Firm-to-Firm Trade:

Imports, Exports, and the Labor Market

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Overview

- Develop granular theory of firms, jobs, and international trade
- Individual firms may export goods and import intermediates
- Guidance from French Customs data on transactions:

  ... French exporters and their customers in 24 EU countries
- Today: toward estimation

Fundamental Features

- As in Chaney (2014, 2017): international trade via firms establishing a network of buyers

  ... with trade frictions becoming information frictions

- Central feature is a fixed point à la Lucas (2009) and Oberfield (2013):

  ... distribution of costs governs suppliers you meet ... which shapes distribution of costs

- Search frictions have implications similar to fixed costs of entry

  ... and bilateral information frictions inhibit trade

Other Related Literature

- **Firm-level imports:** Biscourp and Kramarz (2007); Hummels, Jorgenson, Munch, and Xiang (2011); Blaum, Lelarge, and Peters (2014); Kramarz, Martin, and Mejean (2015); Antras, Fort, Tintelnot (2015).

- **Networks:** Eaton, Eslava, Jinkins, Krizan, and Tybout (2014); Bernard, Moxnes, and Ulltveit-Moe (2014); Lim (2017)

- **Theoretical elements:** BEJK (2003); Melitz (2003); EKK (2011); EKS (2013); Garretto (2013); Armenter and Koren (2014)

