ECON G6905
Topics in Trade

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COLUMBIA UNIVERSITY
IN THE CITY OF NEW YORK

Today: Multiregion firms

Multinational enterprises (MNEs)

- Six facts about foreign direct investment and MNEs
- Horizontal FDI ("the octopus") vs vertical FDI ("the rattlesnake")

Multiregion firms

- The internal geography of firms
- Organizing the multi-establishment firm: entry, layers
- Spillovers with multimarket firms

Facts about multinational firms: Overview

- Multinationals, though few, do majority of international business
- Most FDI has involved high-income economies
- Multinationals are more important in more sophisticated (manufacturing) industries
- A gravity equation for foreign affiliate activity
- Parents provide "headquarter services"
- Acquisitions are a substantial share of FDI

A *multinational* firm is an enterprise that controls and manages establishments in 2+ countries. A *parent* firm is a legal entity (located in source country) that controls another establishment. A *foreign affiliate* is an establishment located in a host ($\neq$ source) country

Multinational firms drive international business

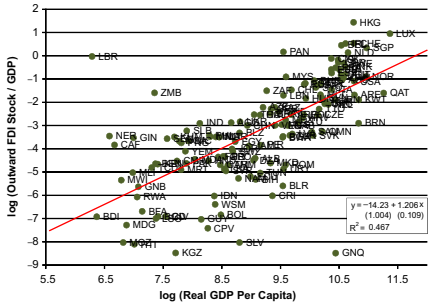
- MNEs (US- and foreign-owned) are 1.1% of US firms, 27% of US employment, and do 90% of US trade (Bernard Jensen Schott 2009)
- Multinational firms generate 28% of global GDP, 23% of employment, and 55% of world exports (OECD 2018, OECD 2019)
- Foreign-owned firms account for 51% of Chinese exports; joint ventures account for 26% (Manova, Wei, Zhang 2015)
- US firms' foreign affiliate sales of $7.7 trillion versus exports of $2.5 trillion.

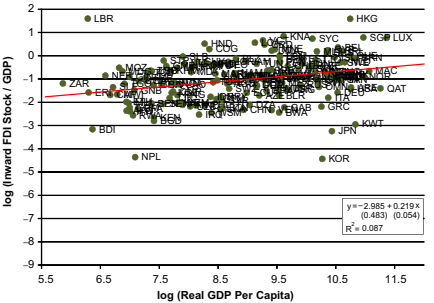
	Finland	France	Ireland	Netherlands	Poland	Sweden
Enterprises	1.5%	0.6%	1.3%	1.2%	10.4%	1.7%
Sales	22.6%	19.0%	63.5%	35.6%	41.2%	31.0%
Employment	17.6%	-	14.3%	20.3%	-	22.9%
Value Added	23.1%	17.2%	62.8%	29.7%	37.0%	26.8%
R&D	30.2%	24.1%	69.2%	32.6%	51.7%	38.1%
Exports (2016)	31.7%	30.0%	40.6%	60.7%	41.4%	45.0%

Source: 2017 business sector data from Eurostat and OECD (exports in 2016).

Most FDI has involved high-income economies

- Developed economies account for 82% of outward (investors' residence) and 66% of inward (assets' location) FDI stock
- Accounting for size, multinational activity is concentrated in developed economies; developing economies more likely to be affiliate destination than parent origin (Antras and Yeaple 2014)



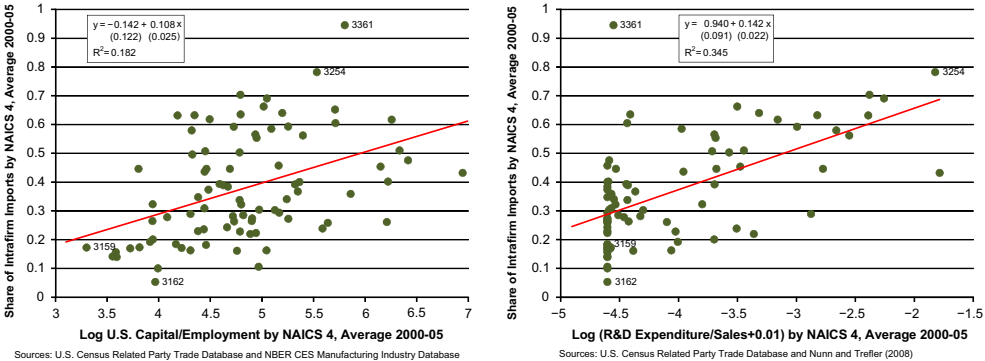


Sources: UNCTAD and World Bank

FDI stats are limited by measurement challenges: book vs market valuation, round-tripping, and tax havens (Sauvant 2017)

Multinationals key in more sophisticated manufacturing industries

A larger share of imports are intrafirm in capital- and research-intensive industries



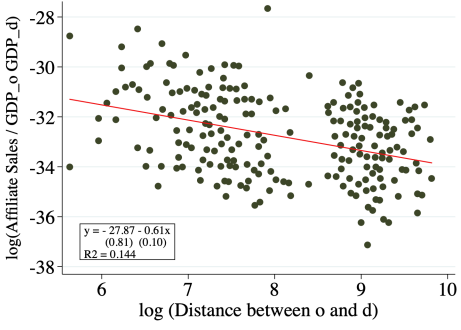
Figures from Antras and Yeaple (2014)

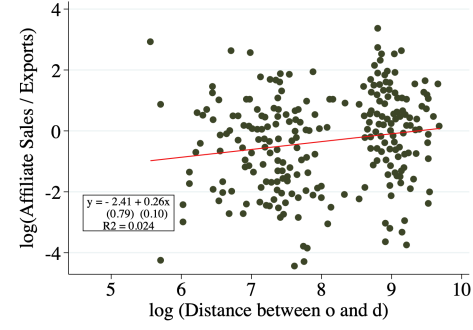
Highlighted NAICS: apparel (3159), footwear (3162), motor vehicles (3361), pharmaceuticals (3254)

- "Zero R&D" industries ($\ln(0.01) \approx -4.6$) says more about accounting practices than R&D
- These correlations are weaker among developing-economy multinationals

