The Global Agglomeration of Multinational Firms

Laura Alfaro
Harvard Business School and NBER

Maggie Xiaoyang Chen
George Washington University

Washington Area International Trade Symposium

March 2011

Introduction

Figure 1: Geographic distribution of MNC headquarters in transportation equipment (e.g., motor vehicles and equipment, motorcycles and parts, aircrafts and parts, and ship and boat building)

Introduction

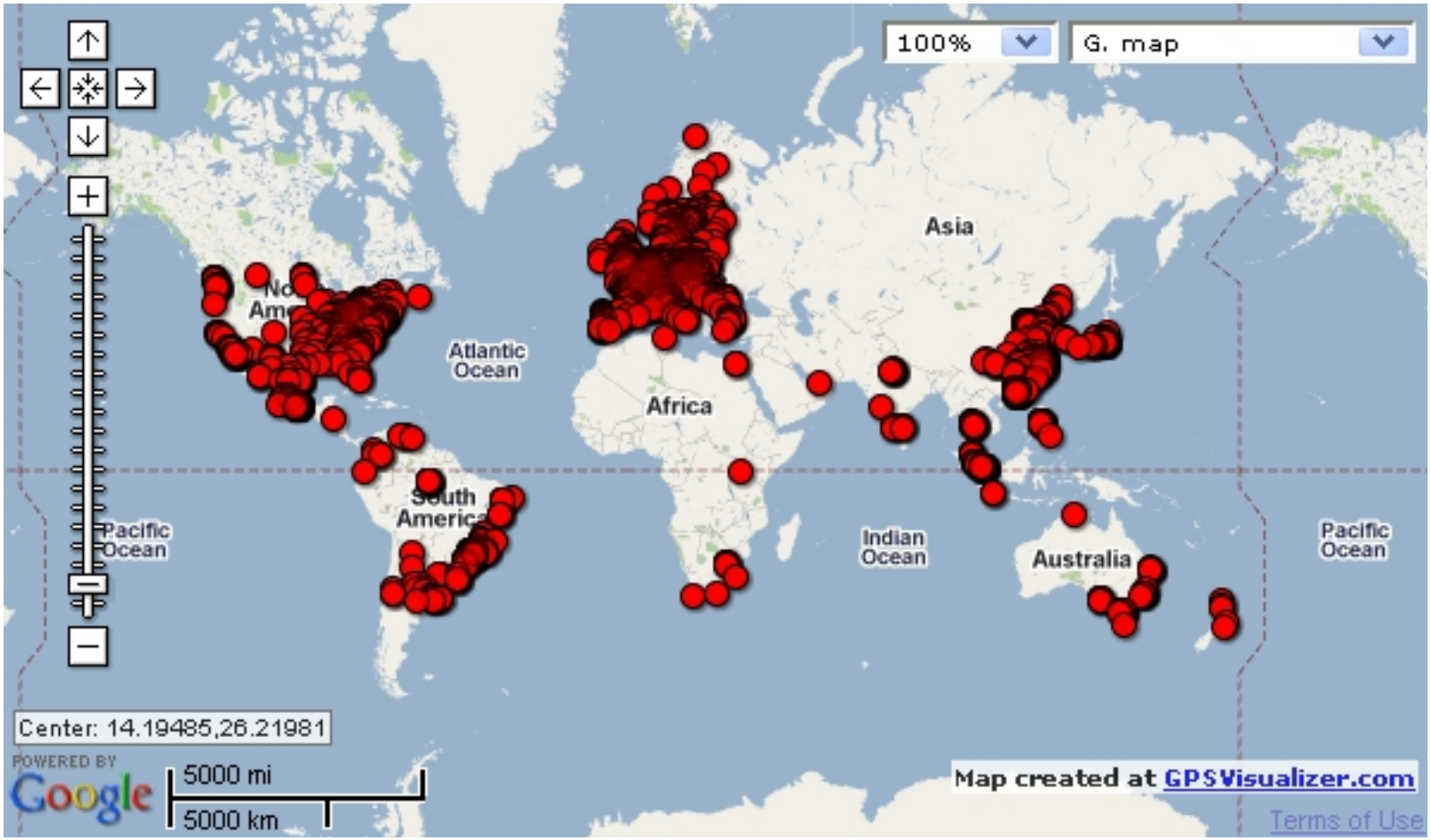


Figure 2: Geographic distribution of MNC subsidiaries in transportation equipment (e.g., motor vehicles and equipment, motorcycles and parts, aircrafts and parts, and ship and boat building)

Introduction

- Do multinationals, known for their global resource and market seeking activities, agglomerate with one another around the world?

Introduction

- Do multinationals, known for their global resource and market seeking activities, agglomerate with one another around the world?
- If they do, what motivates their agglomeration?

Potential Forces of Agglomeration

- **First nature** (the FDI literature)

Potential Forces of Agglomeration

- **First nature** (the FDI literature)
  1. *Market access*

Potential Forces of Agglomeration

- **First nature** (the FDI literature)
  1. *Market access*
     - The common incentives to access markets and avoid trade costs can lead to geographic concentration of MNCs in countries with large markets and high trade costs

Potential Forces of Agglomeration

- **First nature** (the FDI literature)
  1. *Market access*
     - The common incentives to access markets and avoid trade costs can lead to geographic concentration of MNCs in countries with large markets and high trade costs
  2. *Comparative advantage*

Potential Forces of Agglomeration

- **First nature** (the FDI literature)
  1. *Market access*
     - The common incentives to access markets and avoid trade costs can lead to geographic concentration of MNCs in countries with large markets and high trade costs
  2. *Comparative advantage*
     - The motive to exploit countries' comparative advantage can induce geographic concentration of MNCs with similar factor requirements

Potential Forces of Agglomeration

- **First nature** (the FDI literature)
  1. *Market access*
     - The common incentives to access markets and avoid trade costs can lead to geographic concentration of MNCs in countries with large markets and high trade costs
  2. *Comparative advantage*
     - The motive to exploit countries' comparative advantage can induce geographic concentration of MNCs with similar factor requirements
  3. *Other factors*

Potential Forces of Agglomeration

- **First nature** (the FDI literature)
  1. *Market access*
     - The common incentives to access markets and avoid trade costs can lead to geographic concentration of MNCs in countries with large markets and high trade costs
  2. *Comparative advantage*
     - The motive to exploit countries' comparative advantage can induce geographic concentration of MNCs with similar factor requirements
  3. *Other factors*
     - Natural advantage, institutional factors ...

Potential Forces of Agglomeration

- **Second nature** (the urban economics literature)

Potential Forces of Agglomeration

- **Second nature** (the urban economics literature)
  1. *Proximity to customers and suppliers*

Potential Forces of Agglomeration

- **Second nature** (the urban economics literature)
  1. *Proximity to customers and suppliers*
  2. *External scale economies in factor markets*

Potential Forces of Agglomeration

- **Second nature** (the urban economics literature)
  1. *Proximity to customers and suppliers*
  2. *External scale economies in factor markets*
     - Labor

Potential Forces of Agglomeration

- **Second nature** (the urban economics literature)
  1. *Proximity to customers and suppliers*
  2. *External scale economies in factor markets*
     - Labor
     - Capital

Potential Forces of Agglomeration

- **Second nature** (the urban economics literature)
  1. *Proximity to customers and suppliers*
  2. *External scale economies in factor markets*
     - Labor
     - Capital
  3. *Knowledge spillovers*

Objective

In this paper we incorporate the two strands of literature and evaluate:

- How the **"first nature" fundamentals** in FDI and **"second nature" agglomeration forces** in urban economics jointly explain the worldwide geographic distribution of multinational firms?

