Spatial Production Networks\textsuperscript{a}

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\textsuperscript{a}The views and opinions expressed are those of the authors alone and do not necessarily reflect those of the Central Bank of Chile.
Motivation

- Production networks are complex and distributed unevenly across space
  - Fragmented across countries, regions, and firms
  - “Global Value Chains” (World Bank 2019)
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- “Macro” and “micro” approaches (Johnson 2018, Antras-Chor 2021)
  - Microeconomics of how firms form endogenous production networks
  - Macroeconomics determined by production network across countries and regions
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  - Microeconomics of how firms form endogenous production networks
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- Limited understanding of how “macro” and “micro” interact in space
  - How do endogenous production networks form across country or regions?
  - How do these firm-level decisions affect macroeconomic outcomes?
  - How do macroeconomic shocks propagate in space under endogenous networks?
This Paper

- **Microfounded** model of spatial production networks with tractable aggregation
  - Firms search and match with suppliers and buyers in the geographic space
  - Aggregate gravity equations in extensive (number of relationships) and intensive margins (volume per relationship)
  - Characterize equilibrium by two sets of fixed points for buyer and supplier access
  - Establish existence and uniqueness/counterfactuals/sufficient statistics

Apply this model to administrative firm-to-firm transaction level data from Chile

Stylized facts about spatial production networks consistent with the model

Compare role of trade frictions versus search and matching frictions

Reduced-form shocks to study how they propagate geographically

Counterfactual effect of trade shocks with endogenous response of spatial networks
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Endogenous production networks in space: Eaton-Kortum-Kramarz (2016); Miyauchi (2021); Panigraphi (2021); Antras-de-Gortari (2020)


Outline

1. Data and Motivating Facts
2. Model
3. General Equilibrium Analysis
4. Quantitative Analysis
5. Conclusion
Data and Motivating Facts
Domestic firm-to-firm transaction-level dataset in Chile

- Collected by Internal Revenue Service for value-added tax collection purposes
- Covers the universe of domestic trade between all firms in Chile during 2015-2019
- Includes seller and buyer firm ID, sales, products, prices, origin and destination municipality
- Linked to various firm data sets:
  - Customs data (for imports and exports)
  - Firm balance sheet characteristics (for total sales)
  - Matched employer-employee dataset (for employment and wages)
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Motivating Facts

- Fact 1: Number of domestic suppliers and buyers per firm is increasing in firm sales with approximate log-linear relationships.
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Fact 2: Number of domestic suppliers and buyers per firm is positively correlated with population density and proximity to the capital city.
Motivating Facts

■ Fact 1: Number of domestic suppliers and buyers per firm is increasing in firm sales with approximate log-linear relationships.

■ Fact 2: Number of domestic suppliers and buyers per firm is positively correlated with population density and proximity to the capital city.

■ Fact 3: Number of supplier-buyer relationships between municipalities (extensive margin) and the volume of transaction per relationship (intensive margin) decay in geographic distance at different rates.
Model
Setup

- Space is partitioned by a finite number of locations $i, u, d \in \mathbb{N}$

- Continuum of workers of measure $L_i$ in location $i$. No mobility for now

- Two types of goods: intermediate goods and final goods
  - Intermediate goods are traded across locations subject to iceberg trade cost $\tau_{ud} \geq 1$
  - Final goods are not traded

- Two types of producers:
  - “Retailers”: Produce final goods for final consumers
  - “Firms”: Produce intermediate goods for other “firms” and “retailers”

- Focus on presentation of “firms”
Representative consumers have CES preference over final goods, with ES $\eta$

Unit cost of production by “firm” $\omega$ in location $i$

$$c^I(\omega) = \frac{1}{z(\omega)} w_i^\beta \left( \int_{\nu \in \Omega^I_\omega} p(\omega, \nu)^{1-\sigma} d\nu \right)^{\frac{1-\beta}{1-\sigma}}$$

- $z(\omega)$ is productivity of firm $\omega$
- $w_i$ is local wages
- $\Omega^I_\omega$ is the set of varieties that $\omega$ has access to (endogenized by search and matching)
- $p(\omega, \nu)$ is the price charged by supplier $\nu$ to $\omega$
- $\sigma$ is the elasticity of substitution for intermediate goods
Search and Matching Between Firms: Overview