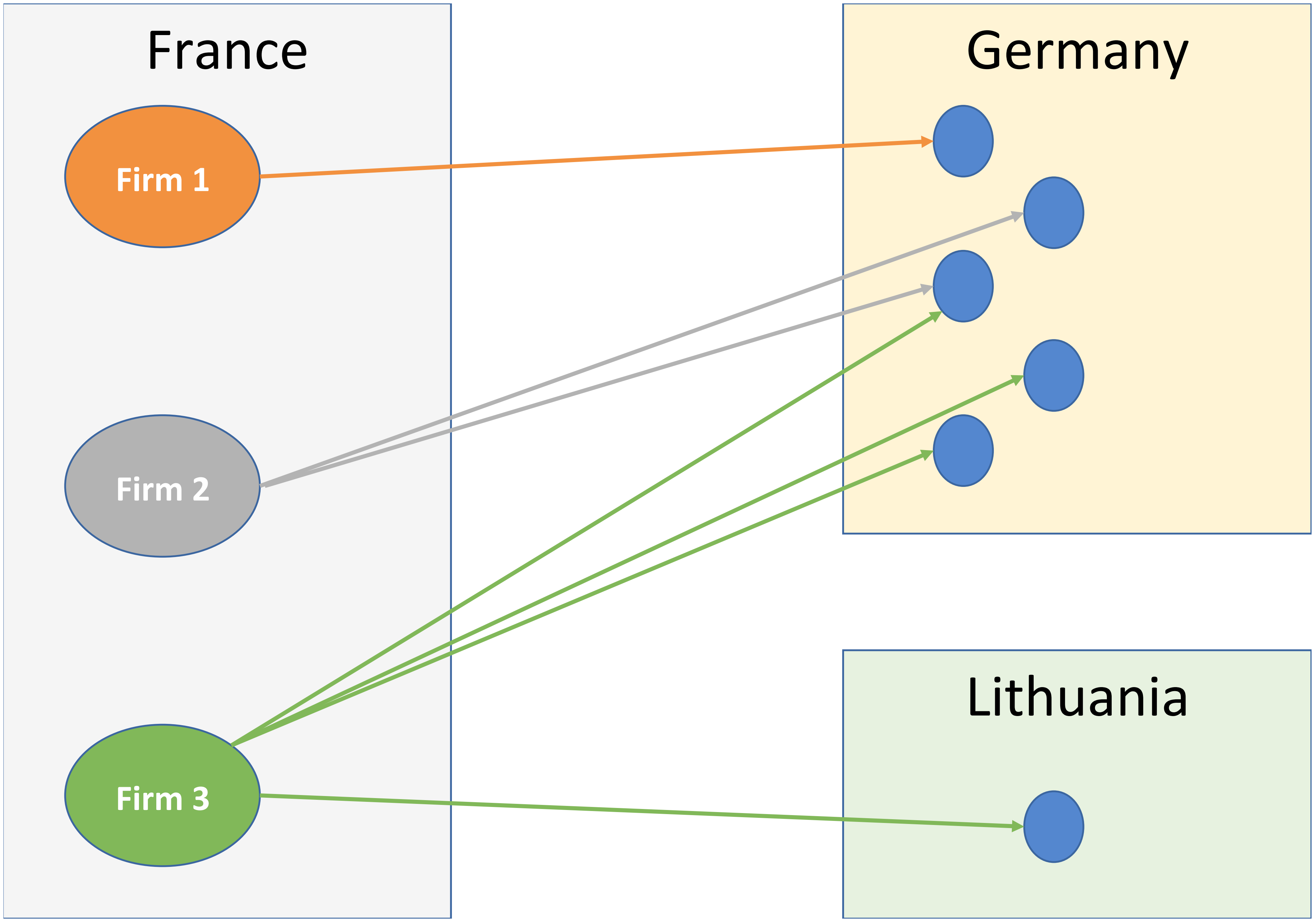
A Peek at the Data

- From Kramarz, Martin, and Mejean (2015):

  ... customers of individual French manufacturing exporters, in each EU country

- Similar stylized facts emerge from Bernard, Moxnes and Ulltveit-Moe (2017):

  ... customers of Norwegian exporters, in every country


France
Firm 1
Firm 2
Firm 3
Germany
Lithuania

Identities

- French exports to destination n:

$$X_{nF} = X_n \pi_{nF}$$

- Relationships between French exporters and buyers in n:

$$R_{nF} = N_{nF} \bar{B}_{nF}$$

Regressions

- Number of French exporters (ignore constant):

$$\ln N_{nF} = \underset{(0.04)}{0.50} \ln X_n + \underset{(0.11)}{0.68} \ln \pi_{nF}$$

- Number of relationships (ignore constant):

$$\ln R_{nF} = \underset{(0.06)}{0.83} \ln X_n + \underset{(0.16)}{1.04} \ln \pi_{nF}$$

- Mean number of buyers per French exporter (ignore constant):

$$\ln \bar{B}_{nF} = \underset{(0.03)}{0.33} \ln X_n + \underset{(0.08)}{0.36} \ln \pi_{nF}$$

