Do Agglomeration Externalities Form Service Clusters? Evidence from a Location Lottery

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Do agglomeration externalities form clusters?

- Many cities have clusters of shops selling similar products.
- Why do they locate nearby even if competition intensifies?
  - Theories: positive spillovers via agglomeration externalities (Marshall, 1920)
    - ⋆ Demand: Clusters attract more customers
    - ⋆ Supply: Knowledge spillovers across shops
  - Empirical evidence suggesting presence of externalities (e.g. Shoag & Veuger, 2018; Benmelech et al. 2019; Nakajima & Teshima, 2020).
- Do agglomeration externalities across firms lead to cluster formation? How?

Do agglomeration externalities form clusters?

- Empirical/nontrivial question: Even in the presence of agglomeration externalities, several countervailing forces may prevent formation of clusters.
  - Agglomeration externalities **(+)**
  - Local competition **(–)**
  - Product switching costs **(–)**
  - Land lot/building ownership transaction costs **(–)**
- Policy relevance: whether proactive urban planning and zoning policies are needed for promoting efficient service agglomeration.
- Empirical challenge: observational data confounded by local amenities, infrastructure, supplier and consumer locations.

This study

- Setting: We focus on a large market building in Hanoi
  - Building hosts 1000+ apparel/fabric wholesale stores.
  - There was a fire in 1994, and the building was reconstructed and reopened (with a new layout) in 1997.
  - Store slots in the new building were allocated by a lottery to the store owners of the previous building.
  - Today, we observe many product clusters within the market.
- Data: We conducted a survey of shop owners
  - Current and past products, slot ownership, lottery participation, etc.

Preview of results

- While the initial slot allocation appears to be random, the clusters were formed soon and accumulated.
- Initial coincidental clusters $\Rightarrow$ neighborhood shops selling the same products
  - Agglomeration externalities across stores $\rightarrow$ clusters ✓
- Mechanism of product changes
  - Product switching within same store owners ✓
  - Ownership changes ✓
- Mechanism of agglomeration externality
  - Supply-side (knowledge) spillover appears to be small
  - Demand-side agglomeration (e.g. shopping externality) is a likely explanation

Literature

1. Evidence of agglomeration externalities (in service sector): Arzaghi and Henderson (2008); Combes et al (2012); Shoag and Veuger (2018); Benmelech et al (2019); Bernstein et al. (2019); Koster et al. (2019); Nakajima and Teshima (2020); Atkin etal. (2022); Oh and Seo (2023); Baum-Snow et al (2024); Miyauchi et al. (2025)
2. Empirical studies on cluster formation (firm location): Leonardi and Moretti (2023); Vitali (2024).

- Our contribution: Exogenous lottery-based initial allocation; causal evidence that store externalities form clusters.

Outline

1. Background
2. Data
3. Empirical specification & main results
4. Mechanisms

Setting: Dong Xuan Market in Hanoi

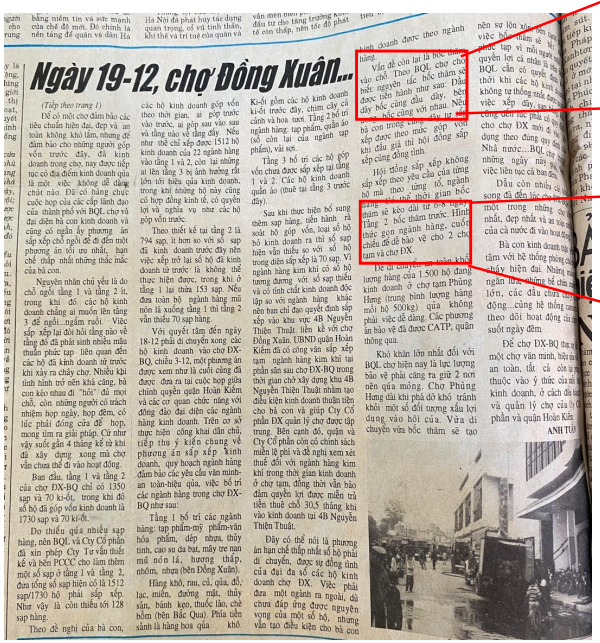
- One of the biggest wholesale markets in Hanoi (1 floor$\sim$9,000 m^2).
- 3-floors building hosting 1000+ apparel and fabric wholesale shops.
- Buyers
  - Apparel: Retail shop owners in/nearby Hanoi.
  - Fabric: Manufactures in/nearby Hanoi.

Institutional contexts

- We focus on shops in one marketplace
  - Influence of locations of other firms in the supply chain is naturally controlled.
  - There is no official area map, and search cost is high.
- Dong Xuan Corp. in charge of management of the market.
  - Collects monthly fees
  - Cleaning
  - Implements general rules/regulations
- "Ownership" (or usage right) of a slot is transferable.
  - Slot owners can transfer the "ownership" of the slot to another person and receive a transfer payment.
  - Corp does not coordinate or help finding new slot owners.

Slot assignments by lottery: History

- 1890: Market opened.
- 1994: Fire.
- 1995: Reconstruction. Shops operated in another market.
- 1996 December: Lottery to allocate slots to pre-fire shop owners.
- 1997 January: Business started in the new building.



Ngày 19-12, chợ Đồng Xuân...

Vấn đề còn lại là bốc thăm vào chỗ. Theo BQL chợ cho biết: nguyên tắc bốc thăm sẽ được tiến hành như sau: Đầu dãy bốc cùng đầu dãy, bên trong bốc cùng với nhau. Nếu