- Production networks linkages: endogenous under search and matching process

- Firms post advertisements across locations depending on anticipated profits
  (Arkolakis 2010; Demir-Fieler-Xu-Yang 2021)
  - Reaching intermediate suppliers and buyers with two-sided search and matching
  - Reaching retailers with one-sided search and matching

- Aggregate random matching technology between locations à la DMP
Firms’ Search Decision

\[
\max \left\{ n_u \right\}_{n_{ui}}, \left\{ n_d \right\}_{n_{id}}, n_i^R \right\}
\]

\[
\frac{n_i^R}{\sigma} D_i^R (c)^{1-\sigma} + \sum_{d \in N} \frac{m_{id}^B n_{id}^B}{\sigma} D_i^l (c_{\tau id})^{1-\sigma}
\]

profit from "retailers"

\[
\sum_{d \in N} \frac{m_{id}^B n_{id}^B}{\sigma} D_i^l (c_{\tau id})^{1-\sigma}
\]

profit from "firm" buyers

\[
-W_i \left\{ f_i^R \frac{(n_i^R)^{\gamma^R}}{\gamma^B} + \sum_{d \in N} f_{id}^B \frac{(n_{id})^{\gamma^B}}{\gamma^B} + \sum_{u \in N} f_{ui}^S \frac{(n_{ui}^S)^{\gamma^S}}{\gamma^S} \right\}
\]

search cost

\[
c = \frac{w_i^B \left( \sum_{u \in N} n_{ui}^S m_{ui}^S (C_{ui})^{1-\sigma} \right)^{1-\beta}}{\beta^{1-\sigma}}
\]

subject to

- \{n_{ui}^S\}_{u}, \{n_{id}^B\}_{d}, n_i^R: number of postings to suppliers, “firm” buyers, and “retailers”
- \(f_i^R, f_{id}^B, f_{ui}^S, \gamma^B, \gamma^S\): exogenous parameters for search cost
- \(m_{ui}^S\): matching rates with suppliers (endogenous)
- \(C_{ui}\): average cost of suppliers from \(u\) to \(i\) (endogenous)
Matching Between Suppliers and Buyers

- Aggregate supplier and buyer postings:

\[ \tilde{M}_{ud}^S = N_d \int n_{ud}^S(z) dG_d(z), \quad \tilde{M}_{ud}^B = N_u \int n_{ud}^B(z) dG_u(z) \]

- \( N_i \): measure of firms in location \( i \)
- \( G_i(\cdot) \): productivity distribution in location \( i \)

- Total number of supplier-to-buyer relationships determined by matching function:

\[ M_{ud} = \kappa_{ud} \left( \tilde{M}_{ud}^S \right)^{\lambda^S} \left( \tilde{M}_{ud}^B \right)^{\lambda^B} \]

- Matching probability (intensity):

\[ m_{ud}^S = \frac{M_{ud}}{\tilde{M}_{ud}^S} \quad m_{ud}^B = \frac{M_{ud}}{\tilde{M}_{ud}^B} \]
Gravity Equations of Bilateral Trade Flows: Extensive and Intensive Margin

Total number of successful relationships and average trade flow from $u$ to $d$:

\[ M_{ud} = \varrho^M \chi^M_{ud} \zeta^M_u \xi^M_d \quad (\text{Extensive Margin}) \]
\[ \bar{r}_{ud} = \varrho^R \chi^R_{ud} \zeta^R_u \xi^R_d \quad (\text{Intensive Margin}) \]

\[ \chi^M_{ud} = \left[ \kappa_{ud} \left( f_{ud}^B \right)^{\frac{\lambda^B}{\gamma^B}} \left( f_{ud}^S \right)^{-\frac{\lambda^S}{\gamma^S}} \left( \tau_{ud}^{1-\sigma} \right) \right]^{\tilde{\gamma}}, \quad \tilde{\gamma} = \left[ 1 - \frac{\lambda^S}{\gamma^S} - \frac{\lambda^B}{\gamma^B} \right]^{-1} \]

\[ \chi^R_{ud} = \left( \tau_{ud} \right)^{1-\sigma} \]

\[ \zeta^M_u \text{ and } \zeta^R_u \text{ capture cost shifters } \Rightarrow \text{Seller effects} \]
\[ \xi^M_d \text{ and } \xi^R_d \text{ capture demand shifters } \Rightarrow \text{Buyer effects} \]