Objective

In this paper we incorporate the two strands of literature and evaluate:

- How the **"first nature" fundamentals** in FDI and **"second nature" agglomeration forces** in urban economics jointly explain the worldwide geographic distribution of multinational firms?
- Do agglomeration forces affect multinational and non-multinational firms differently?

Why This Matters

These questions are central to the debates on the determinants and consequences of foreign direct investment:

- Many host countries have long offered lucrative incentives to multinationals in the hope of building and sustaining FDI clusters and extracting benefits from inward FDI;

Why This Matters

These questions are central to the debates on the determinants and consequences of foreign direct investment:

- Many host countries have long offered lucrative incentives to multinationals in the hope of building and sustaining FDI clusters and extracting benefits from inward FDI;
- Many home countries also seek to keep multinationals at home and control the outflow of FDI;

Why This Matters

These questions are central to the debates on the determinants and consequences of foreign direct investment:

- Many host countries have long offered lucrative incentives to multinationals in the hope of building and sustaining FDI clusters and extracting benefits from inward FDI;
- Many home countries also seek to keep multinationals at home and control the outflow of FDI;
- The location interdependence of multinationals can magnify the effect of economic fundamentals and policies on the outward and inward movements of MNCs.

How We Address the Questions

1. The global co-agglomeration patterns of multinational firms

How We Address the Questions

1. The global co-agglomeration patterns of multinational firms
   - We investigate the location interdependence of firms in different industries, also referred to as co-agglomeration;

How We Address the Questions

1. The global co-agglomeration patterns of multinational firms
   - We investigate the location interdependence of firms in different industries, also referred to as co-agglomeration;
   - This enables us to disentangle the effects of first-nature location fundamentals and various second-nature agglomeration forces.

How We Address the Questions

1. The global co-agglomeration patterns of multinational firms
   - We investigate the location interdependence of firms in different industries, also referred to as co-agglomeration;
   - This enables us to disentangle the effects of first-nature location fundamentals and various second-nature agglomeration forces.
2. Spatially continuous index of agglomeration

How We Address the Questions

1. The global co-agglomeration patterns of multinational firms
   - We investigate the location interdependence of firms in different industries, also referred to as co-agglomeration;
   - This enables us to disentangle the effects of first-nature location fundamentals and various second-nature agglomeration forces.
2. Spatially continuous index of agglomeration
   - We construct the agglomeration index in a continuous metric space using the actual distance between each pair of plants;

How We Address the Questions

1. The global co-agglomeration patterns of multinational firms
   - We investigate the location interdependence of firms in different industries, also referred to as co-agglomeration;
   - This enables us to disentangle the effects of first-nature location fundamentals and various second-nature agglomeration forces.
2. Spatially continuous index of agglomeration
   - We construct the agglomeration index in a continuous metric space using the actual distance between each pair of plants;
   - The index is independent of the level of geographic aggregation and controls for the overall distribution of firms.

How We Address the Questions

3. Worldwide plant-level dataset

How We Address the Questions

3. Worldwide plant-level dataset
   - We employ a new worldwide plant-level dataset that provides detailed location, ownership and activity information for plants in more than 100 countries;

How We Address the Questions

3. Worldwide plant-level dataset
   - We employ a new worldwide plant-level dataset that provides detailed location, ownership and activity information for plants in more than 100 countries;
   - The dataset has two distinct advantages: (i) worldwide coverage and (ii) information of plant physical location.

How We Address the Questions

3. Worldwide plant-level dataset
   - We employ a new worldwide plant-level dataset that provides detailed location, ownership and activity information for plants in more than 100 countries;
   - The dataset has two distinct advantages: (i) worldwide coverage and (ii) information of plant physical location.
4. The role of first-nature incentives and second-nature forces

How We Address the Questions

3. Worldwide plant-level dataset
   - We employ a new worldwide plant-level dataset that provides detailed location, ownership and activity information for plants in more than 100 countries;
   - The dataset has two distinct advantages: (i) worldwide coverage and (ii) information of plant physical location.

4. The role of first-nature incentives and second-nature forces
   - We assess the relative importance of first-nature location fundamentals and second-nature forces;

How We Address the Questions

3. Worldwide plant-level dataset
   - We employ a new worldwide plant-level dataset that provides detailed location, ownership and activity information for plants in more than 100 countries;
   - The dataset has two distinct advantages: (i) worldwide coverage and (ii) information of plant physical location.

4. The role of first-nature incentives and second-nature forces
   - We assess the relative importance of first-nature location fundamentals and second-nature forces;
   - We also examine how the importance of each factor varies between MNC subsidiaries and their headquarters and domestic counterparts.

Literature

1. The broader FDI literature on first-nature motives of FDI: e.g., Markusen (1984), Helpman (1984), Markusen and Venables (1998), Brainard (1997), Carr et al. (2001), Yeaple (2003), Head and Mayer (2004), Helpman, Melitz and Yeaple (2004), and Alfaro and Charlton (2009)

Literature

1. The broader FDI literature on first-nature motives of FDI: e.g., Markusen (1984), Helpman (1984), Markusen and Venables (1998), Brainard (1997), Carr et al. (2001), Yeaple (2003), Head and Mayer (2004), Helpman, Melitz and Yeaple (2004), and Alfaro and Charlton (2009)
2. The trade literature on production linkages and agglomeration incentives

Literature

1. The broader FDI literature on first-nature motives of FDI: e.g., Markusen (1984), Helpman (1984), Markusen and Venables (1998), Brainard (1997), Carr et al. (2001), Yeaple (2003), Head and Mayer (2004), Helpman, Melitz and Yeaple (2004), and Alfaro and Charlton (2009)
2. The trade literature on production linkages and agglomeration incentives
    - Theoretical: e.g., Venables (1996), Krugman and Venables (1996), Puga and Venables (1997), Markusen and Venables (2000), and Baldwin and Ottaviano (2001)

Literature

1. The broader FDI literature on first-nature motives of FDI: e.g., Markusen (1984), Helpman (1984), Markusen and Venables (1998), Brainard (1997), Carr et al. (2001), Yeaple (2003), Head and Mayer (2004), Helpman, Melitz and Yeaple (2004), and Alfaro and Charlton (2009)
2. The trade literature on production linkages and agglomeration incentives
   - Theoretical: e.g., Venables (1996), Krugman and Venables (1996), Puga and Venables (1997), Markusen and Venables (2000), and Baldwin and Ottaviano (2001)
   - Empirical: e.g., Head, Ries and Swenson (1995), Head and Mayer (2004), Crozet, Mayer and Mucchielli (2004), Blonigen, Ellis and Fausten (2005), Blonigen et al. (2007), Bobonis and Shatz (2007), Amiti and Javorcik (2008)

Literature

3. The urban economics literature on the determinants of urban agglomeration: e.g., Ellison and Glaeser (1997), Rosenthal and Strange (2001), Duranton and Puga (2004), Duranton and Overman (2005), Ellison, Kerr and Glaeser (2009), Overman and Puga (2010), Redding (2010)

Presentation Outline

1. Constructing the agglomeration index
2. Constructing the determinants of agglomeration
3. Data
4. Patterns of multinational-firm agglomeration
5. Evaluating the role of first and second natures
   - MNC subsidiaries
   - MNC subsidiary employment
   - MNC headquarters
6. Additional analysis
   - MNC v.s. non-MNC plants
   - Entry patterns of multinational firms
   - Generalized measure of trade costs