A gravity equation for foreign affiliate activity

- Recall the "niave" gravity equation using GDP: $X_{od} = \lambda \frac{\text{GDP}_o^{\alpha} \text{GDP}_d^{\beta}}{\text{distance}_{od}^{\gamma}}$
- Now make X_{od} global sales by affiliates in d owned by parent in o
- Distance coefficient for affiliates sales $\gamma \approx .61$ less negative than distance coefficient for exports $\gamma \approx 1$





Reproduction of figures in Antras and Yeaple (2014)

Foreign affiliates' locations and time zones

Differences in time zones raise communication and coordination costs

- Coordination more important for FDI than trade: "Time zones also have a negative effect on trade, but this effect is smaller than that on FDI. . . the impact of the time zone effect has increased over time." (Stein & Daude 2007)
- Comparing different industries within manufacturing, coordination more important in knowledge-intensive operations: "Subsidiaries with a higher overlap in working hours with their headquarters are, on average, active in industries that are more intensive in knowledge" (Bahar 2019)

Parents provide "headquarter services"

- 1999: US parents account for 74% of total sales, 78% of value added, and 87% of R&D within multinationals
- 2009: US parents account for 65% of total sales, 68% of value added, and 84% of R&D within multinationals
- Affiliates primarily serve foreign markets rather than US parent

Destination of affiliate sales by industry (%)

	Host Country	**Other Foreign**	**United States**
Total manufacturing	0.55	0.33	0.12
Textile and Apparel	0.48	0.28	0.24
Metals and Minerals	0.60	0.31	0.09
Chemicals and Plastics	0.62	0.32	0.06
Machinery	0.49	0.38	0.13
Computers and Electronics	0.38	0.48	0.14
Electronic Equipment	0.63	0.25	0.12
Transport Equipment	0.48	0.27	0.24

Source: BEA's 2014 Benchmark Survey of US Direct Investment Abroad

Cross-border acquisitions are a substantial share of FDI

FDI inflows 2014 (billions USD)

	FDI Inflows	Cross-Border M&A	Announced Greenfield Project Values
World	1,245.0	398.9	714.3
Developed Economies	493.0	274.5	229.6
European Union	254.0	160.6	122.4
North America	146.0	44.1	77.7
Developing Economies	703.0	120.1	459.1
Africa	55.0	5.1	88.0
Latin America and the Caribbean	170.0	25.5	89.3
Developing Asia	475.0	89.3	280.6
Transition Economies	49.0	4.2	25.7

Source: UNCTAD Global Investment Trends Monitor, 2016

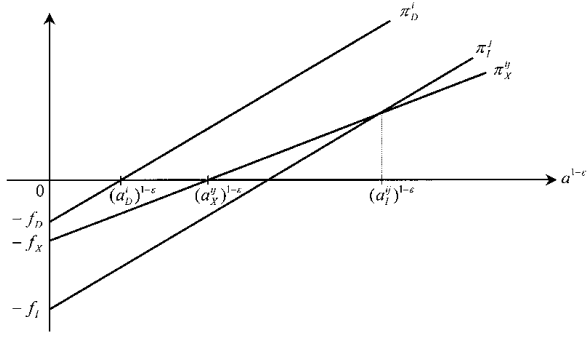
- Acquisitions more prevalent for entering developed economies
- More productive parents tend to establish foreign affiliates via greenfield investment rather than acquisition (Nocke & Yeaple 2008)
- Acquisition targets tend to be more productive than average firm in destination (Arnold & Javorcik 2009, Guadalupe, Kuzmina, Thomas 2012)

Two types of FDI

- **Horizontal** FDI: Foreign affiliate replicates activities performed elsewhere
  - Japanese automakers' US assembly plants
  - Nestlé's 447 factories in 194 countries
  - Yum! Brand fast-food restaurants outside the US
- **Vertical** FDI: Foreign affiliate performs a distinct function of firm's production process
  - Intel's geographic separation of R&D, wafer fabrication, and assembly & testing plants
  - GE's jet engines designed for manufacture in China, analytics and materials science in India, wind-tunnel testing in Germany
- Much investment activity won't neatly belong to one or the other

Horizontal FDI: The proximity-concentration trade-off

- Benefit of **proximity**: Replicating an activity across locations circumvents distance-related trade costs
- Benefit of **concentration**: Concentrating an activity in a single location lowers average costs via economies of scale
- Simplest model casts this as fixed-vs-variable costs: fixed cost to build second plant versus trade costs that apply to each unit shipped



Helpman, Melitz, Yeaple (2004)

More generally, Mrazova, Neary "Selection Effects with Heterogeneous Firms" (2019)

Productivity distribution by sales mode

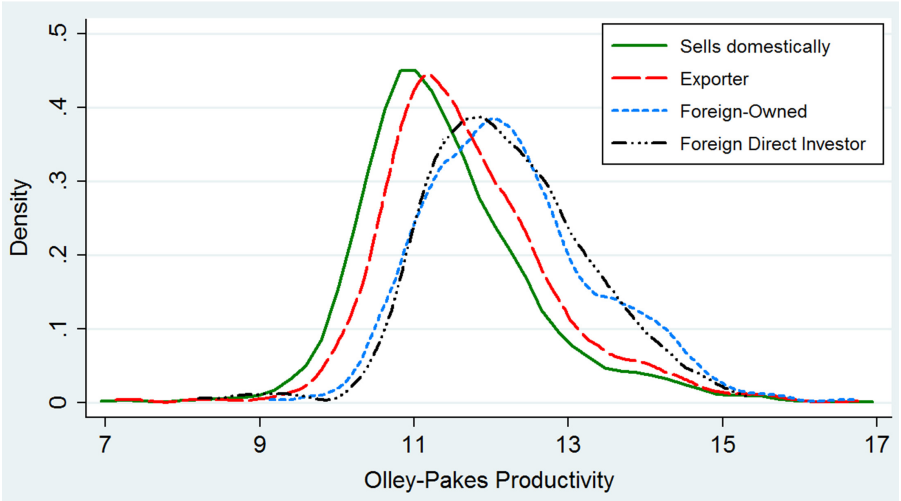


Figure from Antras and Yeaple (2014)

