible information on firm-to-firm links, both across countries and behind the border.

Issue 2: macro-amplification of GSC shocks

- Domestic IO linkages may amplify GSC shocks.
- Large agg. weight on shocks to upstream sectors (IO multiplier).
- Example: Blaum, Lelarge, and Peters (2015) aggregate firm-level gains from imported inputs via IO structure.

Conclusion

We know a lot more about IO-in-macro now than even 5 years ago.

But, a lot of work still to be done, particularly in international macro.

Important micro-to-macro dimensions:

- Aggregating micro-elasticites into macro-elasticities.
- Translating micro-shocks into macro-outcomes.

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