Discussion of Sectoral Development Multipliers

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Papers' key questions and contributions

- **Questions**: Can we promote economic development by supporting key industries? Which policy instrument is the most effective?
  - Existing work highlighting the role of production networks in development usually assumes exogenous productivity and exogenous network (Fadinger et al., 2022; Gloria et al., 2023)

- It **contributes** to the literature, at least, in two fronts:
  - First, it incorporates technology adoption in production network models
  - Second, it highlights the strong interaction between technology adoption and networks (input-output and investment networks), and how that matters for policy

- In addition, it provides an analysis of the effectiveness of different policy instruments (Liu, 2019; Miranda-Pinto, 2018), incorporating adoption subsidies

Key equilibrium objects in the model

- (sales and cost) Domar weights (sectoral sales to GDP ratios):

$$\Psi' = (\Gamma' + \Delta'\Lambda)(I - \nu\phi\Omega)^{-1}; \qquad \tilde{\Psi}' = (\Gamma' + \Delta'\Lambda)(I - \nu\Omega)^{-1}$$

  where $\phi = \frac{\eta-1}{\eta}$ measures sectoral frictions (market power). Could also represent heterogeneous financial frictions Bigio and La'O, 2020)

- Elasticity of aggregate consumption to revenue (r) and adoption subsidies (r^a):

$$d\ln C = \left(\tilde{\Psi}' - \Psi'\right) d\ln r + \left(\tilde{\Psi}' - \frac{\eta-1}{\eta}\Psi'\right) \beta\, \mathrm{diag}(M)\, \nabla_{a,r^a} \left[I + \nabla_{PY,r} + \Lambda\,(I - \nu\Omega)^{-1}\right] d\ln r$$
$$+ \left(\tilde{\Psi}' - \frac{\eta-1}{\eta}\Psi'\right) \beta\, \mathrm{diag}(M)\, \nabla_{a,r^a} d\ln r^a,$$

  with Δ_{a,r^a} another complex function of the networks

Comment I: Adoption changes production structure

- The adoption of modern technologies changes the production network
  - Transportation: upgrading to electric buses greatly changes the firm's production network: no more oil, engine oil, distribution belt, engine spark plugs, etc.
    - New materials are needed: charging ports-related inputs, batteries, batteries' recycling materials/facilities
    - Moreover, easier maintenance displaces labor
    - To produce more electric buses also need more copper, lithium, nickel
    - Other adoptions require new IO linkages: renting AI services every month, rather than in-house software
- Consistent with the fact that IO networks become denser over the development path (Acemoglu and Azar, 2022; Gloria, Miranda-Pinto, and Fleming-Muñoz, 2023)

Endogenous IO network (Ω) over the development path

Acemoglu and Azar (2022) and Gloria, Miranda-Pinto, and Fleming-Muñoz (2023)

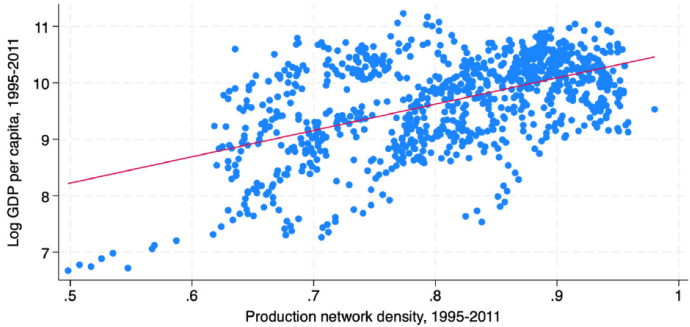

Figure: Figure 1 in Gloria, Miranda-Pinto, and Fleming-Muñoz (2023)

The Investment Network Λ overtime

Figure 1: Investment Network over time

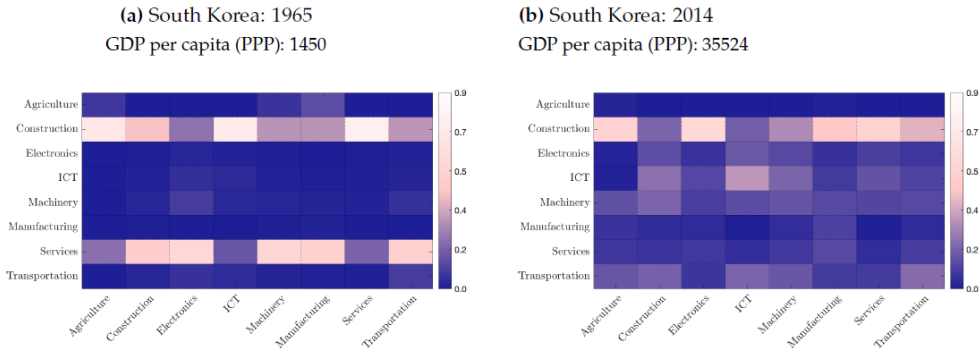

Figure: Figure 1 Caunedo and Casal (2023)