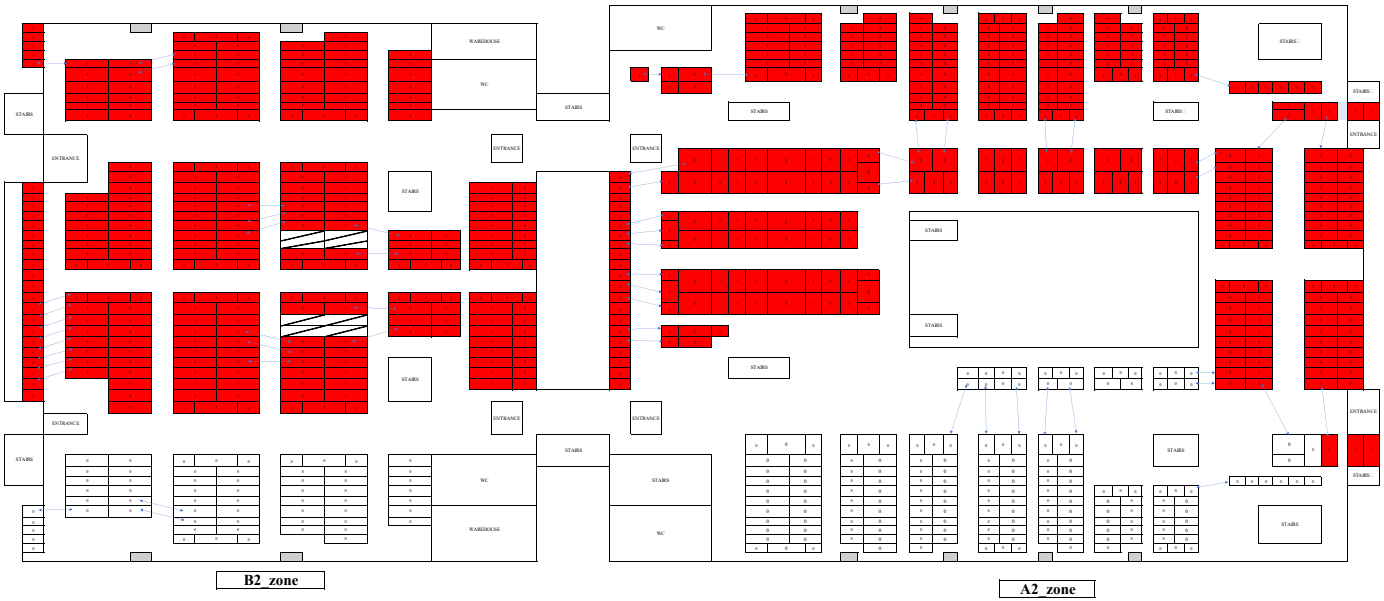
Tầng 2 bốc thăm trước. Hình thức gọn ngành hàng, cuốn chiếu để dễ bảo vệ cho 2 chợ tạm và chợ ĐX.

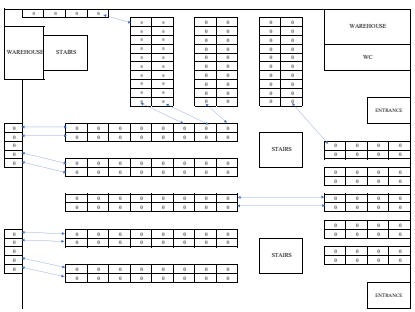
"Lottery by apparel/fabric. Lottery on second floor first, and then third floor. Lottery was separated by corner slots and non-corner slots."

Source: Hà Nội Mới, No. 10010, 1996.

Lottery segmented by Apparel/Fabric zones

Assigned based on products sold in 1994.





As of 1997–2011

- Red: fabric zone
- White: apparel zone

By the Market Corp. regulation, slot owners were not allowed to change between apparel/fabric until 2012.

After 2012

Slot owners were allowed to change apparel/fabric.

Today, we see many product clusters (1)

Figure: Men's pants (3F)

Today, we see many product clusters (2)

Figure: Women's roomwear (2F)

Today, we see many product clusters (3)

Figure: Fabric for suits (2F)

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Surveys (2023 Sept-Oct)

- **Shop-owner survey** (response rate 73.8%).
  - In-person interviews of shop owners
  - Slot ownership, lottery participation, current/past products (**1994**, 1997-), business performance, etc.
- Photos of products as of 2023 (all slots)
- Neighborhood survey (non-missing slots = 91%)
  - In slots where owners have changed: difficult to know products in 1997 and 2010 from store owners
  - Ask about products sold in 1997 and 2010 from the neighboring shop owners

Product type codes (61 products)

A1: 0-18 months | baby
A2: 1.5-5 years | girl
A3: 1.5-5 years | boy
A4: 6-14 years | girl
A5: 6-14 years | boy

B1.1: T-shirt for young ladies
B1.2: Blouse/Shirts for young ladies
B1.3: Sweaters for young ladies
B1.4: Other tops for young ladies
B1.5: Pants for young ladies (other than suits)
B1.6: Jeans for young ladies
B1.7: Other pants for young ladies
B1.8: Skirts for young ladies (other than suits)
B1.9: Dress/One-piece for young ladies
B1.10: Jacket/coat for young ladies
B1.11: Roomwear for young ladies

B2.1: T-shirt for middle-aged ladies
B2.2: Blouse/Shirts for middle-aged ladies
B2.3: Sweaters for middle-aged ladies
B2.4: Other tops for middle-aged ladies
B2.5: Pants for middle-aged ladies
B2.6: Jeans for middle-aged ladies
B2.7: Other pants for middle-aged ladies
B2.8: Skirts for middle-aged ladies
B2.9: Dress/One-piece/Roomwear for middle-aged ladies
B2.10: Jacket/coat for young ladies

B3: Underwear for women
B4: Ao Dai for women
B5: Formal suits for women
B6: Sunscreen coat for women
B7: Sports clothes for women
B8: Mitten/scarf for women

D1: T-shirt for men
D2: Shirts for men
D3: Sweaters for men
D4: Other tops for men
D5: Pants for men (other than suits)
D6: Jeans for men
D7: Shorts for men
D8: Other pants for men
D9: Underwear for men
D10: Jacket/coat for men
D11. Formal suits for men
D12: Sports clothes for men
D13: Mitten/scarf for men