Investment facilitates local customization

- Exporting's "concentration" requires selling the same product
  - Demand dissimilarity favors foreign affiliate over exporting
  - Foreign affiliate can customize products to local demand
  - Ford COO: "The single biggest barrier to globalization [in autos]... is the relatively cheap cost of motor fuel in the US... creates an accompanying disparity in... the most fundamental of vehicle characteristics: size and power." (cf. Cosar et al 2018)
- Export platforms
  - Plant in one foreign market can serve others via exports
  - E.g., Ford Focus had five assembly plants serving different regions
  - Spatially correlated characteristics, e.g. demand similarities, favor a "regional" strategy that captures (some) concentration benefits while avoiding interregional trade costs

Export platforms

Share of US MNE's European affiliates' sales to third markets:

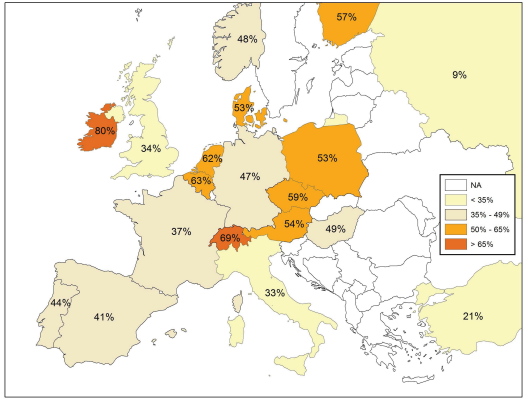


Figure 1: Export platform shares for US multinationals in Europe (year: 2004, source: BEA)

Vertical FDI as specialization within the firm

- Vertical FDI: Foreign affiliate performs a distinct function of firm's production process ("rattlesnake", not "octopus")
- Key element: Locational advantages across different stages
- If you ignore the boundary of the firm, the same logic that drives specialization for arms-length sourcing transactions would drive specialization within the firm

Tangible and intangible inputs

- Standard account of fragmentation emphasizes specialization: upstream unit produces inputs for downstream unit
- Domestic: Median upstream establishment sends 0.4% of its shipments to its firm's downstream establishments (Atalay, Hortacsu, Syverson 2014)
- International: Median manufacturing foreign affiliate sends nothing to and receives nothing from its US parent. Intrafirm trade is concentrated among a small number of large affiliates within large MNEs. (Ramondo, Rappaport, Ruhl 2016)
- Multiplant firms are more likely to own plants in related industries, but that isn't associated with tangible flows of inputs
- This evidence points towards intangible inputs – managerial capabilities, marketing capital, stock of knowledge
- Intangibles are necessarily harder to measure

Is most FDI "horizontal"?

Davies and Markusen (2020) say "the data suggests a dominant role for horizontal investment":

1. Most FDI is between pairs of developed economies (with presumably similar costs) (cf. Ricardian idiosyncrasies a la Davis 1995 or Eaton and Kortum 2002)
2. Affiliate sales are 2-3 times export sales for both goods and services
3. Goods exports from parents to affiliates and from affiliates to parents are only 5.6% and 8.5% of affiliate goods sales

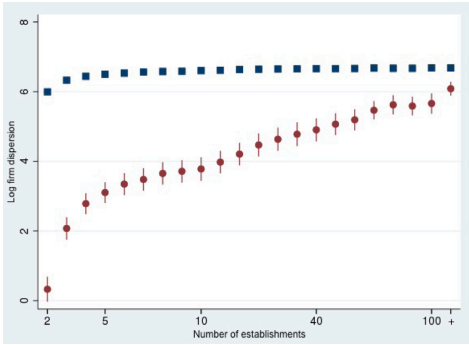
The organization of the multi-establisment firm

The domestic analogue of organizing multinational enterprises

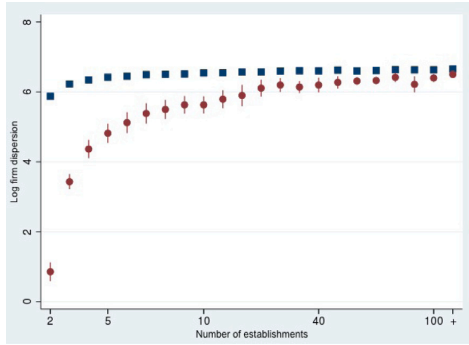
- The internal geography of firms
- Organizing the multi-establishment firm: entry, layers
- Spillovers with multimarket firms

Gravity for establishments within firm (United States)

A firm's establishments are geographically concentrated (Bartelme Ziv 2024)



(a) All firms



(b) Manufacturing

Fig. 1. Cross-sectional firm dispersion. *Notes*: Red circles plot the average log mean establishment distance from firm centroid for each firm size category. Blue squares plot the corresponding measure for synthetically constructed firms. All standard errors are clustered by firm modal 4-digit industry.

Establishments farther from headquarters are smaller

Bartelme Ziv (2024)

Employment and distance within the firm.

Variable	ln Employment	ln Employment	ln Employment
	(A) All firms		
ln miles HQ	−0.039		−0.040
	(0.008)		(0.008)
1_{10+} x ln dist HQ	0.024		0.027
	(0.007)		(0.006)
ln miles to centroid		−0.119	0.024
		(0.021)	(0.011)
1_{10+} x ln miles to cent.		0.083	−0.021
		(0.015)	(0.014)
N	2,105,000	6,415,000	2,105,000

Gravity for establishments within firm (Germany)

Across German counties (Gumpert, Steimer, Antoni 2021):

TABLE III

DISTANCE TO HQ CORRELATES NEGATIVELY WITH LOCATION PROBABILITY AND ESTABLISHMENT SIZE

	Location probability			Log no. est. employees		
	(1)	(2)	(3)	(4)	(5)	(6)
Log distance to HQ	−0.315***	−0.303***	−0.368***	−0.106***	−0.112***	−0.137***
	(0.021)	(0.023)	(0.020)	(0.018)	(0.019)	(0.017)
Log market potential	0.745***	0.780***		0.485***	0.465***	
	(0.026)	(0.031)		(0.044)	(0.046)	
Relative wages	−0.942***	−0.887***		−0.330**	−0.433***	
	(0.062)	(0.063)		(0.108)	(0.109)	
Relative land prices		−0.021***			0.020***	
		(0.005)			(0.005)	
No. observations	3,715,666	3,222,108	3,715,666	21,496	19,203	21,496
No. firms	9,266	8,732	9,266	3,006	2,773	3,006
HQ sector FE	Y	Y	Y	N	N	N
HQ county FE	Y	Y	Y	N	N	N
Legal form FE	Y	Y	Y	N	N	N
County FE	N	N	Y	N	N	Y
Firm FE	N	N	N	Y	Y	Y
Model	Probit			OLS		