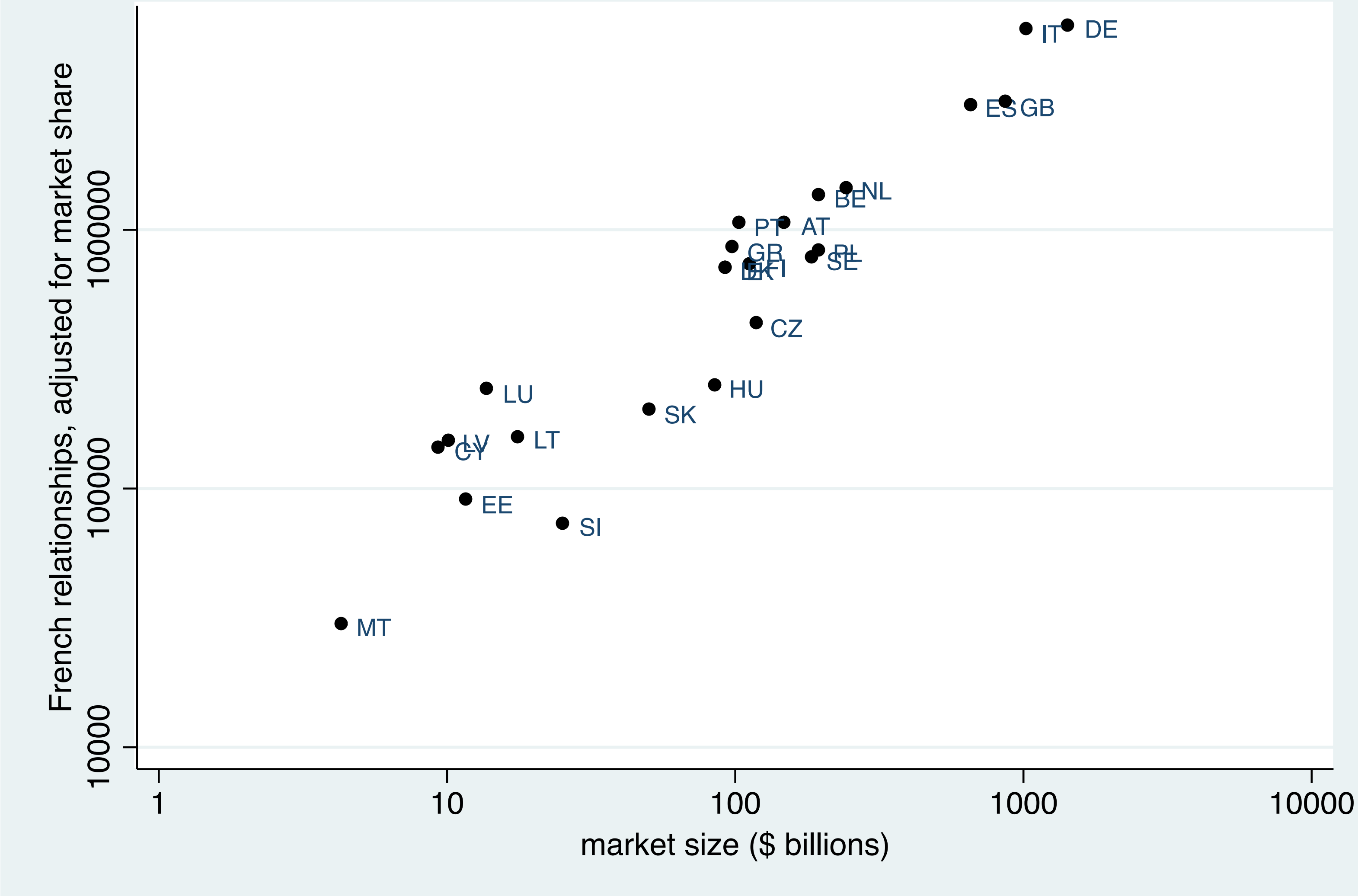
