Discussion of Sectoral Development Multipliers

by F. Buera and N. Tratcher

Jorge Miranda-Pinto

[1]International Monetary Fund and University of Queensland

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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
  - 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)

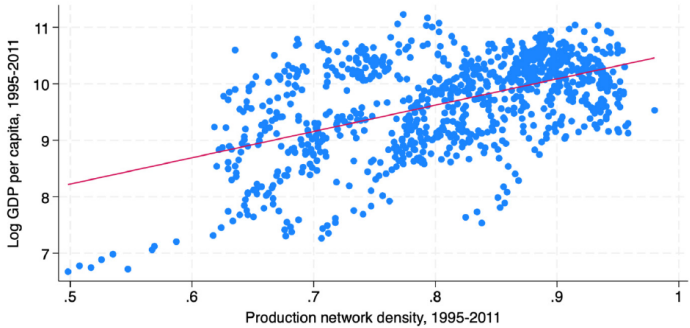


Figure: Figure 1 in Gloria, Miranda-Pinto, and Fleming-Muñoz (2023)

The Investment Network Λ overtime

Figure 1: Investment Network over time

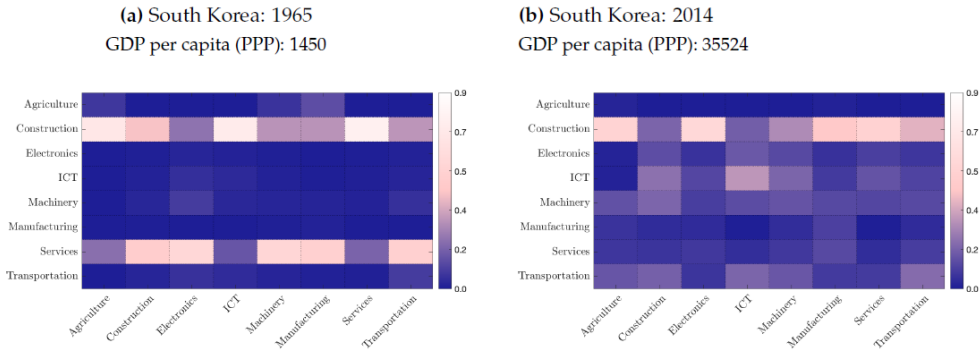
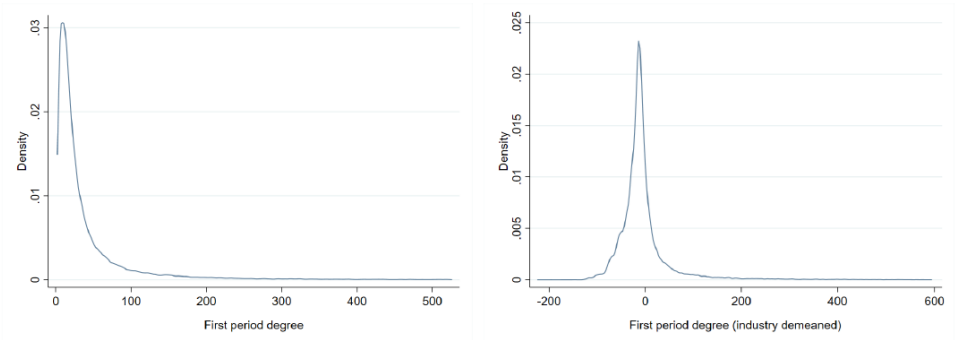


Figure: Figure 1 Caunedo and Casal (2023)

Heterogeneity in firm-level networks

Figure 5. Network degrees distribution



Note: This figure presents the kernel distribution of firm-level degrees the first time these firms report data on linkages. Panel (a) plots the distribution of the raw data, while panel (b) reports the firm degree subtracting the industry average (170 industries classification).

Figure: From Miranda-Pinto, Silva, and Young (2023)

Reorganization of firm-level networks

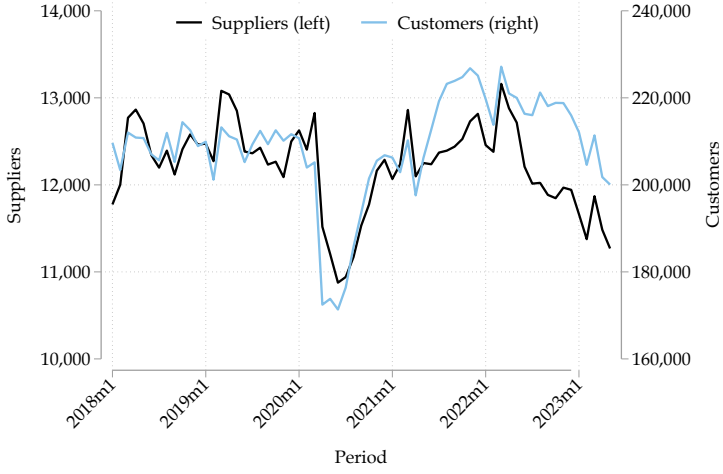


Figure: From Castillo, Céspedes, Miranda-Pinto, and Turen (2024)

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 (natural resources) and imports (materials/investment goods)
  - Sectoral prices are, to a large extent, determined in international markets
- 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
- This shuts down 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
- 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)?
- 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?

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 appear to assume that profits are thrown out of the economy. This is important as profits rebated back to the household affect aggregate consumption, and that also depends on the network (Bigio and La'O, 2020; Miranda-Pinto and Young, 2021; Osotimehin and Popov, 2023)

- 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