Notes. 2012 cross section. The table presents the coefficient estimates of a probit model in columns (1)–(3) (a constant is included; standard errors clustered by HQ county are in parentheses) and a linear model in columns (4)–(6) (standard errors clustered by firm and county are in parentheses). The regressions in columns (4)–(6) control for firm fixed effects, hence they only include ME firms with establishments in at least two counties. ** $p < .01$, *** $p < .001$. Dependent variable: columns (1)–(3): indicator for whether firm i owns at least one establishment in county c; columns (4)–(6): log number of employees of establishment(s) in county c. Independent variables: *Log distance to HQ*: log distance between county c and HQ county of firm i in km; *Log market potential*: log of average of GDP of county c and surrounding counties weighted by distance; *Relative wages/land prices*: average wages/land prices in county c relative to wages/land prices in HQ county of firm i. We compute average wages in a county excluding firm i. Distance, market potential, and relative land prices are computed using data of the German Federal Statistical Office. The number of firms is lower than the number of ME firms due to missing values for the legal form. FE = fixed effects.

Entry decisions of multimarket firms

- The proximity-concentration tradeoff is simple with one foreign market
- With many markets, this becomes a combinatorial problem in which establishments are substitutes (they cannibalize each others' sales)
- To which customers does the firm make sales, from which establishment locations, and in which quantities?
- With uniform population and innocuous competitive structure, optimal solution is tessellating hexagons (Christaller 1933)

Hsieh and Rossi-Hansberg (2023) assume no cannibalization: entry governed by simple productivity cutoff independent of other markets

Entry decisions of multimarket firms

In which markets does the firm set up establishments?

- Tintelnot (2017) on export platforms: firm produces a continuum of product and product-location-specific productivities are random ("EK inside the firm")
- Castro-Vincenzi (2024): trade-off between proximity and comparative advantage with uncertainty; diversify locations to hedge against shocks
- Oberfield, Rossi-Hansberg, Sarte, Trachter (2024): "study a tractable limit case of this problem in which these forces operate at a local level"
- Jia (2008): Wal-Mart vs Kmart make entry decisions in many markets; a strategy is a firm's action in every market (one big game). Solve by iterating on best responses using properties of supermodular games.
- Holmes (2011): infer density benefits from sales cannibalization Wal-Mart chooses to suffer (estimation by moment inequalities given combinatorial scope)

The hierarchical firm: Occupational layers

Caliendo, Monte, Rossi-Hansberg (2015) divide the employees of each firm into "layers" using occupational categories.

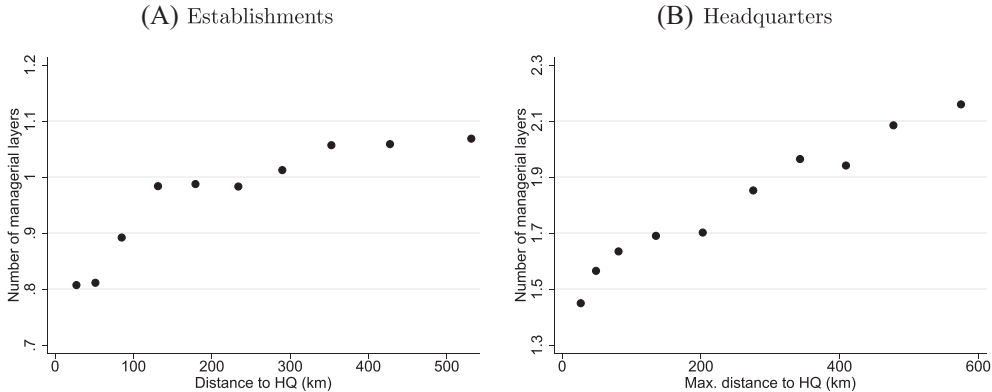
Layers are hierarchical in that (theoretically) "higher layers of management are smaller and include more knowledgeable employees who have as subordinates employees in lower layers" and (empirically) "the typical worker in a higher layer earns more, and the typical firm occupies less of them".

Level	Designation	Occupations
3	CEO	CEOs, managing directors
2	Middle managers	Senior experts, middle managers
1	Supervisors	Supervisors, engineers, technicians, professionals
0	Production workers	Clerks, operators, production workers

Gumpert, Steimer, Antoni (2021) "Local conditions affect not only the organization of the local establishment, but also the organization of the headquarters and other establishments of a multiestablishment firm"

Greater geographic reach brings more layers

Gumpert, Steimer, Antoni (2021) study 2000–2010 panel of German firms (≥ 10 full-time employees in all years)



HQ layers and establishment layers do not move in lockstep

TABLE VI

TRANSITION DYNAMICS OF THE MANAGERIAL ORGANIZATION

Panel A: No. managerial layers of firm

No. layers in $t/t+1$	0	1	2	3	SE	No. firms
0	**85**	8	1		6	10,778
1	5	**81**	8	1	6	18,274
2		7	**79**	8	5	18,754
3			6	**90**	4	22,391

Panel B: No. managerial layers at headquarters (HQ)/establishments (est.)

No. layers in $t/t+1$	0/0	1/0	1/1	2/<2	2/2	3/<3	3/3	SE	No. firms
HQ 0/ est. 0	**85**	5						6	10,778
HQ 1/ est. 0	6	**75**	4	6				8	8,340
HQ 1/ est. 1	1	5	**76**	7		1		4	8,052
HQ 2/ est. 0,1		4	4	**76**	2	6		7	12,046
HQ 2/ est. 2			1	10	**69**	9	1	2	3,410
HQ 3/ est. 0,1,2				5	2	**84**	3	5	13,365
HQ 3/ est. 3						9	**86**	1	4,625

Notes. 2000–2010 data. Panel A displays the percentage share of firms that transition from a number of managerial layers in year t (given in the rows) to a potentially different number of layers or to SE firm status in year $t+1$ (given in the columns). Panel B displays the percentage share of firms that transition from a managerial organization in year t (given in the rows) to a potentially different managerial organization or to SE firm status in year $t+1$ (given in the columns). The figure in front of the slash denotes the number of layers of the HQ. The figure behind the slash denotes the maximum number of layers of the establishments. Firms with a higher number of layers at the establishments than at the HQ are dropped for readability. Empty cells contain fewer than 0.5% of firms. Fewer than 0.5% of firms exit. The diagonal is in bold.