Different spatial structure of “extensive” and “intensive” margins as in facts
General Equilibrium Analysis
Equilibrium reduced to a 2xN system on wages $w_i$ and intermediate shifter $C_i^*$:

- "Buyer access"
  \[ w_i = \frac{1}{\vartheta R L_i} \sum_d X_{id}(\{w\}, \{C^*\}, \{\chi^R\}, \{\chi^N\}) \]
  where \( X_{id} = M_{id} \bar{r}_{id} \)

- "Supplier access"
  \[ (C_i^*)^{1-\sigma} = w_i^{\beta(1-\sigma)} \left( (\bar{\sigma})^{\sigma} M_i \left( \frac{\delta}{\gamma S} \right) N_i \right)^{\beta-1} \left( \frac{\sum_u X_{ui}}{D_i^l} \right)^{1-\beta} \]

Similar to previous literature (Anderson and van Wincoop 2003, Redding and Venables 2004, Donaldson and Hornbeck 2016) while incorporating the endogenous search and matching
Rewriting the two equations yields:

\[(w_i)^{1+\frac{\lambda B}{\gamma B}} (C_i^*)^{(\sigma-1)\tilde{\gamma}} = \sum_d K_{id} D (w_d)^{-\iota} (C_d^*)^{(\sigma-1)\tilde{\gamma} \frac{1-\beta}{1-\beta}}\]

\[(w_i)^{1+\iota} (C_i^*)^{-\frac{(\sigma-1)\tilde{\gamma}}{1-\beta}} = \sum_u K_{ui} U (w_u)^{-\frac{\lambda B}{\gamma B} \tilde{\gamma}} (C_u^*)^{-{(\sigma-1)\tilde{\gamma}}}\]

where \(\iota = \frac{\lambda S}{\gamma S} \tilde{\gamma} \frac{\sigma-1}{1-\beta} + \left(\frac{\lambda B}{\gamma B} \tilde{\gamma} + 1\right) \frac{\beta \sigma-1}{1-\beta}; \tilde{\gamma} = \left[1 - \frac{\lambda S}{\gamma S} - \frac{\lambda B}{\gamma B}\right]^{-1}\)

- \(K_{id} D\) and \(K_{ui} U\) are combination of exogenous parameters, including \(\chi_{ud}^N, \chi_{ud}^R\)

Prove that system can span outcomes of gravity trade models with roundabout production (when \(\gamma^B, \gamma^S \to \infty\)) but not vice versa \((\text{Eaton and Kortum 2002, Caliendo and Parro 2014 (single-sector); Eaton, Kortum, Kramarz 2011; Costinot and Rodriguez-Clare 2014; Antras and Chor 2021})\)

- Characterize existence and uniqueness

- Characterize counterfactuals based on suff. statistics \(\{X_{ui}\}\) à la DEK \((2007)\)
Proportional changes of welfare are given by:

\[
\frac{\hat{w}_i}{P_i^F} = \left( \frac{\hat{\Lambda}_{ii}}{\text{own trade share}} \right) - \frac{1}{\sigma - 1} \frac{1 - \beta}{\beta} \left( \hat{M}_{ii} \right) \text{number of linkages within location} \left( \frac{1}{\sigma - 1} \frac{1 - \beta}{\beta} \right)
\]

- \( \gamma^B, \gamma^S \to \infty \Rightarrow \hat{M}_{ii} = 1 \) as in gravity trade models (ACR 2012)
- \( \hat{M}_{ii} \) captures changes in productivity through endogenous search and matching

\[
\hat{M}_{ii} = \hat{N}_i \hat{a}^S_{ii} \hat{m}^S_{ii}
\]
Quantitative Analysis
Calibration and Spatial Friction Decomposition

