Discussion of "Division of Labor and Productivity Advantage of Cities: Theory and Evidence from Brazil" by Lin Tian

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ABFER Singapore, May 29 2019

Summary

- A solid and beautifully written paper that tries to understand the source of productivity advantages of large cities.
- Brazilian establishment-level employer-employee matched panel in the manufacturing from 2006 to 2014.
- Two stylized facts:
  - positive correlation between division of labor within firms and city size
  - positive correlation between division of labor within firms and sector-level product complexity
- Builds an elegant spatial sorting model with heterogeneous firms and with endogenous division of labor that delivers the stylized facts.

Summary

- Use the National Broadband Plan as a quasi-natural experiment to validate the model and provide targeted moments for the estimation.
- Structurally estimate an extension of the model and find about 15% of the productivity advantage of large cities is due to firms in large cities having greater degree of division of labor.

Stylized Facts

$$\log N_j = \alpha_0 + \alpha_1 \log L_{m(j)} + \text{sector f.e.} + \text{estab. and city controls} + \varepsilon_j, \quad (1)$$

$$\log N_j = \alpha_0 + \alpha_1 \log c_{s(j)} + \text{city f.e.} + \text{estab. and city controls} + \varepsilon_j, \quad (2)$$

- N_j is number of non-managerial and non-supervisory occupations within establishment j
- $L_{m(j)}$ is city population density.
- $c_{s(j)}$ is sector-level number of intermediate inputs or exports share by G3 economies.

Stylized Facts: Comments 1

- As acknowledged in the paper, it's tricky to disentangle division of labor within a firm (focus of the paper) and the boundary of a firm. Garment manufacturing with or without design.
  - What's comparable? Firms with the same set of 2-digit SOC codes (US)? 27-Design, 51-Production.
  - Best if one observes all relevant tasks (occupations) per employee.
  - The "lower bound" argument: Decompose the distribution of occupation codes into a within-firm and a between-firm component and see if in larger cities the between-firm component is larger.
- Without reference to technology. Control for firm-level K/L? Does that vary with population density?

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Stylized Facts: Comments 2

- What does the proxy for sector-level *complexity* capture exactly?
  - The 71-industry USE table of US 2017 (19 manufacturing): 1. Plastics and rubber products; 2. food and beverage and tobacco products; 3. miscellaneous manufacturing; 4. petroleum and coal products; 5. chemical products.
  - By exports share, Brazil's top 5 export manufacturing products in 2018: 1. chemical woodpulp (wood product); 2. light vessels, fire boats, floating docks (other transportation equipment); 3. cars (motor vehicles, bodies and trailers, parts); 4. iron or non-alloy steel products (primary metals); 5. aircraft, spacecraft (other transportation equipment).

Model

Firm with complexity z in sector s produces according to

$$Q_s(z) = \underbrace{A(N, z, c_s)}_{\text{Gains from } N} \underbrace{H(N, L)}_{\text{Costs of } N} l.$$

Key assumptions:

1. Complexity enhances the MB of N: $\frac{d}{dz}\frac{d\log A}{dN} > 0$ and $\frac{d}{dc_s}\frac{d\log A}{dN} > 0$.
2. City size mitigates the MC of N: $\frac{d}{dL}\frac{d\log H}{dN} > 0$.

Two channels that produce the positive correlation between N and L:

- High L lowers the MC of N for all firms.
- High-z and high-c_s firms choose high-N and these firms sort into high-L cities.