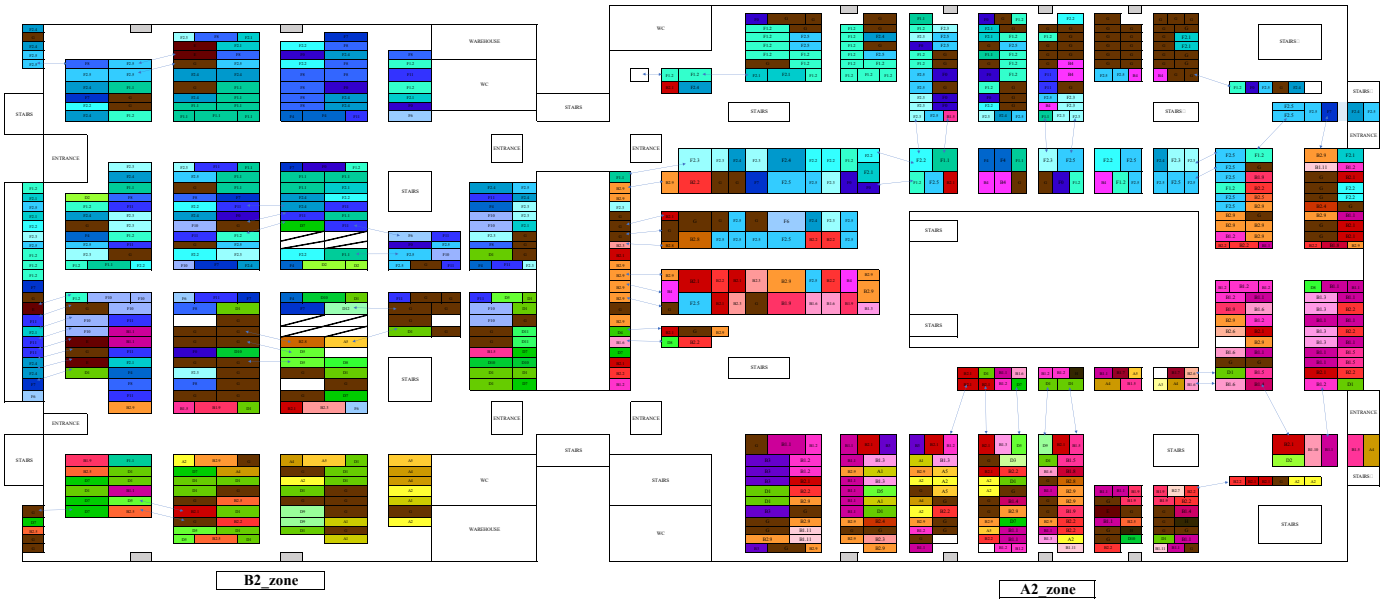
F1.1: Fabrics for men's shirts
F1.2: Fabrics for men's pants/suit (other than jeans)

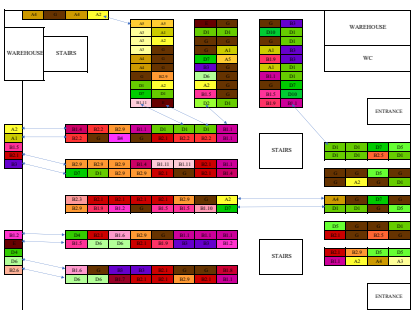
F2.1: Fabrics for women's blouse/shirts
F2.2: Fabrics for women's pants/suit (other than jeans)
F2.3: Fabrics for women's dress
F2.4: Fabrics for women's roomwear
F2.5: Fabrics for Ao Dai and traditional formal wear

F3: Fabrics for jeans
F4: Fabrics for students' uniform
F5: Fabrics for soldiers' uniform
F6: Fabrics for curtain
F7: Fabrics for bedding
F8: Lining fabrics

F10: Fabrics for worker cloth (excluding office cloth)
F11: Fabrics for others

Map of main products in 2023





- Fabric for women's: Blue
- Fabric for men's: Light blue
- Kids: Yellow
- Young women's: Pink
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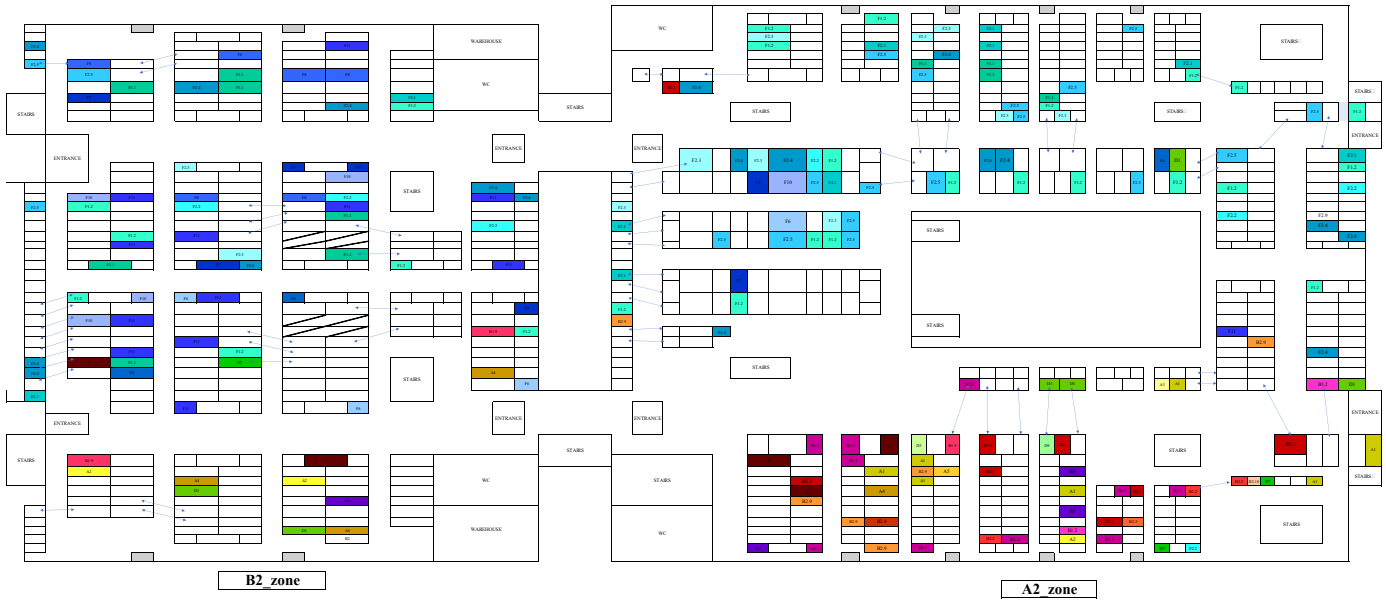
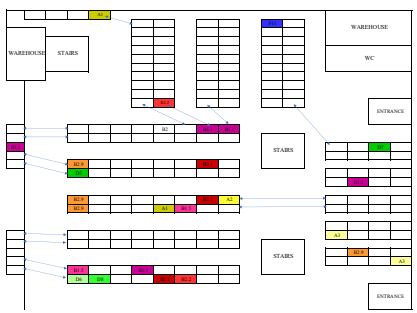
- Men's: Green
- Warehouse/closed: Brown

1997 2010 2023 winter Remark

Lottery assignment

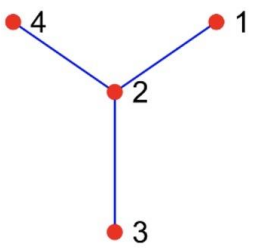




- Based on 1994 product information.
- Data on 266/1046 slots.
- We address the issue of selection biases.