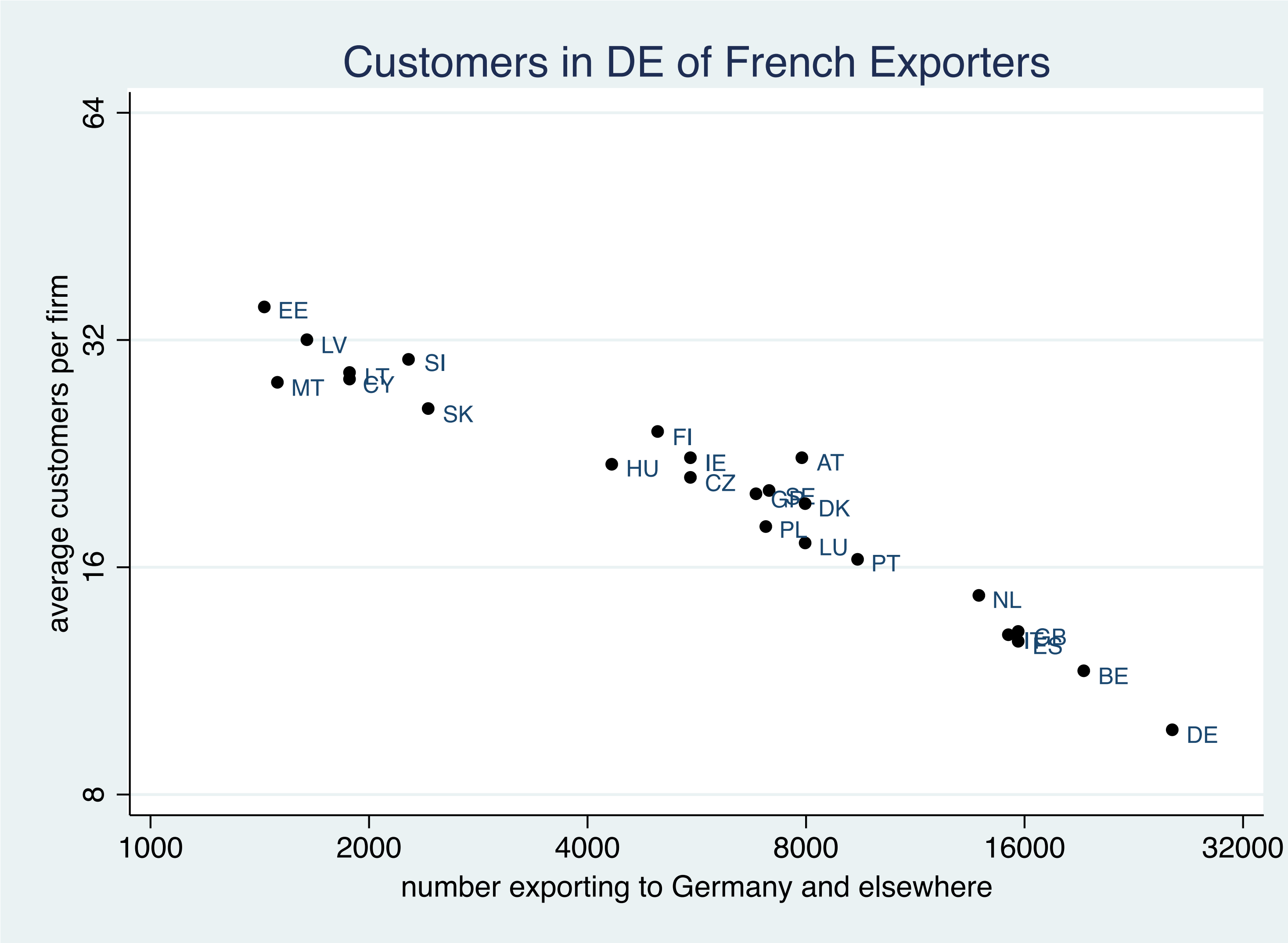