Constructing the Agglomeration Index

Issues in constructing the agglomeration indices

Most existing indices tend to equalize agglomeration with activities located in the same administrative or geographic region (measured by number of firms or size of production in the region). Several issues arise with these measures:

1. Dependence on the level and method of geographic disaggregation

Constructing the Agglomeration Index

Case 1: Underestimating the extent of co-agglomeration between industries A and B

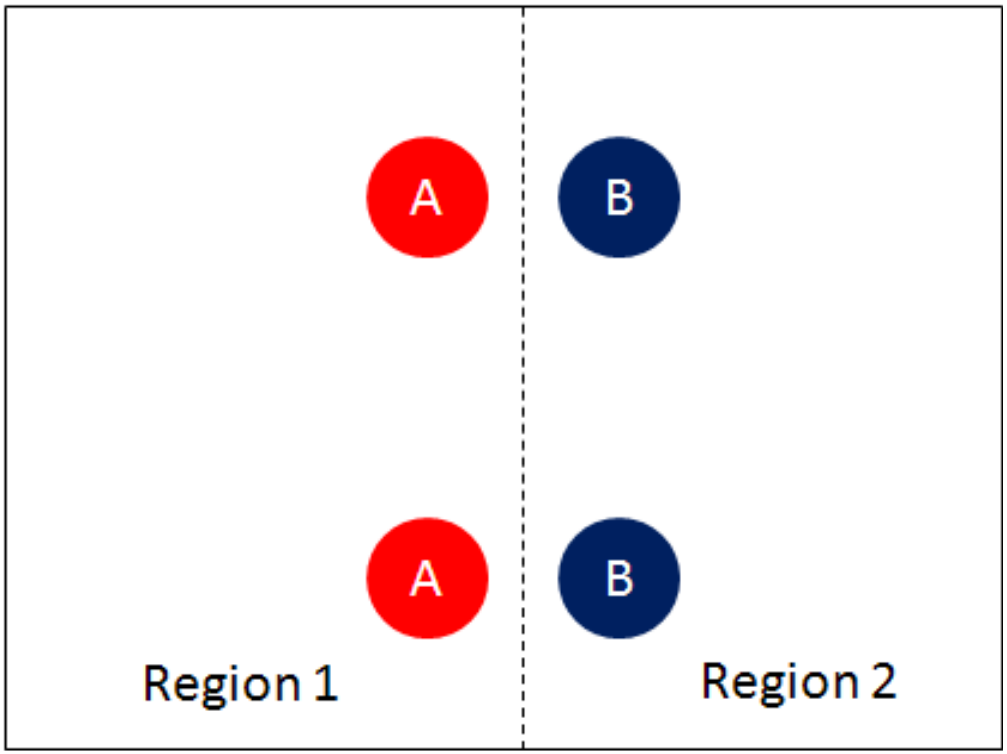


Figure 3: The geographic distribution of industries A and B (each circle represents an establishment; red and blue represent industries A and B, respectively)

Constructing the Agglomeration Index

Case 2: Overestimating the extent of co-agglomeration between industries A and B (Underestimating the extent of co-agglomeration between industries B and C)

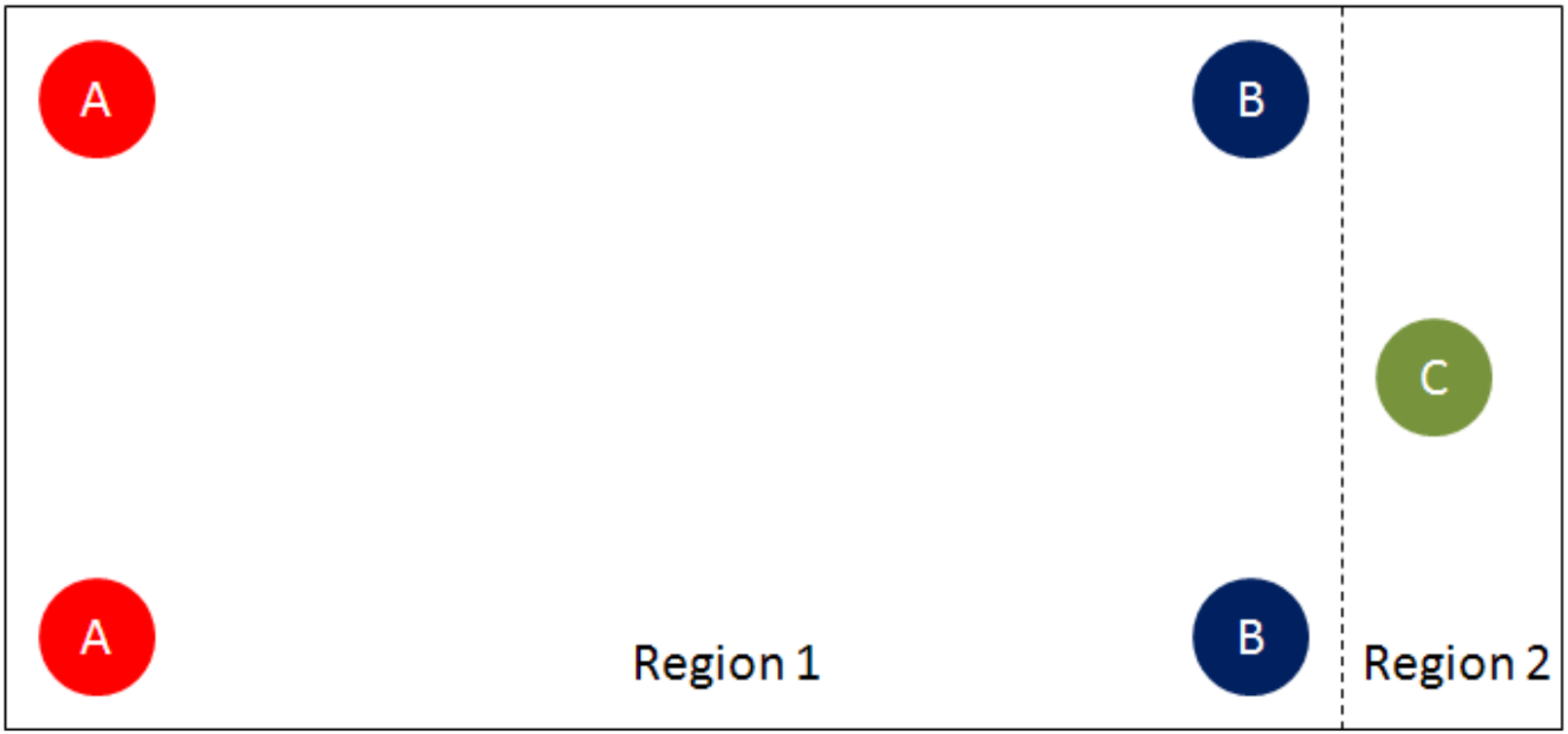


Figure 4: The geographic distribution of industries A, B and C (each circle represents an establishment; red, blue and green represent industries A, B and C, respectively)

Constructing the Agglomeration Index

Issues in constructing the agglomeration indices

2. Can be strongly driven by industrial concentration

Constructing the Agglomeration Index

Issues in constructing the agglomeration indices

2. Can be strongly driven by industrial concentration
3. Cannot separate general geographic concentration due to location attractiveness from agglomeration