2023 (nonmiss in 1994 only)

Measuring distance between a pair of slots



Adjacency list

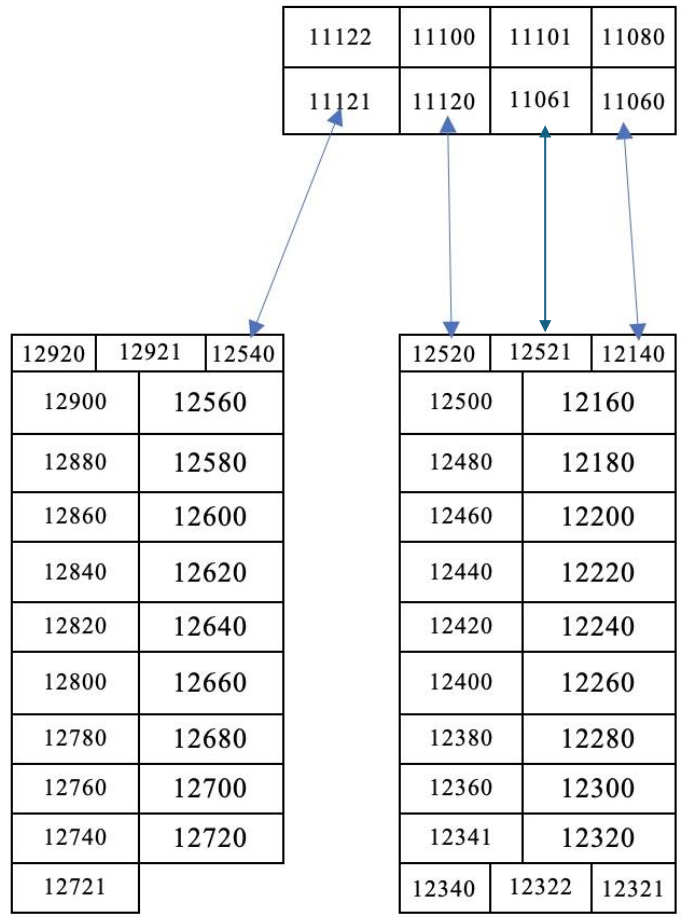
Vertex	Neighbor(s)
1	2
2	1 3 4
3	2
4	2

Adjacency matrix

$$\begin{bmatrix} 0 & 1 & 0 & 0 \\ 1 & 0 & 1 & 1 \\ 0 & 1 & 0 & 0 \\ 0 & 1 & 0 & 0 \end{bmatrix}$$

Distance matrix

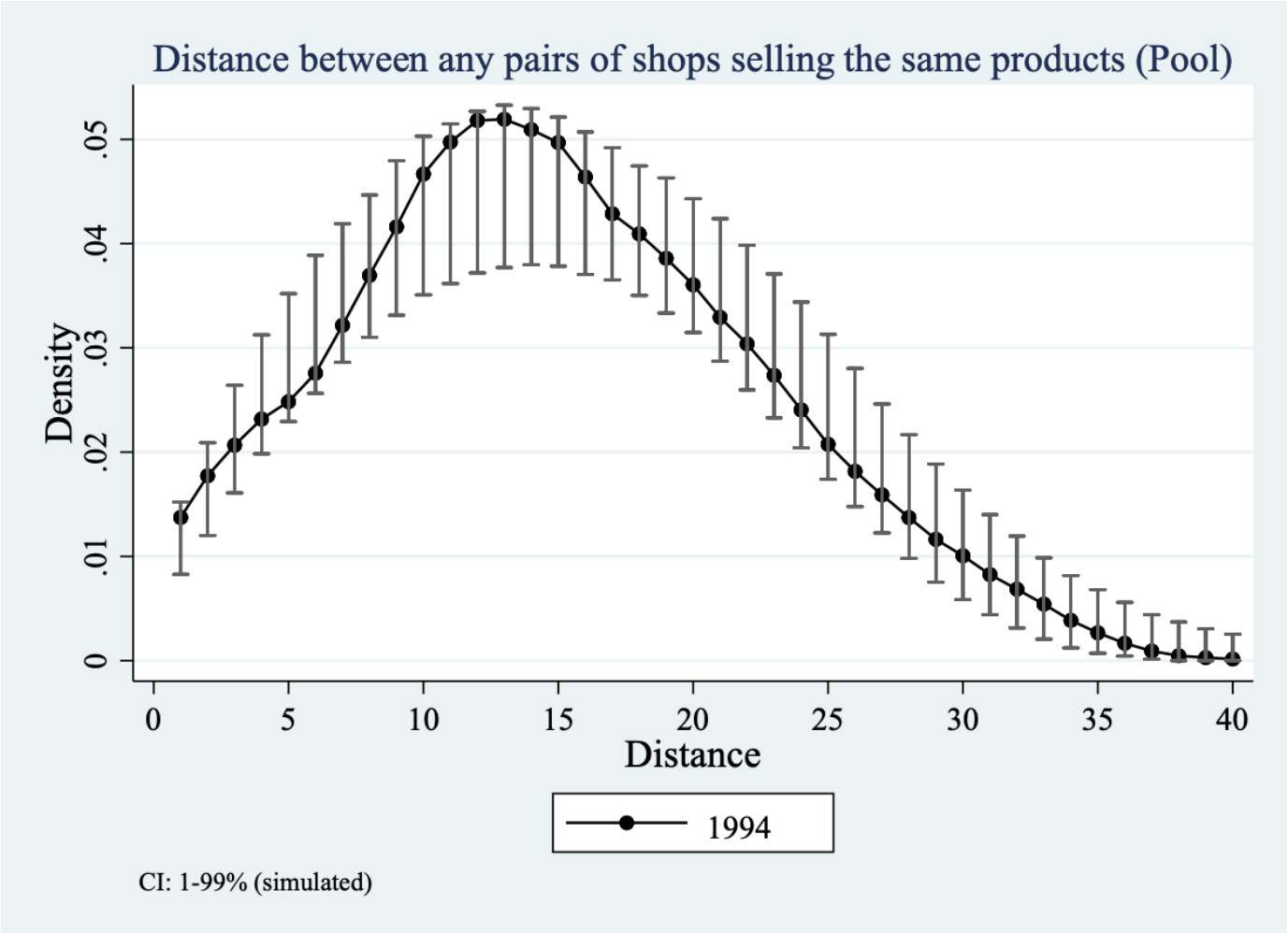
$$\begin{bmatrix} 0 & 1 & 2 & 2 \\ 1 & 0 & 1 & 1 \\ 2 & 1 & 0 & 2 \\ 2 & 1 & 2 & 0 \end{bmatrix}$$