- We calibrate the model with 345 municipalities in Chile + all foreign countries
- Bilateral trade flows from domestic firm-to-firm transaction data and customs data
- Structural parameters \((\lambda^B, \lambda^S, \gamma^B, \gamma^S, \beta, \sigma)\)
  - Search cost elasticity \(\gamma^S = \gamma^B = 2.5\) from:
    \[
    \log \left( \sum_u n^k_{ui}(z) \right) = \frac{1}{\gamma_k} \log (r_i(z)) + \rho^k_i, \quad k \in \{S, B\}
    \]
  - Labor share in production: \(\beta = 0.5\)
  - Matching function elasticity \(\lambda^B = 1\) and \(\lambda^S = 0.6\) (Miyauchi 2021)
  - Elasticity of substitution across intermediate goods: \(\sigma = 1.5\)
- Structural decomposition of spatial frictions:
  - Search and matching costs more sensitive to distance than iceberg trade cost
Counterfactual Simulations of 10% Trade Shock

- Implemented as $\hat{\kappa}_{ROW,d} = 1.1$ (export shock) and $\hat{\kappa}_{u,ROW} = 1.1$ (import shock)

<table>
<thead>
<tr>
<th>Import and Export Shock</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baseline</td>
</tr>
<tr>
<td>No Extensive Margin ($\gamma^S, \gamma^B \to \infty$)</td>
</tr>
</tbody>
</table>

- Ignoring endogenous search and matching substantially overestimates the welfare gains by ignoring the substitution through domestic linkages
- Heterogeneous effects: Higher trade exposure increases benefit from shock
## Significant Geographic Propagation of Trade Shock

<table>
<thead>
<tr>
<th></th>
<th>(1) Welfare</th>
<th>(2) Number of Suppliers</th>
<th>(3) Number of Buyers</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Import Share</strong></td>
<td>0.16***</td>
<td>-0.15***</td>
<td>-0.04***</td>
</tr>
<tr>
<td></td>
<td>(0.01)</td>
<td>(0.01)</td>
<td>(0.01)</td>
</tr>
<tr>
<td><strong>Export Share</strong></td>
<td>0.10***</td>
<td>0.01**</td>
<td>-0.13***</td>
</tr>
<tr>
<td></td>
<td>(0.00)</td>
<td>(0.00)</td>
<td>(0.00)</td>
</tr>
<tr>
<td><strong>Supplier Locations' Import Share</strong></td>
<td>0.13***</td>
<td>-0.03</td>
<td>-0.15***</td>
</tr>
<tr>
<td></td>
<td>(0.02)</td>
<td>(0.02)</td>
<td>(0.02)</td>
</tr>
<tr>
<td><strong>Supplier Locations' Export Share</strong></td>
<td>-0.14***</td>
<td>0.07***</td>
<td>-0.04*</td>
</tr>
<tr>
<td></td>
<td>(0.01)</td>
<td>(0.02)</td>
<td>(0.02)</td>
</tr>
<tr>
<td><strong>Buyer Locations' Import Share</strong></td>
<td>-0.14***</td>
<td>-0.08***</td>
<td>0.22***</td>
</tr>
<tr>
<td></td>
<td>(0.01)</td>
<td>(0.02)</td>
<td>(0.02)</td>
</tr>
<tr>
<td><strong>Buyer Locations' Export Share</strong></td>
<td>0.07***</td>
<td>-0.04***</td>
<td>-0.07***</td>
</tr>
<tr>
<td></td>
<td>(0.01)</td>
<td>(0.01)</td>
<td>(0.01)</td>
</tr>
<tr>
<td><strong>Constant</strong></td>
<td>1.00***</td>
<td>1.00***</td>
<td>1.00***</td>
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<tr>
<td></td>
<td>(0.00)</td>
<td>(0.00)</td>
<td>(0.00)</td>
</tr>
<tr>
<td><strong>Observations</strong></td>
<td>335</td>
<td>335</td>
<td>335</td>
</tr>
<tr>
<td><strong>$R^2$</strong></td>
<td>0.880</td>
<td>0.778</td>
<td>0.855</td>
</tr>
</tbody>
</table>

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$
Conclusion
Conclusion

- Provide a tractable micro-founded model of production networks in space

- Apply our model to firms' domestic and foreign transaction data from Chile
  - How spatial production networks are shaped by different trade frictions
  - How trade shocks affect different regions under endogenous production networks

- Framework can be used for international production networks across countries
Appendix
2. Number of Domestic Suppliers and Buyers per Firm and Geography

- Average Number of Links
  - Customers: 1, 10, 100, 1000
  - Suppliers: 1, 10, 100, 1000