Gumpert, Steimer, Antoni (2021) summary

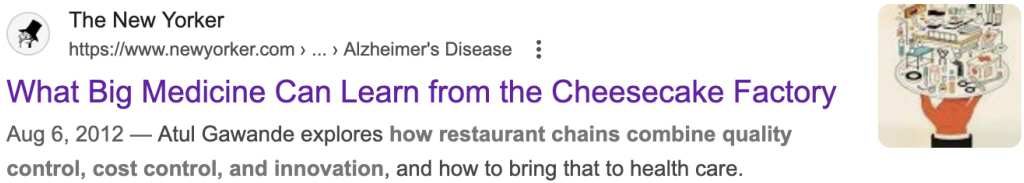
Model:

- Knowledge hierarchy a la Garicano (2000): lower layers solve easy problems and pass difficult tasks up the hierarchy
- Single CEO (at HQ location) with one unit of time at top of hierarchy
- Travel raises CEO's time cost of helping working at non-HQ establishments
- Geographic frictions motivate hiring middle managers to free up CEO time

Consequences of new high-speed railway routes in Germany:

- Establishments that benefit from lower travel times grow faster
- Layers do not respond (model: negative direct effect for middle managers vs positive indirect effect via size)
- Higher wages and more managerial layers at HQ
- Untreated establishments' wages and managerial share rise (model: reduced allocation of CEO time)

Hsieh and Rossi-Hansberg, "The Industrial Revolution in Services"



- Hsieh and Rossi-Hansberg: Services blueprints "allowed firms to replicate cheaply the same production process in multiple locations close to consumers." (See Gawande's *Checklist Manifesto*)
- "Four decades ago, about 85% of hospitals were single-establishment nonprofits. Today, more than 60% of hospitals are owned by for-profit chains or are part of a large network of hospitals owned by an academic institution."

Patterns in US Longitudinal Business Database, 1977–2013

1. Growth in the number of markets per firm has been large and heterogeneous across industries
2. Service industries with faster markets-per-firm growth grew faster
3. These industries had large increases in observable fixed-cost expenditures, such as total employment in R&D and headquarters establishments
4. The number of markets per firm is driven by the top firms in the industry.
5. Increase in national industry concentration is driven by the expansion in markets per firm by top firms
6. The new local markets where top firms enter tend to be smaller

where "markets" might be establishments, ZIP codes, counties, or MSAs

Large and heterogeneous growth in markets per firm

TABLE 1
Weighted Average and Standard Deviation of ΔLog Markets per Firm by Sector, 1977–2013

	Establishments	Zip Codes	Counties	MSAs
Construction	.016	.017	.015	.012
	(.034)	(.031)	(.028)	(.020)
Manufacturing	.019	.017	.012	.006
	(.141)	(.132)	(.115)	(.089)
Other	.180	.128	.081	.050
	(.229)	(.200)	(.150)	(.094)
Wholesale	.156	.139	.076	.030
	(.248)	(.239)	(.156)	(.084)
Retail	.216	.186	.096	.040
	(.237)	(.185)	(.126)	(.078)
Utilities and transportation	.172	.126	.101	.070
	(.234)	(.202)	(.180)	(.148)
Finger	.299	.211	.099	.044
	(.215)	(.170)	(.137)	(.109)

Note.—Table shows weighted average and standard deviation of Δlog establishments/firm, zip codes/firm, counties/firm, and MSAs/firm of the average firm in each 4-digit industry within each 1-digit sector, weighted by Sato-Vartia average of the employment share of each 4-digit industry in 1977 and 2013. "Other" includes 4-digit industries not included in the other 1-digit sectors.

"the change in markets per firm is our metric for the extent to which firms in an industry want to be close to their customers and, therefore, the extent to which they are affected by the industrial revolution in services"

Service industries with faster markets-per-firm growth grew faster

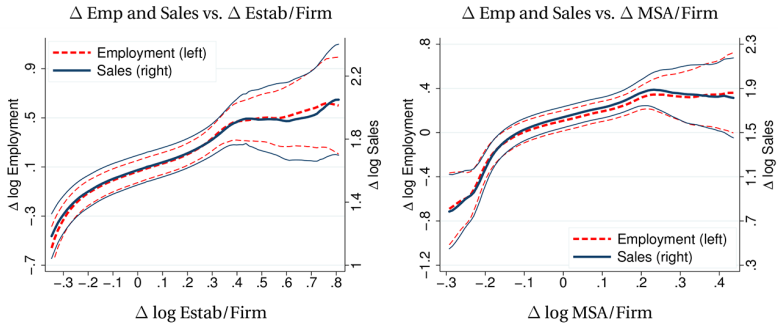


FIG. 3.—Unit of observation is a 4-digit industry ($N = 445$). Figure shows point estimates and 95% confidence intervals of a nonparametric regression of Δlog total employment or total sales of the industry on Δlog establishments/firm (*left*) and Δlog MSAs/firm (*right*) of average firm in the industry. Regressions with employment growth use change from 1977 to 2013 for all variables. Regressions with sales growth are from 1977 to 2012 for sales growth and from 1977 to 2013 for the change in markets/firm, except for utilities and transportation and finance, where sales are from 1987 to 2012 and from 1992 to 2012 and change in markets per firm is from 1987 to 2013 and from 1992 to 2013, respectively.