Initial distance b/w slots selling same product

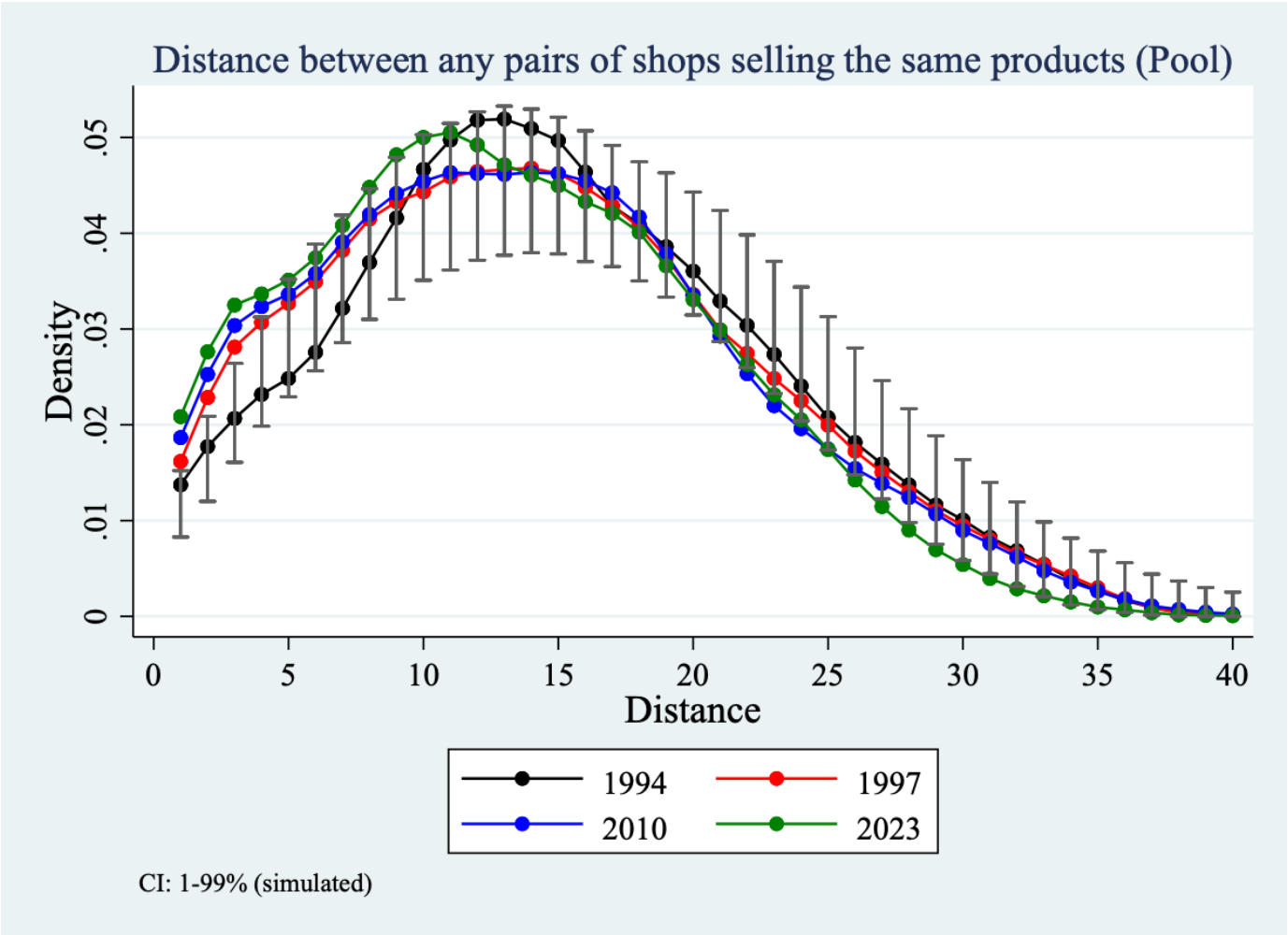
CI obtained by simulating the lottery for 1000 times

Simulation procedure | No exclusion



Distance b/w slots selling same product

CI obtained by simulating the lottery for 1000 times. No restriction



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Empirical specification

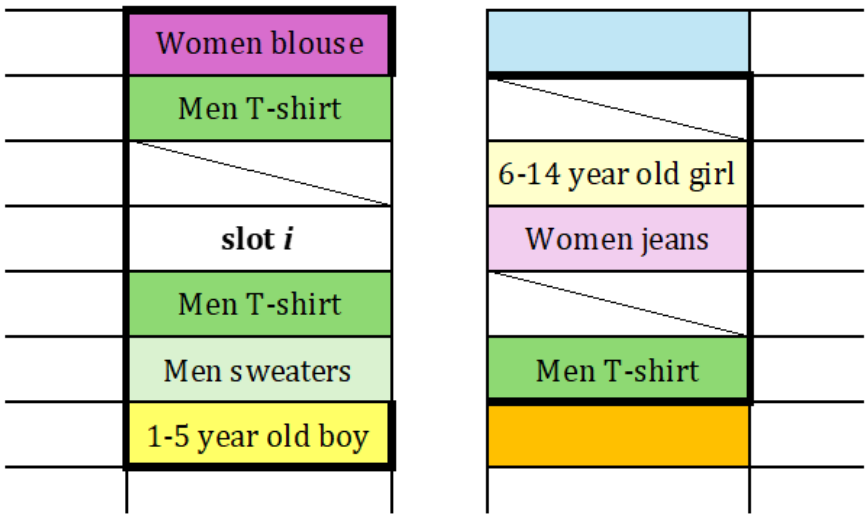
We examine the effect of "initial products" of the neighbors on cluster formation.

Pooling slots (i) and products (k); fixing year (t):

$$\text{Prod}_{i,k}^{t} = \beta^{t}\text{ProdNeig}_{i,k}^{1994} + \text{StrataProdFE}_{i,k} + \alpha_i + \varepsilon_{i,k}^{t}$$

- $\text{Prod}_{i,k}^{t} = 1$ if slot i sells product k in year t; 0 otherwise.
- $\text{ProdNeig}_{i,k}^{1994}$: share of i's neighbors who sold k pre-lottery.
  - Defining neighbors by a m-step neighbor (m=2,...9)
- $\text{StrataProdFE}_{i,k}$: lottery segment FE $\times$ product FE.
- α_i: slot FE
- SEs clustered at slot level in baseline (results are robust when spatial cluster is used).