- Population Density
  - Customers: 1, 10, 100, 1000
  - Suppliers: 1, 10, 100, 1000

- Distance to Santiago (Km)
  - Customers: 1, 10, 100, 1000
  - Suppliers: 1, 10, 100, 1000
Consider the regression

\[ \log Y_{ij} = \beta \log Dist_{ij} + \xi_i + \zeta_j + \epsilon_{ij} \]

- \( i, j \) are municipalities in Chile
- \( Y_{ij} \): bilateral trade flows (total); the volume of transaction per relationship (intensive); number of relationships between suppliers and buyers (extensive)

<table>
<thead>
<tr>
<th></th>
<th>Total (1)</th>
<th>Intensive (2)</th>
<th>Extensive (3)</th>
</tr>
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<tbody>
<tr>
<td>Log Distance</td>
<td>-1.139***</td>
<td>-0.405***</td>
<td>-0.734***</td>
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<tr>
<td></td>
<td>(0.008)</td>
<td>(0.005)</td>
<td>(0.004)</td>
</tr>
<tr>
<td>( R^2 )</td>
<td>0.161</td>
<td>0.062</td>
<td>0.185</td>
</tr>
<tr>
<td>Year FE</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>( N )</td>
<td>119932</td>
<td>119932</td>
<td>119932</td>
</tr>
</tbody>
</table>
Complete Solution to Firms’ Search Problem

\[ n_{ui}^{S}(z) = a_{ui}^{S} z^{\frac{\delta}{\gamma^{S}}}; \quad n_{i}^{R}(z) = a_{i}^{R} z^{\frac{\delta}{\gamma^{B}}}; \quad n_{id}^{B}(z) = a_{id}^{B} z^{\frac{\delta}{\gamma^{B}}} \]

where

\[ a_{id}^{B} = \left( m_{id}^{B} \frac{D_{d}^{l}}{w_{i^{f}_{id}}^{B}} (\tau_{id})^{1-\sigma} (C_{i}^{*})^{1-\sigma} \right)^{\frac{1}{\gamma^{B}-1}} \]

\[ a_{i}^{R} = \left( \frac{1}{w_{i}^{f}_{i}^{R}} D_{i}^{R} (C_{i}^{*})^{1-\sigma} \right)^{\frac{1}{\gamma^{B}-1}} \]

\[ a_{ui}^{S} = \left( \frac{(1-\beta) D_{i}^{*}}{w_{i}^{f}_{i}^{S}} m_{ui}^{S} (C_{i}^{*})^{\beta \frac{\sigma-1}{1-\beta}} (C_{ui})^{1-\sigma} \right)^{\frac{1}{\gamma^{S}-1}} \]

and

\[ D_{i}^{*} = a_{i}^{R} D_{i}^{R} + \sum_{d} m_{id}^{B} a_{id}^{B} D_{d}^{l} (\tau_{id})^{1-\sigma}; \quad (C_{i}^{*})^{1-\sigma} \equiv w_{i}^{\beta(1-\sigma)} \left( \sum_{u \in N} a_{ui}^{S} m_{ui}^{S} (C_{ui})^{1-\sigma} \right)^{1-\beta} \]
Mathematical structure commonly appears in trade/spatial models (Allen, Arkolakis, Li 2021):

\[(w_i)^{1+\frac{\lambda B}{\gamma B}} \tilde{\gamma} (C_i^*)(\sigma-1)\tilde{\gamma} = \sum_d K_{id} (w_d)^{1-\iota} (C_d^*)^{-\frac{1}{1-\beta}} \frac{(\sigma-1)\tilde{\gamma}}{1-\beta}\]

\[(w_i)^{1+\iota} (C_i^*)^{-\frac{(\sigma-1)\tilde{\gamma}}{1-\beta}} = \sum_u K_{ui} (w_u)^{-\frac{1}{1-\beta}} (C_u^*)^\frac{1}{1-\beta} \gamma \tilde{\gamma} (C_u^*)^{-\frac{1}{1-\beta}} \gamma\]

where \(\iota = \frac{\lambda S}{\gamma S} \tilde{\gamma} \frac{\sigma-1}{1-\beta} + \left(\frac{\lambda B}{\gamma B} \tilde{\gamma} + 1\right) \frac{\beta \sigma-1}{1-\beta}; \tilde{\gamma} = \left[1 - \frac{\lambda S}{\gamma S} - \frac{\lambda B}{\gamma B}\right]^{-1}\)