Figure 3: French Relationships and Market Size



Customers in DE of French Exporters
average customers per firm
64
32
16
8
1000
2000
4000
8000
16000
32000
number exporting to Germany and elsewhere
EE
LV
SI
LT
CY
MT
SK
FI
HU
IE
CZ
AT
GR
SE
DK
PL
LU
PT
NL
GB
IT
ES
BE
DE

Model of Firm-to-Firm Trade

Setting

- Many countries (n destination, i source) $n, i = 1, ..., \mathcal{N}$

- Separated by iceberg trade costs d_{ni} ...

  ... and search frictions $\boldsymbol{\lambda_{ni}}$

- Endowed with workers of various skills and a continuum of potential producers

Production

- Measure of potential firms in i with efficiency above z:

$$\mu_i^z(z) = T_i z^{-\theta}$$

- Each firm has Cobb-Douglas production function over K tasks

- A task is performed by labor or by purchasing an input from another firm

Matching

- Chance meetings between buyers (manufacturers looking for inputs M_n or others B_n)

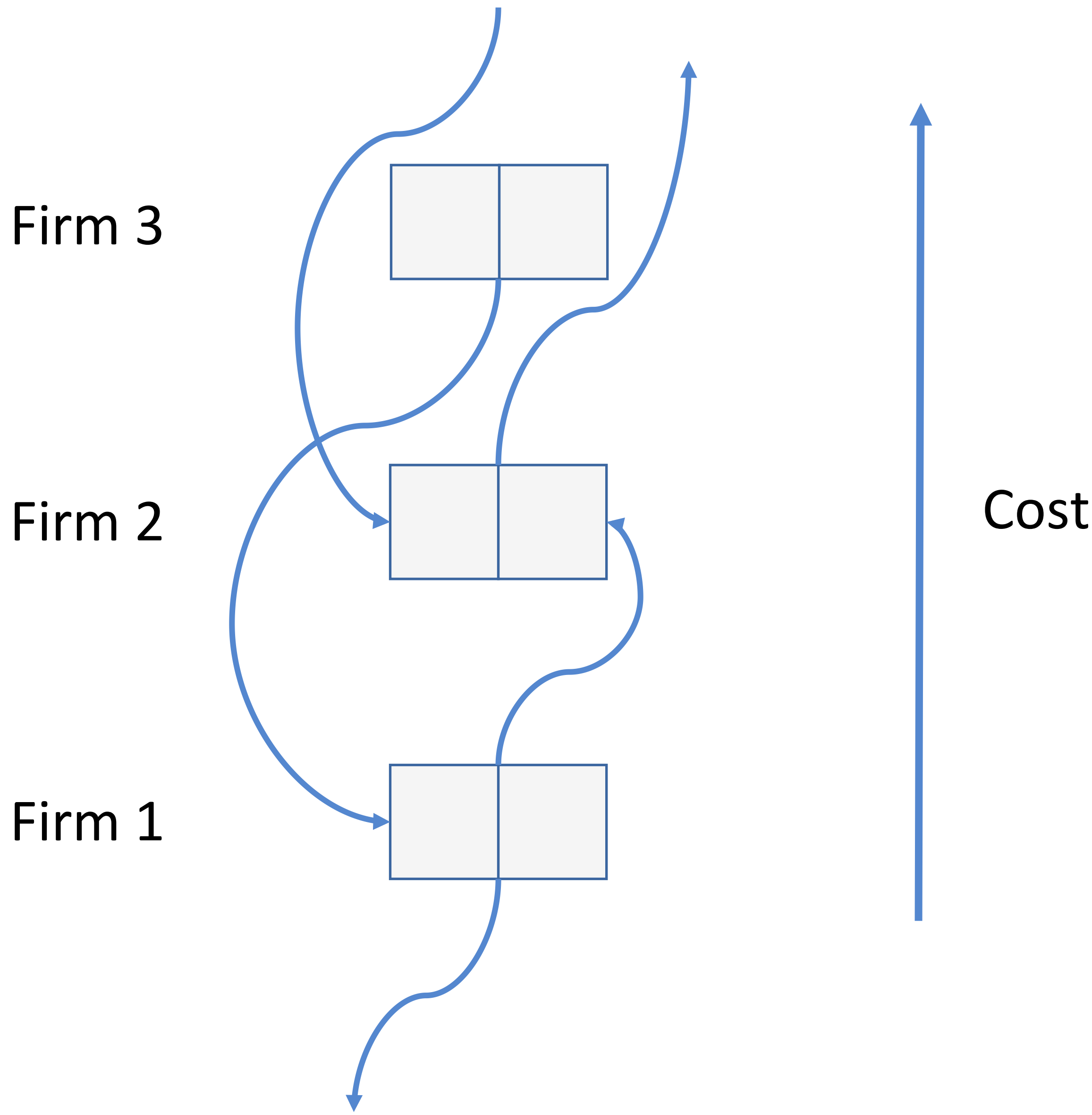
  ... and suppliers with cost below c (looking for customers) governed by a matching function:

$$m_n(c) = \frac{\lambda K}{1-\gamma}\left(M_n + B_n\right) L_n^{-\varphi} \mu_n(c)^{1-\gamma}$$

  where

$$\mu_n(c) = \sum_i \boldsymbol{\lambda_{ni}} \mu_{ni}(c)$$

  and $\mu_{ni}(c)$ is measure of firms from i that supply n at a cost below c


Firm 3
Firm 2
Firm 1
Cost

Distributional Results

- Buyer encounters suppliers (with cost below c), distributed Poisson:

$$\rho_n(c) = \frac{\lambda}{1-\gamma} L_n^{-\varphi} \mu_n(c)^{1-\gamma}$$

- Chooses low cost supplier or employs labor, with random efficiency

- Resulting distribution for cost of firm j in country n performing a task:

$$\Pr\left[c_n(j) \leq c\right] = G_n(c) = 1 - e^{-\Xi_{1,n} c^{\theta(1-\gamma)}}$$

$$\Xi_{1,n} = \frac{\lambda}{1-\gamma} L_n^{-\varphi} \Upsilon_n^{1-\gamma} + w_n^{-\theta(1-\gamma)}$$

Main Result

- Measure of firms from i that supply n at a cost below c:

$$\mu_{ni}(c) = d_{ni}^{-\theta} T_i \boldsymbol{\Xi}_i c^{\theta}$$

where

$$\boldsymbol{\Xi}_i = \left(\frac{\lambda}{1-\gamma} L_i^{-\varphi} \left(\sum_{i'} \boldsymbol{\lambda}_{ii'} d_{ii'}^{-\theta} T_{i'} \boldsymbol{\Xi}_{i'} \right)^{1-\gamma} + w_i^{-\theta(1-\gamma)} \right)^{\frac{1-\beta_0}{1-\gamma}}$$