Illustration of $ProdNeig_{i,k}^{1994}$ construction



Share of 3-step neighbors

- selling Men T-shirt = 3/8
- selling Men sweaters = 1/8
- selling Women jeans = 1/8
- selling Women blouse = 1/8
- selling 1-5 year old boy = 1/8
- selling 6-14 year old girl = 1/8

Effect of initial coincidental agglomeration

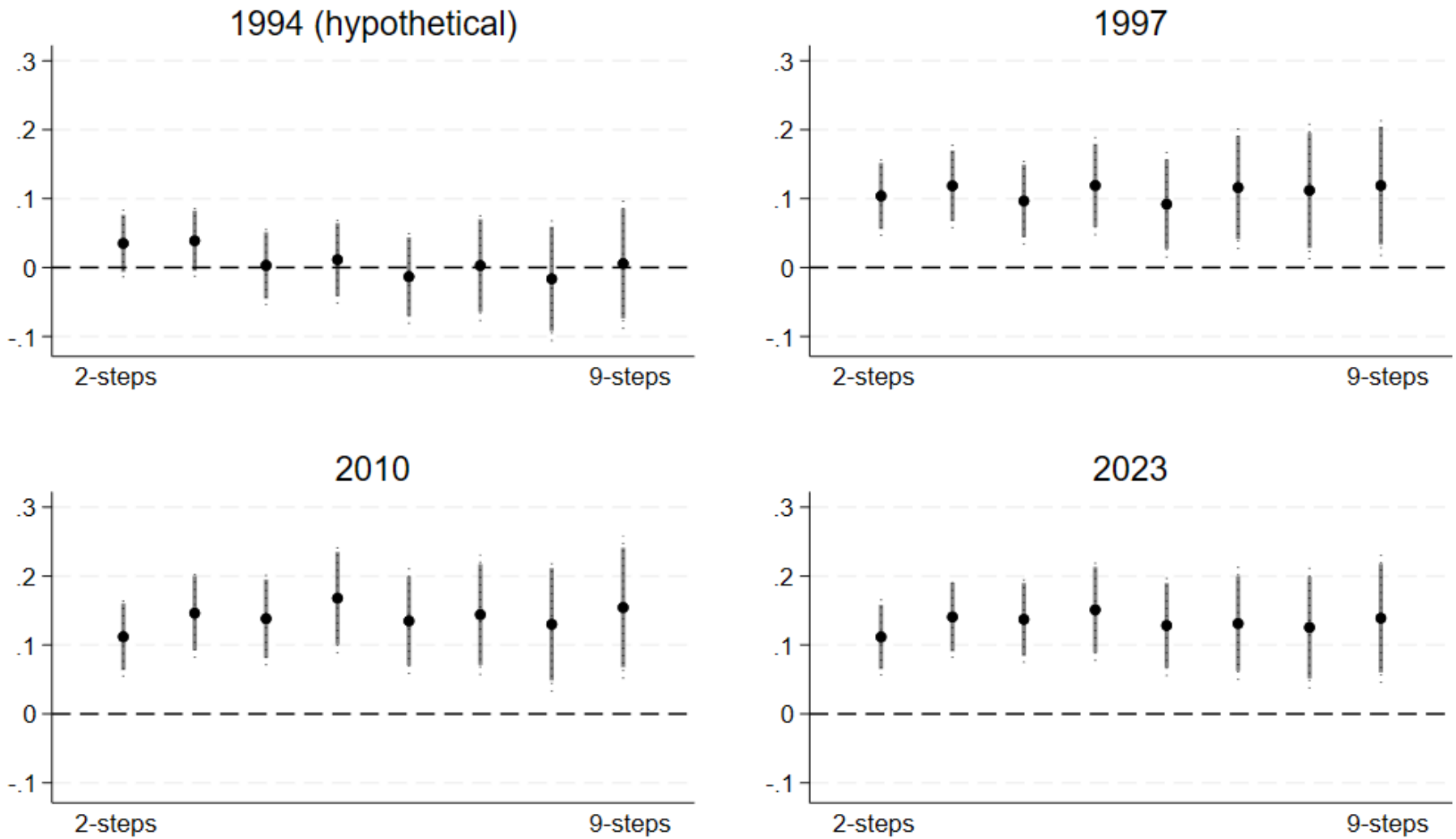
3-step neighbors

	(1) 1994 product	(2) 1997 product	(3) 2010 product	(4) 2023 product
Panel A: Using sample of slots with non-missing 1994 info				
Share of neighbors selling k in 1994	0.038	0.119***	0.147***	0.141***
	(0.026)	(0.031)	(0.033)	(0.030)
Observations	11592	11546	11546	11592
Panel B: Using sample of all available slots with info in each year				
Share of neighbors selling k in 1994		0.100***	0.118***	0.099***
		(0.016)	(0.015)	(0.013)
Observations		37996	41722	42596

Sum-stats balanced | Sum-stats expanded | Winter product | Spatial cluster

Effect of initial coincidental agglomeration

Balanced-panel sample.



NonMissNeig x Prod(large cat) FE | Excl eroded area | Ring plot

Checks on possible sample selection biases

- What basic slot features predict non-missing? Result
  - Average distance to other slots, fabric-area slots - No
  - Corner slots, 2nd floor slots - Yes.
    - ⋆ We control for corner-slot FE $\times$ floor FE $\times$ product FE in empirical specification (as part of control for lottery segment).

- Observing coincidental agglomeration of k sellers in neighbor does not predict higher chance of observing product k seller (as of 1994 product).
  - If coincidental agglomeration of product k sellers in neighbor helps survival of product k sellers, we should observe correlation.