Industries with growing geographic scope add HQ services

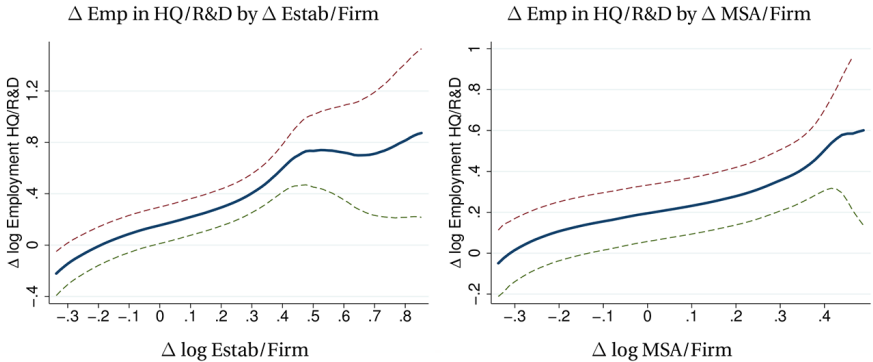


FIG. 4.—Unit of observation is a 4-digit industry ($N = 445$). Figure shows coefficients and 95% confidence intervals of a nonparametric regression of Δlog aggregate employment in HQ and R&D of establishments in an industry from 1977 to 2013 on Δlog establishments (*left*) or MSAs (*right*) per firm of the average firm in the industry from 1977 to 2013. See text for details on how we identify R&D and HQ establishments of firms in each industry.

Top firms drive geographic expansion, national concentration

TABLE 4
Regression of ΔLog Markets per Firm of Top Firms on ΔLog Markets per Firm of All Firms

	ΔLog Markets per Firm of Top Firms	
	Top 1%	Top 10%
ΔLog establishments/firm	2.309	2.060
	(.098)	(.046)
ΔLog MSAs/firm	4.343	3.331
	(.182)	(.060)

TABLE 5
Regression of ΔEmployment and Sales Concentration on ΔLog Markets per Firm

	Employment Concentration			Sales Concentration		
	Top 1%[a]	Top 10%[a]	HHI	Top 1%[b]	Top 10%[b]	HHI
ΔLog establishments/firm	.665	.326	.086	.358	.244	.053
	(.062)	(.023)	(.014)	(.072)	(.026)	(.022)
ΔLog MSAs/firm	1.317	.592	.104	.679	.477	.089
	(.161)	(.062)	(.036)	(.168)	(.062)	(.051)

TABLE 7
Change in Market Size of Top-10% Firms

	Top-10% Firms	
	By Employment (1)	By Establishments/Firm (2)
ΔMSA size of top firms/all firms	−.262	−.059
	(.065)	(.014)

Smith, Ocampo (2025): "The Evolution of US Retail Concentration"

- Construct sales by 18 product categories for individual retail stores using 1992–2012 Census of Retail Trade to measure concentration of local product markets
- General merchandisers account for more than 20% of sales in electronics and appliances, groceries, and clothing
- National and local HHI increased almost in parallel between 1992 and 2012
- Expansion of large retailers across markets accounting for 89% of the increase in national retail concentration between 1992 and 2012
- Online and other nonstore retailers have a small effect because they account for less than 10% of CRT sales
- Retail is the only sector with consistently increasing local concentration
- Consumers are simultaneously purchasing a wider variety of brands as they buy those products from a smaller set of retail firms (retail firms may gain market power with consumers and negotiating power with suppliers)

Back to the Cheesecake Factory

- Employment grew from 14,200 in 2003 to 38,100 in 2018
- Establishments grew from 61 to 214
- Employment per establishment fell from 233 to 178
- Employees per HQ establishment (NAICS 54 + 55) grew from 140 to 450
- "We interpret this large expansion in HQ employees as the firm's investment in fixed-cost-intensive technologies."

Spillovers with multimarket firms

Firm-wide product decisions imply cross-market spillovers

- "The cooks in the R&D facility then teach the new recipes to the kitchen managers of each restaurant at a biannual meeting in California."
- In Verhoogen (2008), Volkswagen produces different Beetles for the Mexican and US markets
- Consumer-packaged goods producers don't make distinct CPGs for each county
- Dingel (2017) shows that market access to high-income consumers elicits quality upgrading (plant-level economies of scale)
- Hyun and Kim (2025): A negative demand shock in one market causes quality downgrading for products offered elsewhere

Firms doing R&D at one site can share this across establishments; a best practice learned at one location can be disseminated to other establishments

- Bilir, Morales (2020): 20% of return to US R&D investment is realized abroad for median US multinational

Hyun, Kim (2025): "... The Uniform Product Replacement Channel"

"regional housing market disruptions spill over across US local markets through intrafirm spatial networks... identify spillovers by linking granular data on product-county-level prices and quantities with producer-level information and exploiting variation in firms' exposure to differential declines in local house prices"

Table 1: Extensive Margins: Markets, Products, Firms, and Plants

Variable	Obs	Mean	Std. Dev.	P10	P25	P50	P75	P90
	Panel A: Firm variables							
$N_{f,07}^{\text{counties}}$	4,171	513.243	669.991	10	35	155	808	1,655
$N_{f,07}^{\text{states}}$	4,171	24.278	18.682	2	6	21	47	49
$N_{f,07}^{\text{UPCs}}$	4,171	54.239	231.783	2	4	12	37	110
$N_{f,07}^{\text{groups}}$	4,171	2.701	3.421	1	1	2	3	6
$N_{f,07}^{\text{plants}}$	3,901	23.03	133.964	1	1	1	2	13
$S_{f,07}$	4,171	15.586	147.974	.005	.034	.278	2.13	14.677
	Panel B: UPC variables							
$N_{u,07}^{\text{counties}}$	226,230	225.577	415.986	1	5	34	203	789
$N_{u,07}^{\text{states}}$	226,230	15.791	16.953	1	2	7	27	47
	Panel C: County variables							
$N_{c,07}^{\text{firms}}$	991	848.316	353.868	341	616	876	1,110	1,306
$N_{c,07}^{\text{UPCs}}$	991	28,995.06	15382.66	7,994	17,404	28,730	40,399	49,854

Note. Panel A provides three separate extensive margins of firms in addition to the firm-level sales: a number of markets (counties and states), products (UPC and product groups), and plants (establishments). Panel B presents the number of counties and states each UPC serves, and Panel C shows how many firms and UPCs operate in each market. The subscript f denotes a firm, u denotes a UPC, and c denotes a county. N^{counties} is the number of counties, N^{states} is the number of states, N^{UPCs} is number of UPCs, N^{groups} is the number of product groups, N^{plants} is the number of plants (or establishments), N^{firms} is the number of firms, and S denotes sales, which is in millions of US dollars. The sample is restricted to those counties and firms used in the main regression analyses.