Constructing the Agglomeration Index

Development in agglomeration indices

1. Ellison and Glaeser (1997): a dartboard approach

Constructing the Agglomeration Index

Development in agglomeration indices

1. Ellison and Glaeser (1997): a dartboard approach
2. Duranton and Overman (2005): a continuous-space concentration index

Constructing the Agglomeration Index

Step 1: Actual geographic distributions

- First, we obtain the latitude and longitude of each plant based on physical location information and compute the great-circle distance for each pair of plants ($N \times (N-1)/2$ with $N = 32,427$ for MNCs)

Constructing the Agglomeration Index

Step 1: Actual geographic distributions

- First, we obtain the latitude and longitude of each plant based on physical location information and compute the great-circle distance for each pair of plants ($N \times (N-1)/2$ with $N = 32,427$ for MNCs)
- Then, we obtain the kernel estimator of bilateral distances at any point τ (i.e., $f_{k\tilde{k}}(\tau)$) for each of the 7,875 (=126×125/2) pairwise industries:

$$f_{k\tilde{k}}(\tau) = \frac{1}{n_k n_{\tilde{k}} h} \sum_{i=1}^{n_k} \sum_{j=1}^{n_{\tilde{k}}} K\left(\frac{\tau - \tau_{ij}}{h}\right). \quad (1)$$

Constructing the Agglomeration Index

Step 1: Actual geographic distributions

- First, we obtain the latitude and longitude of each plant based on physical location information and compute the great-circle distance for each pair of plants ($N \times (N-1)/2$ with $N = 32,427$ for MNCs)
- Then, we obtain the kernel estimator of bilateral distances at any point τ (i.e., $f_{k\tilde{k}}(\tau)$) for each of the 7,875 (=126×125/2) pairwise industries:

$$f_{k\tilde{k}}(\tau) = \frac{1}{n_k n_{\tilde{k}} h} \sum_{i=1}^{n_k} \sum_{j=1}^{n_{\tilde{k}}} K\left(\frac{\tau - \tau_{ij}}{h}\right). \tag{1}$$

- Alternatively we can treat each worker as the unit of observation:

$$f^{w}_{k\tilde{k}}(\tau) = \frac{1}{h \sum_{i=1}^{n_k} \sum_{j=1}^{n_{\tilde{k}}} (r_i r_j)} \sum_{i=1}^{n_k} \sum_{j=1}^{n_{\tilde{k}}} r_i r_j K\left(\frac{\tau - \tau_{ij}}{h}\right). \tag{2}$$

Constructing the Agglomeration Index

Step 2: Counterfactual geographic distributions

- We draw, for each industry pair, 1,000 random samples from the entire dataset. Each counterfactual industry has a similar number of observations as the actual data to control for the potential effect of industry size.

Constructing the Agglomeration Index

Step 2: Counterfactual geographic distributions

- We draw, for each industry pair, 1,000 random samples from the entire dataset. Each counterfactual industry has a similar number of observations as the actual data to control for the potential effect of industry size.
- We then obtain the kernel estimator for each of the 1,000 samples. This gives us $1,000$ kernel estimators for each of the $7,875$ industry pairs.

Constructing the Agglomeration Index

Step 2: Counterfactual geographic distributions

- We draw, for each industry pair, 1,000 random samples from the entire dataset. Each counterfactual industry has a similar number of observations as the actual data to control for the potential effect of industry size.
- We then obtain the kernel estimator for each of the 1,000 samples. This gives us $1,000$ kernel estimators for each of the $7,875$ industry pairs.
- We compute the 95% global confidence band $\overline{f}_{k\tilde{k}}(\tau)$ for various threshold distance (200, 400, 800 and 1600 kilometers).

Constructing the Agglomeration Index

Step 3: Agglomeration index

Finally, we obtain, for each industry pair k and $\widetilde{k}$:

$$agglomeration_{k\widetilde{k}}(T) \equiv \sum_{\tau=0}^{T} \max\left(f_{k\widetilde{k}}(\tau) - \overline{f}_{k\widetilde{k}}(\tau), 0\right) \tag{3}$$

or employment-weighted

$$agglomeration^{w}_{k\widetilde{k}}(T) \equiv \sum_{\tau=0}^{T} \max\left(f^{w}_{k\widetilde{k}}(\tau) - \overline{f}^{w}_{k\widetilde{k}}(\tau), 0\right). \tag{4}$$

The index measures the extent to which plants in industries k and $\widetilde{k}$ agglomerate within the threshold distance T and the statistical significance thereof.

Constructing the Determinants of Agglomeration

First nature: location fundamentals

To account for the effect of first-nature motives, we estimate an **expected** geographic agglomeration index based exclusively on market access and comparative advantage factors

Constructing the Determinants of Agglomeration

First nature: location fundamentals

We proceed in three stages:

- **Step 1:** We estimate an FDI equation following Yeaple (2003) and Alfaro and Charlton (2009):

$$y_{c\tilde{c}k} = \gamma_0 + \gamma_1 marketsize\_ave_{c\tilde{c}} + \gamma_2 distance_{c\tilde{c}} + \gamma_3 skill\_diff_{c\tilde{c}} + \gamma_4 skill\_diff_{c\tilde{c}} \times skillintensity_k + \gamma_5 tariff_{c\tilde{c}k} + \lambda_{ck} + \lambda_{\tilde{c}k} + \varepsilon_{c\tilde{c}k}.$$

Constructing the Determinants of Agglomeration

First nature: location fundamentals

- **Step 2:** We obtain fitted values of $y_{c\widetilde{c}k}$ predicted exclusively by the first-nature location fundamentals, and sum them up for each host region $\widetilde{c}$ and industry k to obtain $\widehat{y}_{\widetilde{c}k}$.

Constructing the Determinants of Agglomeration

First nature: location fundamentals

- **Step 2:** We obtain fitted values of $y_{c\widetilde{c}k}$ predicted exclusively by the first-nature location fundamentals, and sum them up for each host region $\widetilde{c}$ and industry k to obtain $\widehat{y}_{\widetilde{c}k}$.
- **Step 3:** We repeat step 1 of Duranton and Overman's procedure and obtain the geographic agglomeration index predicted by first-nature motives.

Constructing the Determinants of Agglomeration

Second nature: agglomeration economies

1. Proximity to suppliers and customers

Constructing the Determinants of Agglomeration

Second nature: agglomeration economies

1. Proximity to suppliers and customers
   - Inter-industry input-output linkage (BEA Benchmark I-O Accounts)

Constructing the Determinants of Agglomeration

Second nature: agglomeration economies

1. Proximity to suppliers and customers
   - Inter-industry input-output linkage (BEA Benchmark I-O Accounts)
2. External scale economies in factor markets: Labor

Constructing the Determinants of Agglomeration

Second nature: agglomeration economies

1. Proximity to suppliers and customers
   - Inter-industry input-output linkage (BEA Benchmark I-O Accounts)
2. External scale economies in factor markets: Labor
   - Industry-pair similarity (correlation) in occupational labor requirements (BLS Industry-Occupation Employment Matrix)

Constructing the Determinants of Agglomeration

Second nature: agglomeration economies

1. Proximity to suppliers and customers
   - Inter-industry input-output linkage (BEA Benchmark I-O Accounts)
2. External scale economies in factor markets: Labor
   - Industry-pair similarity (correlation) in occupational labor requirements (BLS Industry-Occupation Employment Matrix)
3. External scale economies in factor markets: Capital