- Observing coincidental agglomeration of a product (vs. mixture of various products) in neighbor does not predict more/less missing. Result

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Product switching vs. ownership changes

Total effect (to be decomposed)

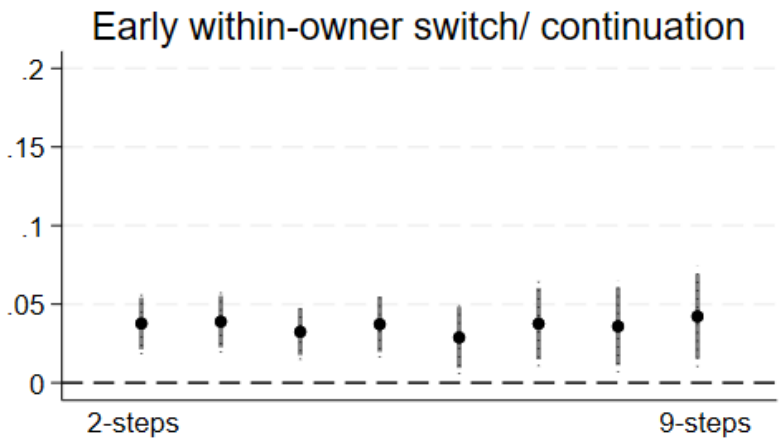
$$\text{Total}_{i,k} = \beta \text{ProdNeig}_{i,k}^{1994} + \textit{Controls}_{i,k} + \varepsilon_{i,k}$$

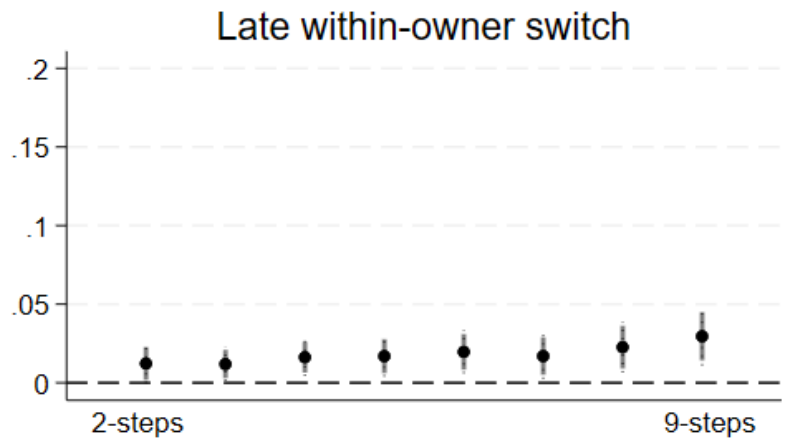
where $\text{Total}_{i,k} = 1$ if product k is sold at slot i in **any year** between 1997–2023; 0 otherwise. Include slots missing 1994 product info.

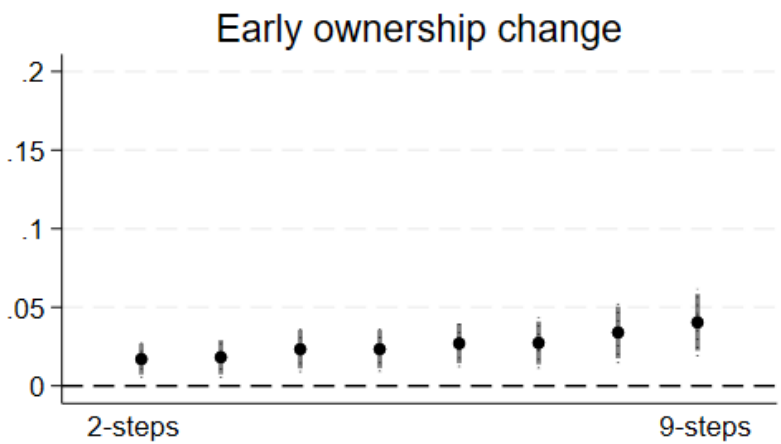
Decompose $\text{Total}_{i,k}$ into mutually exclusive 4 cases:

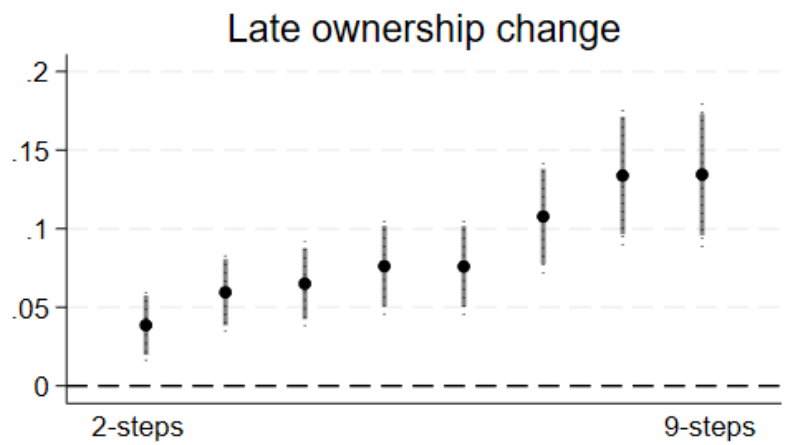
1. (Early within-owner switch/continuation) Product k is sold at slot i in 1997 by the lottery-assigned owner
2. (Late within-owner switch) Product k is newly introduced at slot i in 1998-2023 by the lottery-assigned owner
3. (Early ownership change) Product k is sold at slot i in 1997 by a new owner
4. (Late ownership change) Product k is sold at slot i in 1998-2023 by a new owner

Product switching vs. ownership changes









Adjacent owner Within-slot changes

Mechanism of agglomeration externalities

Positive agglomeration externalities can exist broadly in two channels

- Demand-side: clusters attract more customers
  - Lower price (Dudey 1990)
  - Product variety (Wolinsky 1983; Fischer and Harrington, 1996; Konishi 2005; Takahashi, 2013; Nakajima & Teshima, 2019)
  - Chain shopping (Miyauchi et al. 2025; Oh & Seo 2023)
- Supply-side: knowledge spillovers across firms in clusters (Arzaghi and Henderson, 2008; Atkin et al. 2022; Chaurey et al. 2025)
  - Learning which products have higher demand
  - Learning about input sources

Idea for empirical strategy

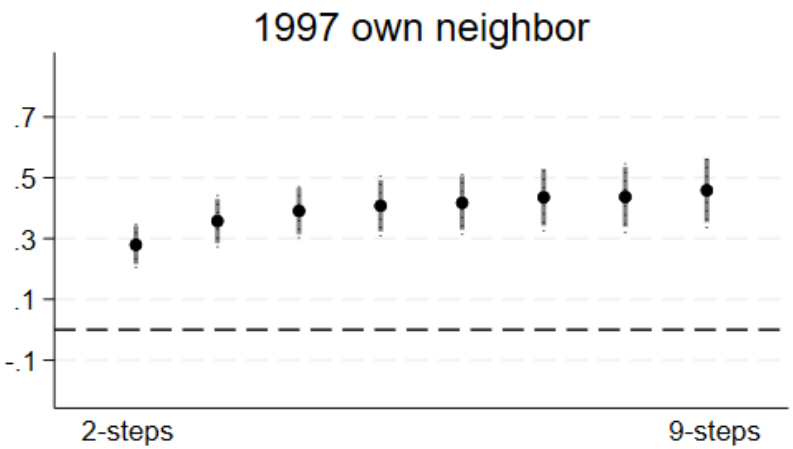
- Some owners own multiple slots, say, slots A and B.
- If supply-side spillover exists, products of slot A's neighbors should affect products sold at B (as well as those sold at A).