Regress county-firm 2007–2009 sales growth on housing price growth

Table 2: The Direct and Indirect Effects of the Housing Market Disruptions

	$\tilde{\Delta}S_{cf}$, 2007-2009							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Ordinary Least Squares				IV Estimation Using			
					elasticity	sensitivity	lending	all
$\tilde{\Delta}HP_c$	0.06**	0.06**						
	(0.03)	(0.03)						
$\tilde{\Delta}HP_{cf}$ (other)	0.35***		0.34***	0.40***	0.60***	0.72***	0.41**	0.44**
	(0.11)		(0.12)	(0.10)	(0.14)	(0.25)	(0.20)	(0.22)
County-Firm Controls	✓		✓	✓	✓	✓	✓	✓
County Controls		✓						
Firm FE		✓						
Sector FE	✓		✓					
County FE			✓					
County x Sector FE				✓	✓	✓	✓	✓
First-stage F statistics					541.20	231.20	540.50	254.70
Hansen's J-stat p-value								0.24
R^2	0.20	0.61	0.24	0.39				
$E[\tilde{\Delta}S_{cf}{:}\tilde{\Delta}HP_{p95}\text{-}\tilde{\Delta}HP_{p5}]$	.027	.028						
$E[\tilde{\Delta}S_{cf}{:}\tilde{\Delta}HP_{p95,other}\text{-}\tilde{\Delta}HP_{p5,other}]$	.030		.030	.035	.053	.064	.036	.039
Observations	840,681	840,681	840,681	840,681	448,604	587,436	658,607	417,869

Lower sales stem from net creation, not continuing products

"Firms replace higher-value products with lower-value products in response to the housing market disruptions, and such product replacements are synchronized across markets within each firm, including the markets with stable housing prices."

Table 3: County-Firm-Retail-level Regression Analyses

	(1) $\tilde{\Delta}S_{crf}$	(2) $\tilde{\Delta}S^{R}_{crf}$	(3) $\tilde{\Delta}S^{C}_{crf}$	(4) $\tilde{\Delta}S_{crf}$	(5) $\tilde{\Delta}S^{R}_{crf}$	(6) $\tilde{\Delta}S^{C}_{crf}$	(7) $\tilde{\Delta}S_{crf}$	(8) $\tilde{\Delta}S^{R}_{crf}$	(9) $\tilde{\Delta}S^{C}_{crf}$
$\tilde{\Delta}HP_{cf}$ (other)	0.45***	0.43***	0.02	0.44***	0.43***	0.01	0.41***	0.41***	0.01
	(0.11)	(0.08)	(0.04)	(0.11)	(0.08)	(0.04)	(0.11)	(0.08)	(0.05)
$\tilde{\Delta}HP_{cr}$ (other)	0.38***	0.07***	0.31***						
	(0.04)	(0.01)	(0.06)						
$\tilde{\Delta}HP_{crf}$ (other)							0.12	0.10	0.03
							(0.15)	(0.13)	(0.06)
County-Retail-Firm Controls	✓	✓	✓	✓	✓	✓	✓	✓	✓
County x Sector FE	✓	✓	✓	✓	✓	✓	✓	✓	✓
County x Retail FE				✓	✓	✓	✓	✓	✓
R^2	0.29	0.29	0.31	0.39	0.32	0.40	0.39	0.33	0.40
Observations	1,846,616	1,846,616	1,846,616	1,847,979	1,847,979	1,847,979	1,842,926	1,842,926	1,842,926

Note. The subscript c is a county, r is a retail chain, and f is a firm, defined as a producer. The sector is based on 4-digit SIC. $\tilde{\Delta}S_{crf}$ is county-retail-firm-specific sales growth, and $\tilde{\Delta}S^{R}_{crf}$ and $\tilde{\Delta}S^{C}_{crf}$ decompose $\tilde{\Delta}S_{crf}$ into net creation and continuing product sales growth. $\tilde{\Delta}HP_{cf}$ (other) is the indirect demand shock defined in Section 2, which is the initial

"Propagation and Amplification of Local Productivity Spillovers"

Giroud, Lenzu, Maingi, Mueller (2024):

- Study the same 47 plant openings as Greenstone, Hornbeck, Moretti (2010) (11 in '82–'85, 18 '86–'89, 18 '90–'93) (cf. Patrick 2016)
- Million-dollar plant ("MDP") openings raise productivity of local plants and distant plants that belong to multi-plant firms with a local establishment
- This "global" productivity spillover does not decay with distance and is stronger if plants are in industries that share knowledge with each other
- While productivity spillovers between plants of *different* firms are highly localized, they seem to propagate without much friction between different plants of the *same* firm

GLMM: Local productivity spillovers

County i, case c, plant k, industry s, year t

$$\text{TFP}_{ickst} = \xi_c + \xi_k + \xi_{st} + \beta_1 \text{Post}_{ct} + \beta_2(\text{Winner}_i \times \text{Post}_{ct}) + \varepsilon_{ickst},$$

LOCAL PRODUCTIVITY SPILLOVER.

	TFP		
	(1)	Unweighted (2)	Distance (3)
MDP	0.040	0.038	
	(0.016)	(0.014)	
MDP × (<50 miles)			0.043
			(0.015)
MDP × (50 to 100 miles)			0.027
			(0.014)
MDP × (100 to 250 miles)			0.011
			(0.010)
Plant FE	Yes	Yes	Yes
Industry × year FE	Yes	Yes	Yes
Case FE	Yes	Yes	Yes
R-squared	0.88	0.82	0.86
Observations	157,000	157,000	2,209,000

Note: The dependent variable is TFP at the plant level. MDP is an indicator for the winner county that is 1 from the year of the MDP opening onward. In column (3), (<50 miles), (50 to 100 miles), and (100 to 250 miles) are indicators for whether a plant lies within 50 miles, between 50 and 100 miles, and between 100 and 250 miles, respectively, of the MDP. Only the main coefficients of interest are shown. Except for column (2), observations are weighted by plant-level employment. Standard errors are double clustered at the county and year level. The sample period is from 1977 to 1998.