Constructing the Determinants of Agglomeration

Second nature: agglomeration economies

1. Proximity to suppliers and customers
   - Inter-industry input-output linkage (BEA Benchmark I-O Accounts)
2. External scale economies in factor markets: Labor
   - Industry-pair similarity (correlation) in occupational labor requirements (BLS Industry-Occupation Employment Matrix)
3. External scale economies in factor markets: Capital
   - Industry-pair similarity (correlation) in capital-good demand (BEA capital flow data)

Constructing the Determinants of Agglomeration

Second nature: agglomeration economies

1. Proximity to suppliers and customers
   - Inter-industry input-output linkage (BEA Benchmark I-O Accounts)
2. External scale economies in factor markets: Labor
   - Industry-pair similarity (correlation) in occupational labor requirements (BLS Industry-Occupation Employment Matrix)
3. External scale economies in factor markets: Capital
   - Industry-pair similarity (correlation) in capital-good demand (BEA capital flow data)
4. Knowledge spillovers

Constructing the Determinants of Agglomeration

Second nature: agglomeration economies

1. Proximity to suppliers and customers
   - Inter-industry input-output linkage (BEA Benchmark I-O Accounts)
2. External scale economies in factor markets: Labor
   - Industry-pair similarity (correlation) in occupational labor requirements (BLS Industry-Occupation Employment Matrix)
3. External scale economies in factor markets: Capital
   - Industry-pair similarity (correlation) in capital-good demand (BEA capital flow data)
4. Knowledge spillovers
   - Industry-pair patent citation intensity (NBER Patent Database)

Data

The WorldBase database

- We employ a worldwide plant-level dataset, WorldBase

Data

The WorldBase database

- We employ a worldwide plant-level dataset, WorldBase
- We use four main categories of information for each plant:

Data

The WorldBase database

- We employ a worldwide plant-level dataset, WorldBase
- We use four main categories of information for each plant:
  - Primary industry information including four-digit SIC code

Data

The WorldBase database

- We employ a worldwide plant-level dataset, WorldBase
- We use four main categories of information for each plant:
  - Primary industry information including four-digit SIC code
  - Ownership information including headquarters and global parents

Data

The WorldBase database

- We employ a worldwide plant-level dataset, WorldBase
- We use four main categories of information for each plant:
  - Primary industry information including four-digit SIC code
  - Ownership information including headquarters and global parents
  - Location information of both the plants and headquarters

Data

The WorldBase database

- We employ a worldwide plant-level dataset, WorldBase
- We use four main categories of information for each plant:
  - Primary industry information including four-digit SIC code
  - Ownership information including headquarters and global parents
  - Location information of both the plants and headquarters
  - Operational information including sales and employment

Data

The WorldBase database: advantages

1. Worldwide coverage

The WorldBase database: advantages

1. Worldwide coverage
   - A significant fraction of agglomeration activities occurs across borders

Table A.1: Distribution of Establishment Pairs by Distance and Different Countries

	All pairs		Pairs located in two different countries		
	Pairs (mil)	Ave. dist (km)	Pairs (mil)	Percentage	Ave. dist (km)
dist $\leq$ 200	28.3	91.6	5.6	0.2	131.4
dist $\leq$ 400	54.8	194.1	24.5	0.4	268.7
dist $\leq$ 800	124.2	423.0	85.6	0.7	510.9
dist $\leq$ 1600	257.1	806.6	198.7	0.8	885.8

Notes: Authors' calculations.

The WorldBase database: advantages

2. Physical address and postal code information

The WorldBase database: advantages

2. Physical address and postal code information
    - This enables us to obtain the latitude and longitude of each plant from a geocoding software (Yahoo! Geocoding API), compute between-plant distance, and examine agglomeration in a continuous metric space