- And, measure relevant to buyers in n:

$$\mu_n(c) = \sum_i \boldsymbol{\lambda}_{ni} \mu_{ni}(c) = \Upsilon_n c^{\theta}$$

Key Macro Implications

- Bilateral trade shares (n's purchases devoted to imports from i):

$$\pi_{ni} = \frac{\boldsymbol{\lambda_{ni}} d_{ni}^{-\theta} T_i \Xi_i}{\Upsilon_n}$$

- Labor shares in production:

$$\beta_i^L = (1 - \beta_0) \frac{w_i^{-\theta(1-\gamma)}}{\Xi_{1,i}}$$

Closing the Model (for another day!)

Firm-Level Results

Suppliers finding Buyers

- Recall the matching function, $m_n(c)$

- Number of buyers in n for firm in i (with cost c in i) is Poisson:

$$\eta_{ni}(cd_{ni}) = \boldsymbol{\lambda_{ni}} f_n(cd_{ni})$$

where, letting $\phi = \theta(1-\gamma)$:

$$\begin{aligned} f_n(x) &= (1-\gamma)\frac{m_n(x)}{\mu_n(x)}\left[1 - G_n(x)\right] \\ &= (M_n + B_n)\, L_n^{-\varphi} \Upsilon_n^{-\gamma}(x)^{-\theta\gamma} K\lambda e^{-\Xi_{1,n}(x)^{\phi}} \end{aligned}$$

Computations

- Use Poisson parameter $\eta_{ni}(cd_{ni})$ to solve for firm-level observables ...

  ... by integrating over the density of producers with cost c in the source country:

$$d\mu_{ii}(c) = T_i \Xi_i \theta c^{\theta - 1} dc$$

- Calculate measure of active producers by country, and bilaterally

  ... exporters and relationships

Measure of Active Firms

- Number of buyers around the world for a firm from i (cost c) is Poisson:

$$\eta_i^W(c) = \sum_n \eta_{ni}(cd_{ni})$$

- Measure of active firms in i:

$$M_i = \int_0^\infty \left(1 - e^{-\eta_i^W(c)}\right) d\mu_{ii}(c)$$

Firm Entry by Destination

- Measure of firms from i selling in n:

$$N_{ni} = \int_0^\infty \left(1 - e^{-\eta_{ni}(cd_{ni})}\right) d\mu_{ii}(c)$$

- Changing the variable of integration:

$$N_{ni} = d_{ni}^{-\theta} \int_0^\infty \left(1 - e^{-\boldsymbol{\lambda_{ni}} f_n(c)}\right) d\mu_{ii}(c)$$

Entry and Market Size

- The search friction acts like a fixed cost,

  ... entry margin varying with $M_n + B_n$, $\boldsymbol{\lambda_{ni}}$, and $d_{ni}^{-\theta}$

- For fixed $\boldsymbol{\lambda_{ni}}$ and Υ_n, get N_{ni} rising in proportion to i's market share in n (π_{ni})

  ... as in EKK I

- If $\boldsymbol{\lambda_{ni}}$ rises with π_{ni}, then N_{ni} rises less than in proportion, as $\boldsymbol{\lambda_{ni}}$ hits diminishing returns

  ... as having just one customer in n is all it takes to be an exporter to n

Relationships

- The measure of relationships between sellers in i and buyers in n:

$$R_{ni} = \int_0^\infty \eta_{ni}(cd_{ni})d\mu_{ii}(c) = \pi_{ni}\left(M_n + B_n\right) K \frac{\frac{\lambda}{1-\gamma} L_n^{-\varphi} \Upsilon_n^{1-\gamma}}{\Xi_{1,n}}$$

- Note it's proportional to π_{ni}, hence to $\boldsymbol{\lambda_{ni}} d_{ni}^{-\theta}$ (as in the data)