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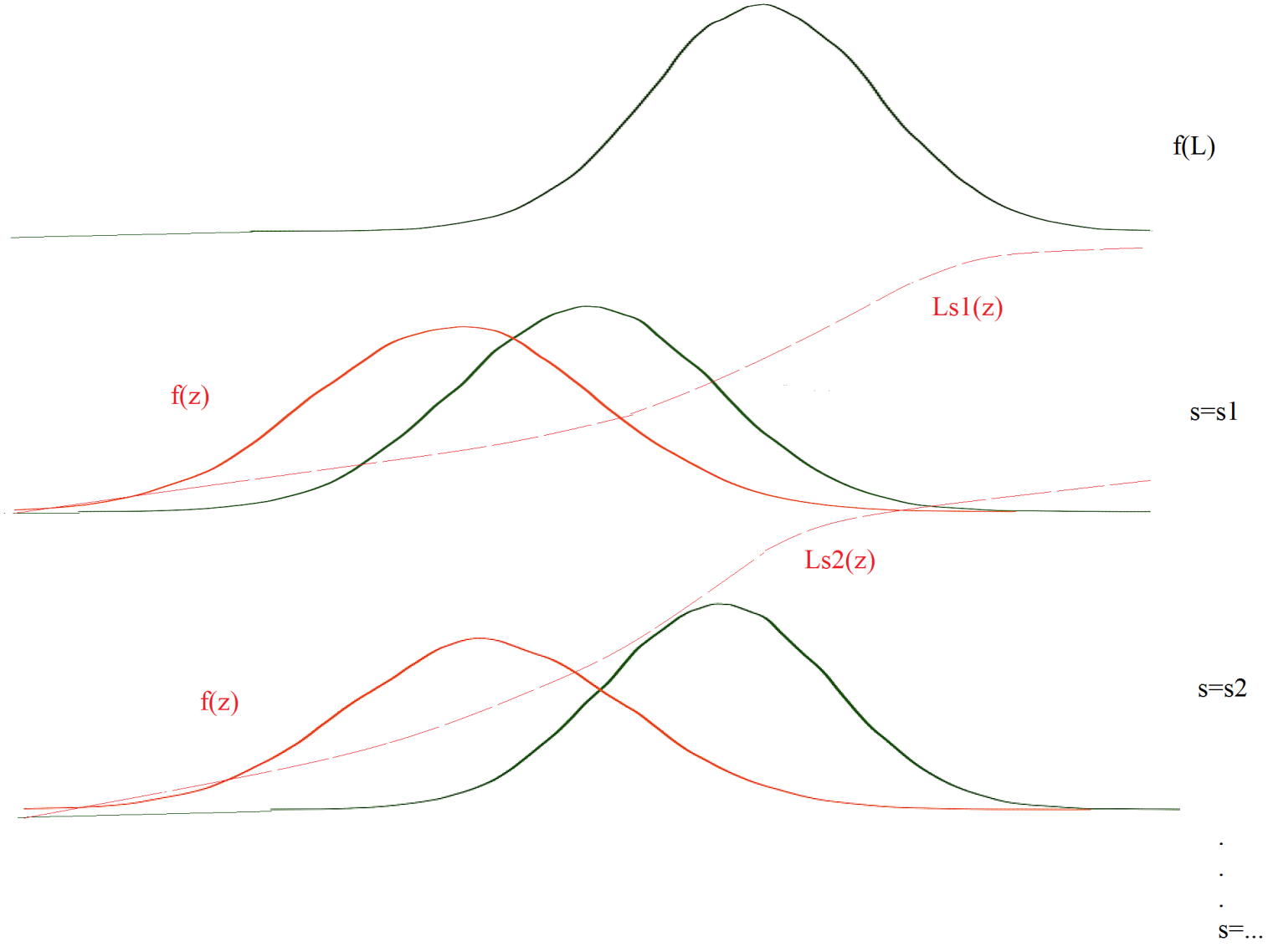

Model: Comments

- z or c_s can be anything that is complementary to the productivity improvement from the division of labor.
  - *Complexity* very abstract.
  - *Division of labor* very abstract.
- Coming back to the example of garment manufacturers.
- Another view of the world. Map from observables, set of occupations and skills, to observables, choice of locations.

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Model: Comments

- Imagine workers with heterogeneous skills (Eeckhout, Pinheiro and Schmidheiny, 2014). A correlation between skill and the size of cities gives positive correlation between productivity and the size of cities. Consider firms' organization characterized by a set of pairs (occupation, skill).
- Why this view?
  - Natural setting to introduce technology. K is left out of discussion. ICT affects occupational structure (Aum, Lee and Shin, 2018 etc).
  - Meaningful discussion of the extent of division of labor: limited by market or by cost (Becker and Murphy, 1992).

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Empirical Support: Comments

- The DID strategy identifies the ITT effect of broadband installation. The effect is significant and stronger for firms located in bigger cities and firms producing more complex products.
- Interpretation: Broadband reduces the coordination cost of division of labor. Look for evidence for the mechanism.
- How does the treatment affect other firm-level outcomes? How does the newly added occupation correlate with existing occupations?
  - Hiring a delivery guy versus hiring an engineer after the treatment. In either case, does that mean improved division of labor?

Estimation: Comments

1. Externally calibrated parameters : within sector EOS, btw sector EOS, and CD preference for non-tradable goods
   - $\eta = 0.97$ corresponds to expenditure share of non-tradable goods?
2. Extend the model to leave room for other effects:

$$\log A(N,z,c_s) + \log H(N,L) = (\log z)(1+\log N)^{c_s} - (\log N)(1+\log L)^{-\theta_s} + \underbrace{\alpha_s \log L}_{\text{agglomeration externality}} + \underbrace{(\log z)(1+L)^{\nu_s}}_{\text{direct complementarity}} + \varepsilon$$

3. SMM to pin down $c_s, \theta_s, \alpha_s, \nu_s$ and variance of z and ε.
   - Mysterious how to use the ATE of the quasi-natural experiment.
   - Cost of division of labor interpretation important.
4. Counterfactual: In the model, assign L according to the rank of z; fix N at sector-average; simulate the counterfactual productivities of cities. Regress counterfactual productivities on city sizes, the coefficient is 15% lower than the coefficient obtained from simulated data.

Conclusion

- A real treat to read this paper.
- Firm's internal structure is a super interesting topic. This paper focuses on one aspect: the set of tasks $\Leftrightarrow$ the number of occupations.
- Demonstrate Lin's impressive set of skills. Certainly more impressive than if it was written by 3 coauthors. Next paper greater division of labor?