Patterns of Multinational-Firm Agglomeration

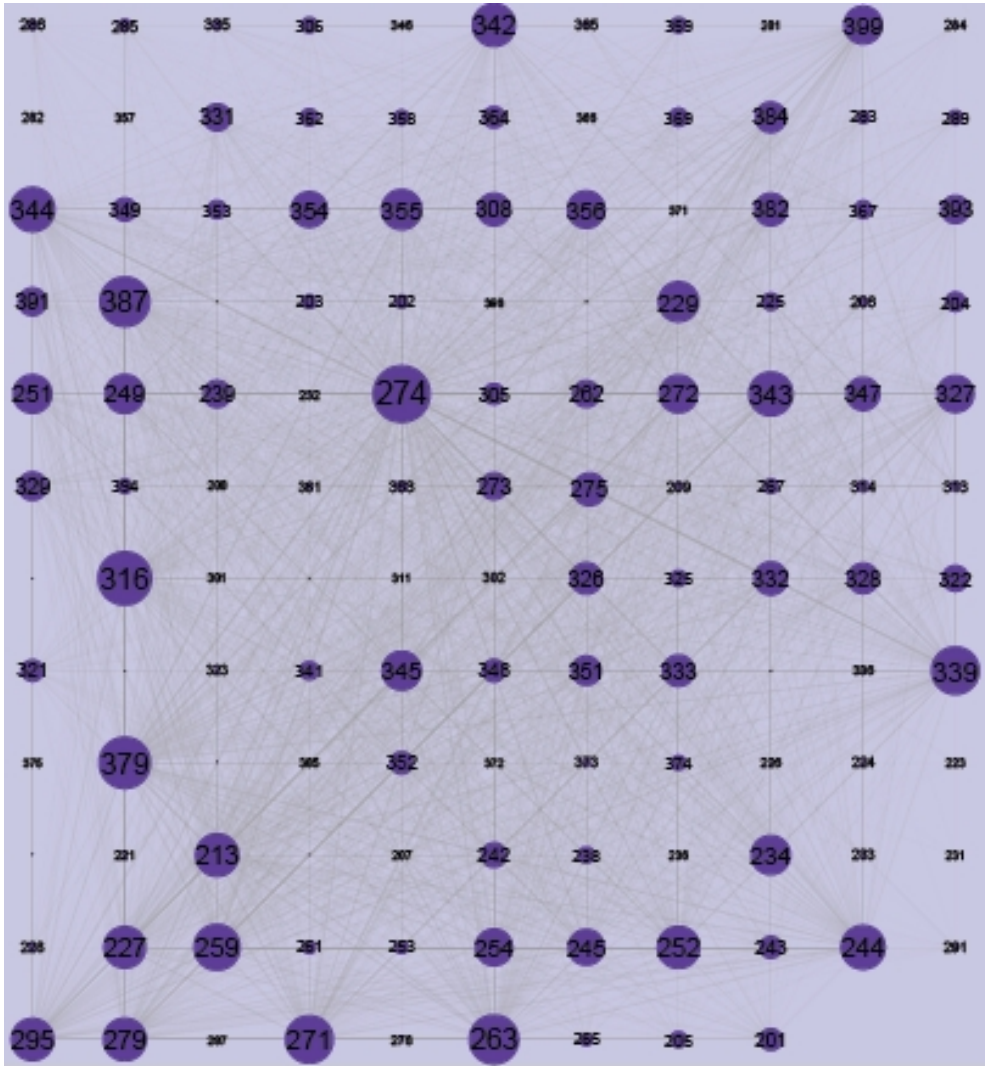
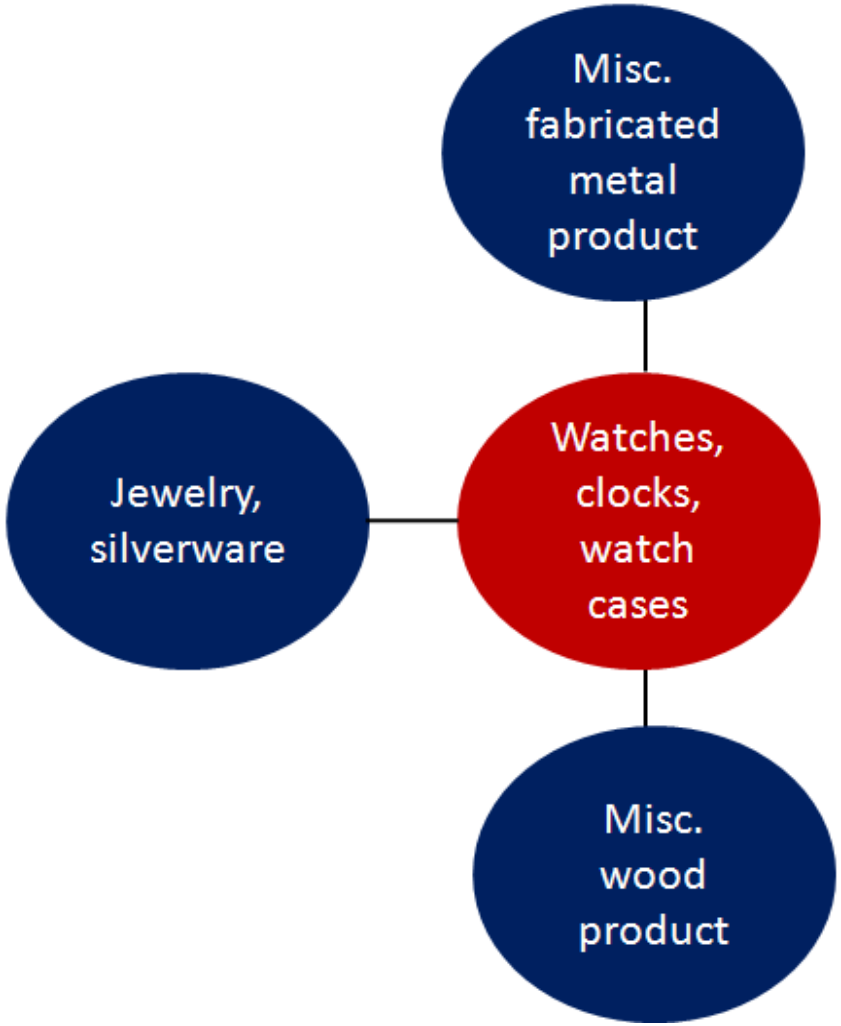
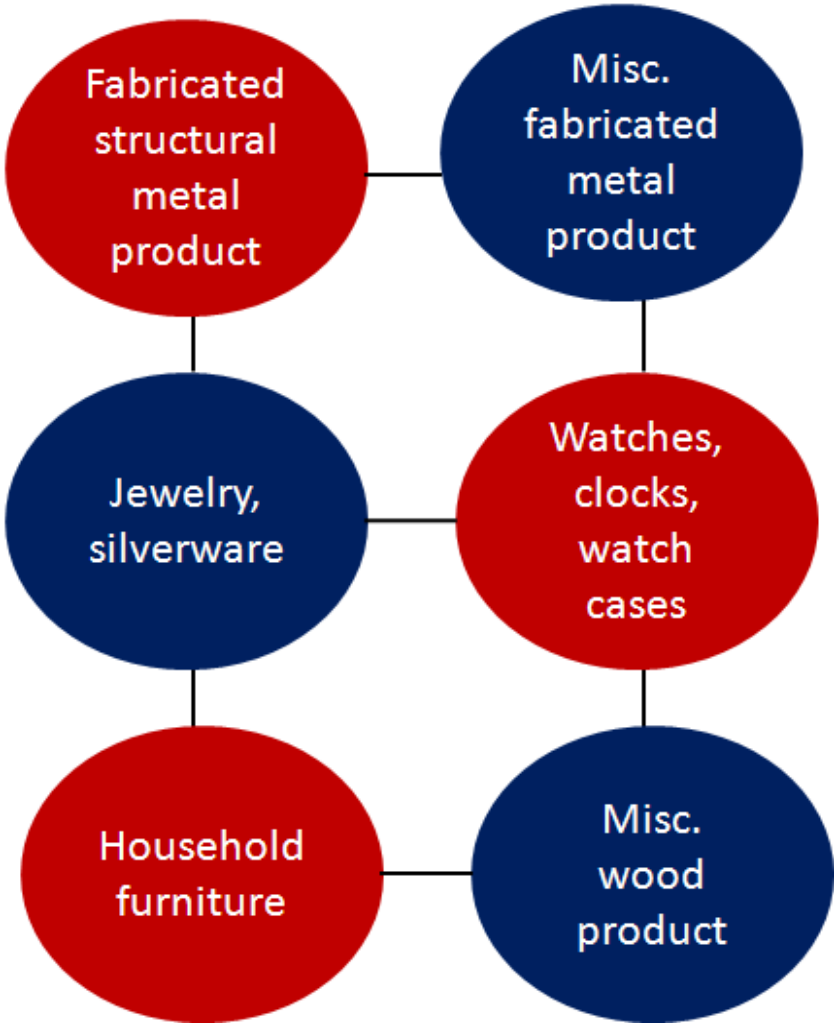


Figure 5: The agglomeration pattern of MNC subsidiaries

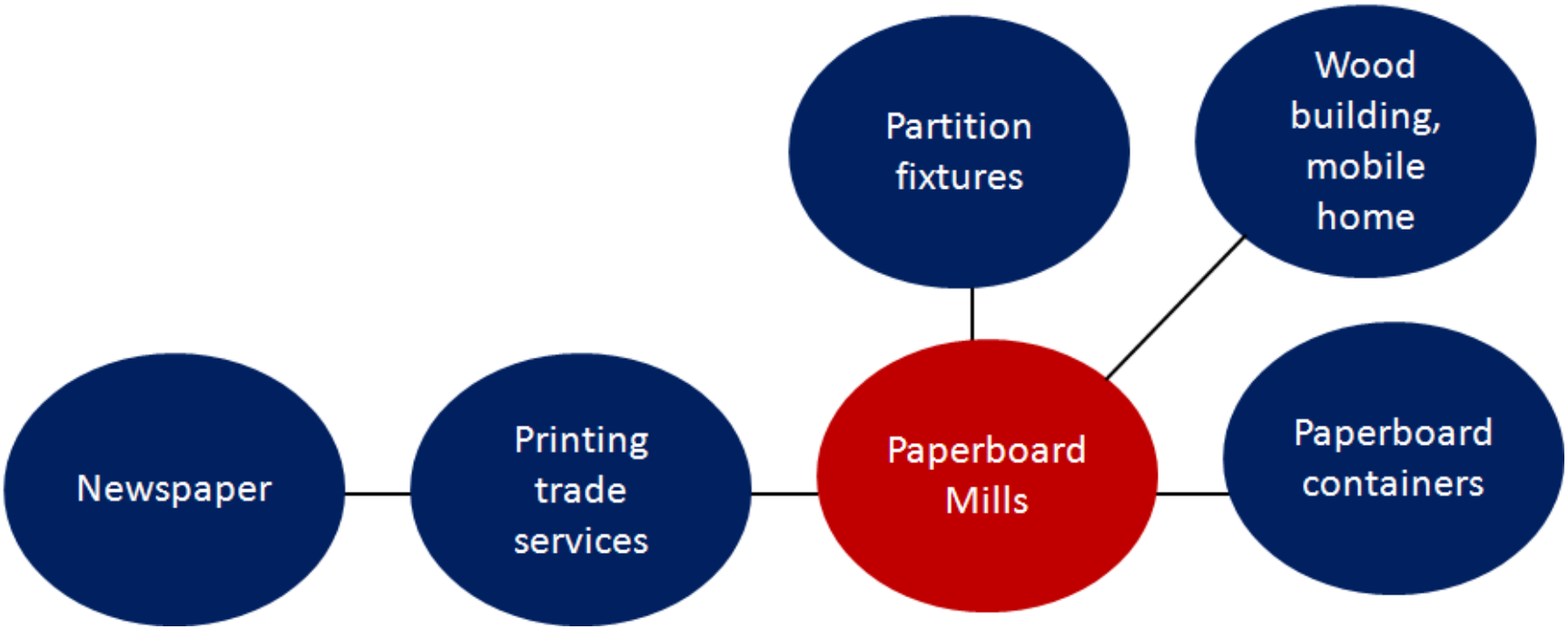
Patterns of Multinational-Firm Agglomeration