- Here, and in what follows, consider only other manufacturers as customers

Distribution of Buyers per Exporter

- Fraction of exporters (from i to n) with s buyers:

$$\frac{N_{ni}(s)}{N_{ni}} = \frac{1}{N_{ni}} \int_0^\infty \frac{e^{-\eta_{ni}(cd_{ni})}\eta_{ni}(cd_{ni})^s}{s!} d\mu_{ii}(c)$$

Toward Estimation

Simplifications

- Service works perform task 0, manufacturing workers all other tasks
- Task-specific contact rates: $\lambda_0 = 0$ and $\lambda_k = \lambda$
- Task shares: β_0 (purchased services) and $\beta_k = (1 - \beta_0)/K$
- Other buyers behave in parallel to manufacturers

Strategy I

- Partial equilibrium: condition on π_{ni}, labor shares in manufacturing $\beta_n^{\mathbf{1},L}$, and relationships of French firms

  ... fit key macro implications perfectly!

- Set bilateral information frictions:

$$\lambda_{ni} = \left(\frac{\pi_{ni}}{\pi_{ii}}\right)^{\psi}$$

- Iceberg costs absorb all the rest to fit bilateral trade shares.

Strategy II

- Labor shares satisfies:

$$\beta_n^{1,L} = (1-\beta_0)\frac{w_{1,n}^{-\phi}}{\Xi_{1,n}}$$

- From results of previous slide, back out the $\Xi_{1,n}$ from:

$$\Xi_{1,n} = \frac{1-\beta_0}{1-\beta_0-\beta_n^{1,L}}\lambda L_n^{-\varphi}\Upsilon_n^{\phi/\theta}$$

Strategy III

- Relationships of French firms:

$$\begin{aligned} R_{nF} &= \pi_{nF}\left(M_n + B_n\right) K \frac{\frac{\lambda}{1-\gamma} L_n^{-\varphi} \Upsilon_n^{\phi/\theta}}{\Xi_{1,n}} \\ &= \pi_{nF}\left(M_n + B_n\right) \frac{\theta}{\phi} K \frac{1 - \beta_0 - \beta_n^{1,L}}{1 - \beta_0} \end{aligned}$$

- Invert, to obtain the number of customers:

$$M_n + B_n = \frac{R_{nF}}{\pi_{nF}} \frac{\phi}{\theta K} \frac{1 - \beta_0}{1 - \beta_0 - \beta_n^{1,L}}$$

Data

- Data we condition on comes from WIOD, 2005:

  ... Timmer, Dietzenbacher, Los, Stehrer, and de Vries (2015)

- Lihua Xiao and Lixing Liang constructed, for manufacturing industries:

$$\pi_{ni} = \frac{X_{ni}}{X_n}$$

  and

$$\beta_n^{\mathbf{1},L} = \frac{V_n}{Y_n}$$

- For congestion, L_n is population

Parameters

- Set two parameters: $\beta_0 = 0.3$, $K = 20$

- Fit 5 others: $\theta = 3.1$, $\phi = 2.1$, $\varphi = 0.25$, $\psi = 0.53$, $\lambda = 0.45$

- Everything we need to calculate model implications

Results

Buyers per French Exporter

	Lithuania	Denmark	U.K.	Germany
Mean	1.6	3.0	4.2	5.8
Median	1	2	2	2
90th	3	6	10	14
99th	7	20	32	51

Regressions on Simulated Data

- Number of French exporters:

$$\ln N_{nF} = 0.61 \ln X_n + 0.71 \ln \pi_{nF}$$

- Number of relationships (same as data):

$$\ln R_{nF} = 0.82 \ln X_n + 1.05 \ln \pi_{nF}$$

- Mean number of buyers per French exporter:

$$\ln \bar{B}_{nF} = 0.21 \ln X_n + 0.34 \ln \pi_{nF}$$

Buyers per Firm in Germany Conditional on Entry

- Regression corresponding to Figure (ignore constant):

$$\ln \bar{B}_{DF}|_n = \underset{(0.02)}{-0.38} \ln N_{nF|D}$$

- Regression on simulated data :

$$\ln \bar{B}_{DF}|_n = -0.55 \ln N_{nF|D}$$

Conclusion

- Theory captures some striking patterns in the micro data
- Yet easy to work with at the aggregate level
- Amenable to estimation in partial equilibrium
- Then, many issues to explore with GE counterfactuals