GLMM: Global productivity spillovers

"Winner$_i$ is now an indicator for whether the plant's parent firm has a plant in the winner county before and after the MDP opening, and a "case" includes all treated plants as well as all plants in the corresponding control group"

GLOBAL PRODUCTIVITY SPILLOVER.

	TFP		
	(1)	(2)	(3)
MDP	0.018	0.020	0.018
	(0.007)	(0.008)	(0.008)
Plant FE	Yes	Yes	Yes
Industry × year FE	Yes	-	-
Industry × county × year FE	-	Yes	Yes
Case FE	Yes	-	Yes
Control group	Plants of runner-up firms	Plants of MC firms in same county	Plants of runner-up firms in same county
R-squared	0.87	0.86	0.88
Observations	1,407,000	1,046,000	423,000

Note: The dependent variable is TFP at the plant level. MDP is an indicator for whether the plant's parent firm has a plant in the winner county before and after the MDP opening. The indicator is 1 from the year of the MDP opening onward. In column (1), the control group consists of all plants of runner-up firms. In column (2), the control group consists of all plants of MC firms in the same county as the treated plant. In column (3), the control group consists of all plants of runner-up firms in the same county as the treated plant. In all three columns, the sample is restricted to MC plants outside the winner and runner-up counties. Only the main coefficients of interest are shown. Observations are weighted by plant-level employment. Standard errors are double clustered at the county and year level. The sample period is from 1977 to 1998.

GLMM: No wage increases in distant counties

EMPLOYMENT AND WAGES.

	Local Spillover		Global Spillover	
	Employment (1)	Wages (2)	Employment (3)	Wages (4)
MDP	0.035	0.037	0.016	0.002
	(0.013)	(0.016)	(0.007)	(0.004)
Plant FE	Yes	Yes	Yes	Yes
Industry × year FE	Yes	Yes	-	-
Industry × county × year FE	-	-	Yes	Yes
Case FE	Yes	Yes	Yes	Yes
R-squared	0.97	0.80	0.98	0.58
Observations	157,000	157,000	423,000	423,000

Note: This table presents variants of the regressions in column (1) of Table II (columns (1) and (2)) and column (3) of Table III (columns (3) and (4)) in which the dependent variable is either employment (columns (1) and (3)) or wages (columns (2) and (4)) at the plant level. Only the main coefficients of interest are shown. Observations are weighted by plant-level employment. Standard errors are double clustered at the county and year level. The sample period is from 1977 to 1998.

GLMM: Global productivity spillovers are distance-invariant

DISTANCE TO THE MDP.

	TFP				
	Excluding Plants Within 100 Miles of the MDP (1)	Excluding Plants Within 250 of the MDP (2)	Excluding Plants Within 500 Miles of the MDP (3)	Excluding Plants in MDP State (4)	Excluding Plants in MDP Census Division (5)
MDP	0.018	0.017	0.018	0.018	0.018
	(0.007)	(0.007)	(0.008)	(0.008)	(0.008)
Plant FE	Yes	Yes	Yes	Yes	Yes
Industry × county × year FE	Yes	Yes	Yes	Yes	Yes
Case FE	Yes	Yes	Yes	Yes	Yes
R-squared	0.88	0.88	0.89	0.88	0.88
Observations	402,000	365,000	286,000	395,000	345,000

Note: This table presents variants of the regression in column (3) of Table III in which treated plants in close proximity to the MDP are excluded from the sample. Only the main coefficients of interest are shown. Observations are weighted by plant-level employment. Standard errors are double clustered at the county and year level. The sample period is from 1977 to 1998.

GLMM: Larger effects for industries sharing knowledge

KNOWLEDGE FLOWS.

	TFP		
	Same Industry (1)	Mutual R&D Flows (2)	Mutual Patent Citations (3)
MDP	0.017	0.015	0.013
	(0.008)	(0.008)	(0.007)
MDP × knowledge flows	0.012	0.533	0.356
	(0.005)	(0.263)	(0.175)
Plant FE	Yes	Yes	Yes
Industry × county × year FE	Yes	Yes	Yes
Case FE	Yes	Yes	Yes
R-squared	0.88	0.88	0.88
Observations	423,000	423,000	423,000

Note: This table presents variants of the regression in column (3) of Table III. In column (1), both terms in equation (1) are interacted with a dummy variable indicating whether the treated plant is in the same 4-digit SIC code industry as the MDP. In columns (2) and (3), both terms in equation (1) are interacted with measures of mutual R&D flows and patent citations, respectively, between the industry of the treated plant and the industry of the MDP. The measures are the unidirectional measures $\text{Tech}_{ij} \equiv \max\{\text{TechIn}_{i \leftarrow j}, \text{TechOut}_{i \rightarrow j}\}$ and $\text{Patent}_{ij} \equiv \max\{\text{PatentIn}_{i \leftarrow j}, \text{PatentOut}_{i \rightarrow j}\}$ from Ellison, Glaeser, and Kerr (2010). Only the main coefficients of interest are shown. Observations are weighted by plant-level employment. Standard errors are double clustered at the county and year level. The sample period is from 1977 to 1998.

"While labor market pooling and knowledge externalities may both contribute to the local productivity spillover, it is unlikely that a larger labor market in the winner county would affect the productivity of distant plants hundreds of miles away."

GLMM: Model

- Model features within-region, across-plant heterogeneity
- Plant-level productivity depends on local knowledge and knowledge in other regions in which the parent firm operates
- Within a region and sector, plants' productivities aggregate into a single productivity index
- Across regions and sectors, model nests an economic-geography version of Caliendo and Parro (2015)
- Estimate model parameters by matching diff-in-diffs coefficients for plant-level micro moments
- Counterfactual scenario: "the aggregate gains are greatest if the plant opens in a well-developed region, consistent with the observed location choices of the MDPs in the data"

Summary

Multinational and multi-region firms appear very important, and there's lots of exciting research on this topic recently

Next week: Research consultations