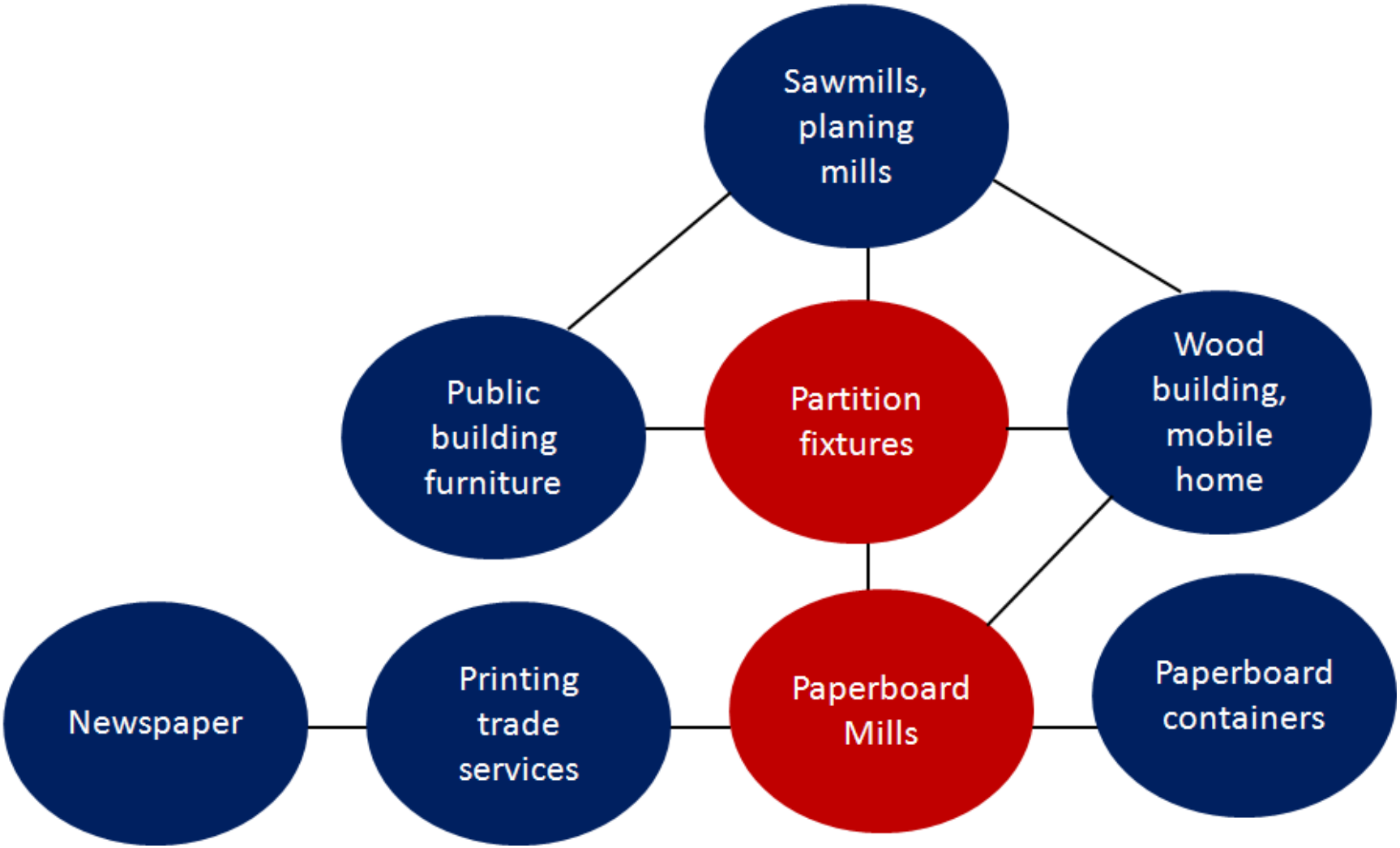
Patterns of Multinational-Firm Agglomeration