Reorganization of firm-level networks even in the short-run

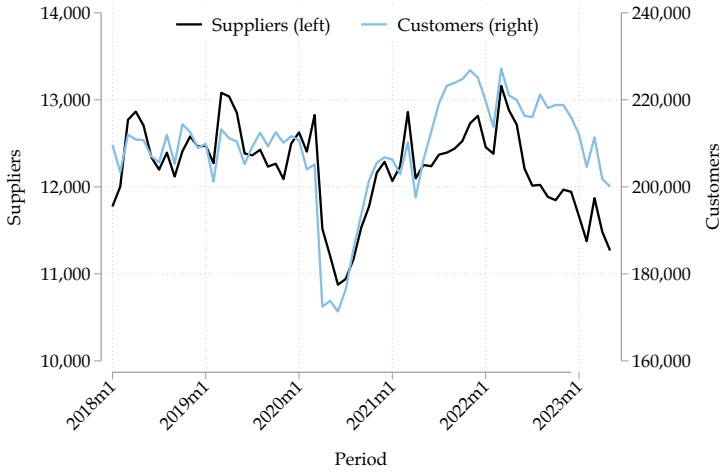

Figure: From Castillo, Céspedes, Miranda-Pinto, and Turen (2024)

Comment I: Adoption changes production structure

- In the model, adopters acquire new linkages (only) when adopting the new technology
- Through adoption, these firms change their indirect IO linkages
- Hence, the endogeneity in within-sector adoption can effectively change sectoral production linkages
- Indeed, at the sectoral level, $\tilde{\Psi}' = (\Gamma' + \Delta'\Lambda)(I - \nu\Omega)^{-1}$ changes with adoption
  - The authors could take advantage of this feature of the model and match network moments along the development path

Comment II: Open economy

- Developing/Emerging countries are small open economies that rely on exports (commodities) and imports (commodities/investment goods)

- In India, about 30% of total basic metals used in the basic metals sector itself or other sectors are imported
  - Another large fraction of key/large/adopter firms are exporters. India's exports to GDP ratio is 26%. Lots of aluminum, petroleum, and rice

- Commodity prices are, to a large extent, determined in international markets (e.g., shaped by US monetary policy: Miranda-Pinto, Pescatori, Prifti, and Verduzco-Bustos, 2023)

- This mutes a key channel in the paper: endogenous price responses (including adoption good) and, therefore, the adoption rate

Comment II: Open economy

- Base metals and machinery are key sectors in terms of their multiplier. They are also highly tradable (and key for the energy transition: externalities)

- Hence, subsidies to these sectors, will be less effective (due to muted price responses)

- How would their multiplier change if, in the model, their price is exogenously given in international markets (SOE)?

  - In Silva et al. (2024) we show that commodity price shocks differ from productivity shocks and how the network matters for it

- Could rephrase the question to: given the network centrality of (highly) tradable sectors, and the evolution of international (commodity) prices, what sectors should we target?

  - Should we think of different policy instruments (e.g., exchange rate policies)?

Comment III: Policy implementation

- Political economy issues prevent the smooth design and implementation of targeted taxes/subsidies
  - Lots of disagreement regarding subsidizing the Nickel sector in Australia (given the large decline in the Nickel's price)
  - Similar in Peru-Chile with Copper and Lithium: energy transition could greatly affect their demand and their price (Boer, Pescatori, and Stuermer, 2023)
  - Should we build complex clusters to use Copper and Lithium and produce more complex goods? Large adoptions costs and uncertain returns
- More flexibility in implementing granular government spending (Ghassibe and Ferrari, 2024), with the same goal ($\approx$ revenue subsidies)

Comment IV: Assumptions/calibration

- Trade also challenges the calibration of adoption rates: given traditional technology, higher productivity firms export more, increasing HHI.
  - Especially relevant in India after the 1990s trade liberalization
  - Authors could take advantage of The World Bank's *Firm Adoption of Technology Survey*
- Authors assume that profits are thrown out of the economy. This is important as profits rebated back to the household affect aggregate consumption/GDP.
  - This also depends on the network (Bigio and La'O, 2020; Miranda-Pinto and Young, 2021; Osotimehin and Popov, 2023)
- For future research:
  - Elasticities of substitution: in the longer run (across steady-states) elasticities can be larger than one (Miranda-Pinto and Young, 2021; Peters and Ruane, 2023)
  - Adoption takes time. Currently, the model assumes instantaneous adoption and does not consider depreciation of capital goods

Conclusion

- Very interesting and highly relevant paper!
- A lot to learn from incorporating production complementarities, through networks, in a setting with endogenous technology adoption
- Ideal set up to study the effectiveness of industrial policies in small open economies like ours
- Besides its current contributions, the paper opens up many avenues for future research