**Proposition**

*If \(\frac{\lambda B}{\gamma B} \tilde{\gamma} + (1 + \iota) (1 - \beta) \geq 0\) then the equilibrium always exists and it is unique up-to-scale.*
Responses to Shocks

- Denote observed import and export share by $\Psi_{id} = \frac{X_{id}}{\sum_{\ell} X_{i\ell}}$ and $\Lambda_{ui} = \frac{X_{ui}}{\sum_{\ell} X_{i\ell}}$
- Consider counterfactual changes in $\hat{K}_{id}^D$ and $\hat{K}_{id}^U$ ($\hat{x} \equiv x'/x$)

**Proposition**

The counterfactual changes of wages $\hat{w}_i$ and intermediate cost shifter $\hat{C}_i^*$ are solved by

$$
(\hat{w}_i)^{1+\frac{\lambda^B}{\gamma^B} \tilde{\gamma}} (\hat{C}_i^*)^{(\sigma-1)\tilde{\gamma}} = \sum_d \hat{K}_{id}^D (\hat{w}_d)^{-\frac{\lambda^B}{\gamma^B} \tilde{\gamma}} (\hat{C}_d)^{-\frac{(\sigma-1)\tilde{\gamma}}{1-\beta}} \Psi_{id}
$$

$$
(\hat{w}_i)^{1+\frac{\lambda^B}{\gamma^B} \tilde{\gamma}} (\hat{C}_i^*)^{-\frac{(\sigma-1)\tilde{\gamma}}{1-\beta}} = \sum_u \hat{K}_{ui}^U (\hat{w}_u)^{-\frac{\lambda^B}{\gamma^B} \tilde{\gamma}} (\hat{C}_u)^{-\frac{(\sigma-1)\tilde{\gamma}}{1-\beta}} \Lambda_{ui}
$$

- Aggregate $X_{ui}$ and structural parameters ($\lambda^B, \lambda^S, \gamma^B, \gamma^S, \beta, \sigma$) are sufficient
Use model-predicted gravity equations to decompose trade frictions into “iceberg trade cost” and “search and matching frictions”

Iceberg trade cost is revealed from “intensive” margin of trade flows:

\[
\tilde{\tau}_{ud}^* \equiv \left( \frac{\tau_{ud}}{\tau_{uu} \tau_{dd}} \right)^{1-\sigma} = \frac{\bar{\tau}_{ud}}{\bar{\tau}_{uu} \bar{\tau}_{dd}}
\]

Search and matching costs is revealed by combining “extensive” and “intensive” margin of trade flows:

\[
\tilde{\kappa}_{ud}^* \equiv \left( \frac{\tilde{\kappa}_{ud}}{\tilde{\kappa}_{uu} \tilde{\kappa}_{dd}} \right)^{1-\sigma} = \frac{M_{ud}}{M_{uu} M_{dd}} (\tilde{\tau}_{ud}^*)^{-\left(\frac{\lambda_B}{\gamma_B} + \frac{\lambda_S}{\gamma_S}\right)} \tilde{\gamma},
\]

where

\[
\tilde{\kappa}_{ud} \equiv \left[ \kappa_{ud} \left( f_{ud}^B \right)^{-\frac{\lambda_B}{\gamma_B}} \left( f_{ud}^S \right)^{-\frac{\lambda_S}{\gamma_S}} \right] \tilde{\gamma}
\]
## Decomposition of Spatial Frictions

<table>
<thead>
<tr>
<th>Trade: $\tilde{\tau}_{ud}$</th>
<th>Search-Matching: $\tilde{\kappa}_{ud}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1)</td>
<td>(2)</td>
</tr>
<tr>
<td>Log Distance</td>
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</tr>
<tr>
<td></td>
<td>(0.003)</td>
</tr>
<tr>
<td>$R^2$</td>
<td>0.051</td>
</tr>
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<tr>
<td>$N$</td>
<td>99284</td>
</tr>
</tbody>
</table>

- Search and matching costs is more sensitive to geographic distance than (physical) iceberg trade cost
Heterogeneous Effects: Higher Exposure Increases Benefit from Shock