Patterns of Multinational-Firm Agglomeration



Patterns of Multinational-Firm Agglomeration



Patterns of Multinational-Firm Agglomeration

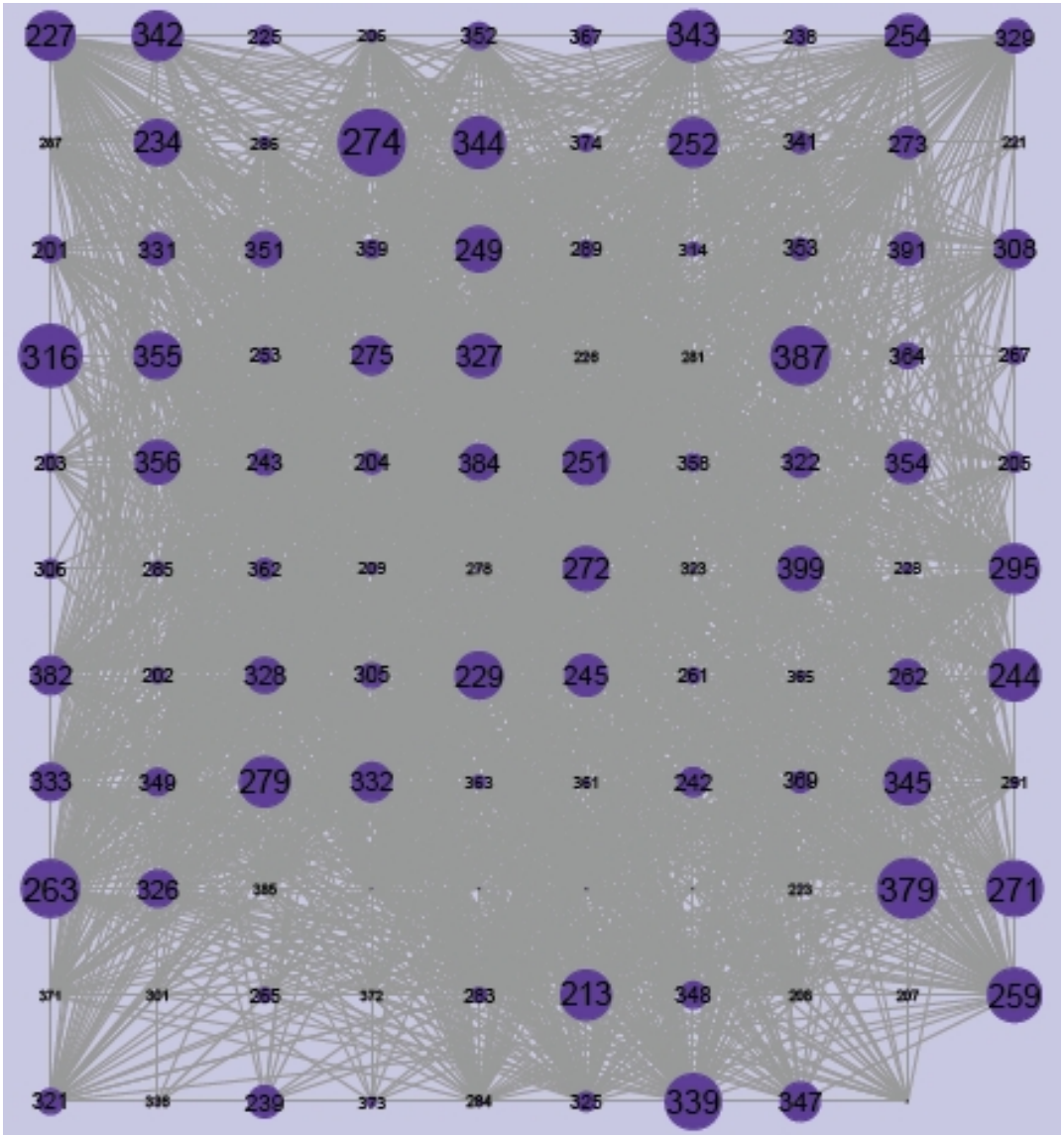


Figure 6: The agglomeration pattern of MNC headquarters

Evaluating the Role of First and Second Natures

$$agglomeration_{k\tilde{k}}(T) = \alpha_K + \beta_1 firstnature_{k\tilde{k}} + \beta_2 IOlinkage_{k\tilde{k}} + \beta_3 labor_{k\tilde{k}} + \beta_4 capital_{k\tilde{k}} + \beta_5 knowledge_{k\tilde{k}} + \varepsilon_{k\tilde{k}}, \quad (5)$$

Evaluating the Role of First and Second Natures

MNC subsidiaries

Table 3: Agglomeration Economies and MNC Subsidiary Agglomeration

	T= 200 km	T= 400 km	T= 800 km	T= 1600 km
IO Linkages	0.265*	0.573*	1.331**	2.596**
	(0.147)	(0.306)	(0.656)	(1.296)
Capital	0.038***	0.093***	0.241***	0.506***
	(0.014)	(0.032)	(0.066)	(0.139)
Labor	-0.002	-0.015	-0.079	-0.231
	(0.016)	(0.035)	(0.068)	(0.160)
Knowledge	0.609**	1.178**	2.521**	4.395**
	(0.293)	(0.546)	(1.117)	(2.371)
First Nature	0.018	0.019	0.020	0.021*
	(0.025)	(0.019)	(0.022)	(0.012)
# Obs.	7875	7875	7875	7875
R^2	0.571	0.600	0.627	0.631
	Beta Coefficients			
IO Linkages	0.014	0.014	0.014	0.013
Capital	0.035	0.039	0.043	0.046
Labor	-0.002	-0.007	-0.015	-0.023
Knowledge	0.031	0.027	0.025	0.022
First Nature	0.266	0.264	0.279	0.333

Notes: Bootstrapped standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. All regressions

Evaluating the Role of First and Second Natures

MNC subsidiary employment

Table 5: Agglomeration Economies and MNC Subsidiary Employment Agglomeration

	T= 200 km	T= 400 km	T= 800 km	T= 1600 km
IO Linkages	-0.145	-0.256	-0.272	-0.750
	(0.209)	(0.403)	(0.683)	(1.160)
Capital	0.041*	0.109**	0.315***	0.557***
	(0.023)	(0.044)	(0.089)	(0.144)
Labor	0.048*	0.088*	0.120	0.128
	(0.026)	(0.048)	(0.104)	(0.162)
Knowledge	2.262***	3.957***	6.243***	9.333***
	(0.516)	(0.867)	(1.613)	(2.356)
First Nature	0.0004***	0.0004***	0.0004***	0.0004**
	(0.0001)	(0.0001)	(0.0001)	(0.0002)
# Obs.	7875	7875	7875	7875
R^2	0.327	0.327	0.363	0.402
	Beta Coefficients			
IO Linkages	-0.007	-0.006	-0.003	-0.005
Capital	0.033	0.045	0.066	0.065
Labor	0.042	0.039	0.027	0.016
Knowledge	0.100	0.091	0.073	0.061
First Nature	0.315	0.349	0.390	0.435

Notes: Bootstrapped standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. All regressions

Evaluating the Role of First and Second Natures

MNC Headquarters

Table 6: Agglomeration Economies and MNC Headquarters Agglomeration

	T= 200 km	T= 400 km	T= 800 km	T= 1600 km
IO Linkages	0.090	0.156	0.127	0.457
	(0.174)	(0.406)	(0.815)	(1.254)
Capital	0.026	0.084**	0.261***	0.459***
	(0.019)	(0.040)	(0.088)	(0.164)
Labor	0.043**	0.064	0.019	-0.085
	(0.021)	(0.044)	(0.104)	(0.180)
Knowledge	0.793***	1.727***	3.870***	6.935***
	(0.241)	(0.477)	(1.153)	(1.735)
First Nature	0.022**	0.023***	0.024*	0.019
	(0.009)	(0.009)	(0.013)	(0.018)
# Obs.	7875	7875	7875	7875
R^2	0.639	0.65	0.664	0.667
	Beta Coefficients			
IO Linkages	0.003	0.003	0.001	0.002
Capital	0.017	0.024	0.032	0.033
Labor	0.030	0.020	0.003	-0.007
Knowledge	0.028	0.027	0.027	0.028
First Nature	0.212	0.212	0.208	0.213

Notes: Bootstrapped standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. All regressions

Additional Analysis

- MNC v.s. non-MNC plants

Additional Analysis

- MNC v.s. non-MNC plants
- Entry patterns of MNCs

Additional Analysis

- MNC v.s. non-MNC plants
- Entry patterns of MNCs
- The agglomeration between MNC and domestic plants

Additional Analysis

- MNC v.s. non-MNC plants
- Entry patterns of MNCs
- The agglomeration between MNC and domestic plants
- Generalized measure of trade costs

Conclusion

- Multinationals' agglomeration goes above and beyond first-nature driven geographic concentration

Conclusion

- Multinationals' agglomeration goes above and beyond first-nature driven geographic concentration
- Second-nature forces including knowledge spillovers, capital-market externalities, and vertical production linkages play a significant role

Conclusion

- Multinationals' agglomeration goes above and beyond first-nature driven geographic concentration
- Second-nature forces including knowledge spillovers, capital-market externalities, and vertical production linkages play a significant role
- In comparison to domestic plants, knowledge spillovers and capital market externalities exert a stronger effect on the clustering of multinational firms while labor market pooling has a weaker impact

Conclusion

- Multinationals' agglomeration goes above and beyond first-nature driven geographic concentration
- Second-nature forces including knowledge spillovers, capital-market externalities, and vertical production linkages play a significant role
- In comparison to domestic plants, knowledge spillovers and capital market externalities exert a stronger effect on the clustering of multinational firms while labor market pooling has a weaker impact
- These results suggest that more consideration should be given to the interdependence of multinational firms especially in policy making aimed at influencing the flow of FDI