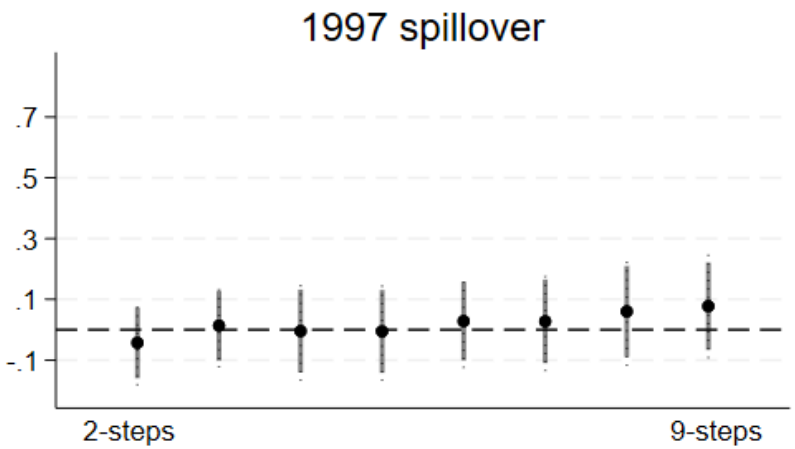
Examine spillover across slots within owners

$$\text{Prod}^t_{i,j,k} = \beta_1 \text{ProdNeig}^t_{i,j,k} + \beta_2 \text{ProdNeig}^t_{-i,j,k} + \textit{Control}_{i,j,k} + \varepsilon_{i,j,k}$$

We observe only few multiple-slots owners with 1994 info, but we observe more of such owners in later years. Summary stats

$\rightarrow$ Use 1997 product & ownership of neighbors (correlational evidence but biases are likely to be positive)





Conclusion

- Causal evidence: service clusters emerge from store-to-store externalities.
  - Initial coincidental clusters $\Rightarrow$ neighborhood shops selling the same products
- Mechanisms:
  - Product switching + slot transfers, both at play.
  - Demand-side agglomeration force.
- Policy implications
  - Agglomeration force is strong enough to self-form service clusters.
  - Strict zoning policies could be detrimental.
- Next steps
  - Buyer survey (to explore demand-side mechanisms)
  - Tracking survey of past owners (to add more 1994 product data)

Outline

5 Appendix

Lottery segmented by 3 slot positions

- Best corner = corner slots facing the main corridor
- Second best corner = corner slots not facing main corridor

Assigned based on slot position in 1994.

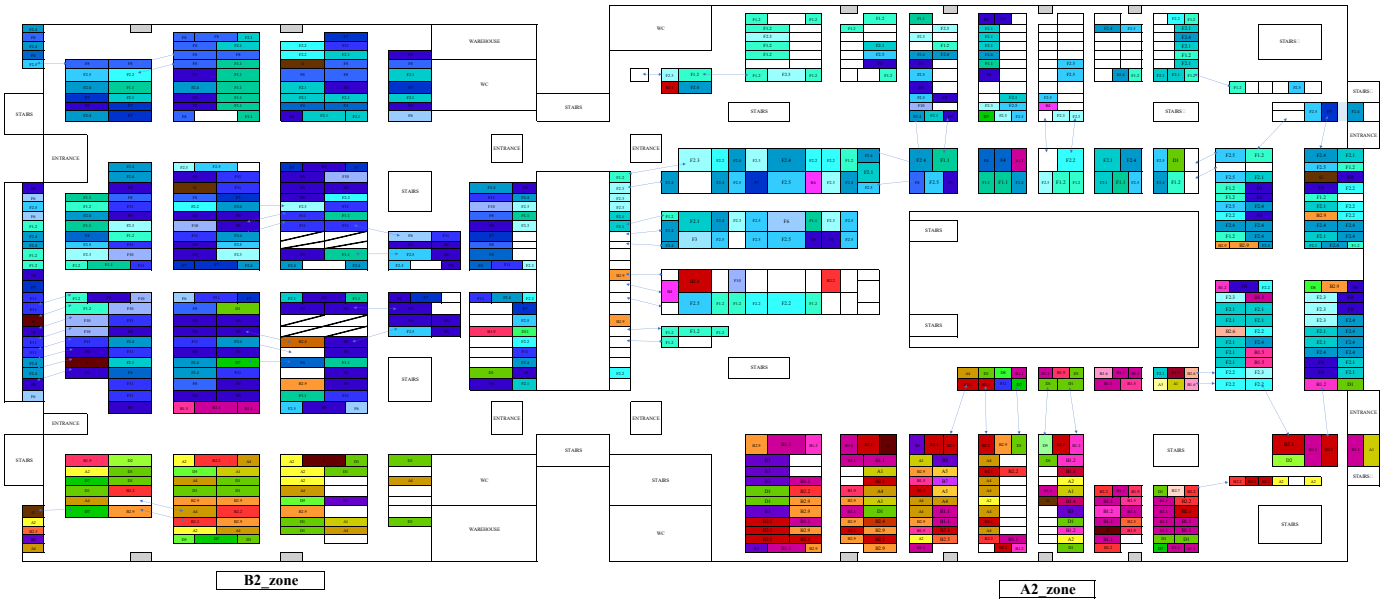
- Best Corner slots: Green
- Second-best corner slots: Yellow

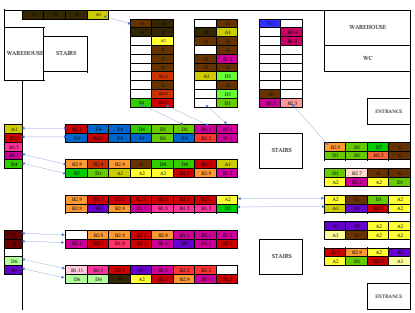
Remarks

- For illustration, we colored the map by the main product type.
- In reality, shops have multiple product types.
- Mean # of product type
  - 1.60 in 1994
  - 1.53 in 1997
  - 1.52 in 2010
  - 1.53 in 2023
- We run slot (i) $\times$ product type (k) -level regression.

Back

Map of main products in 1997

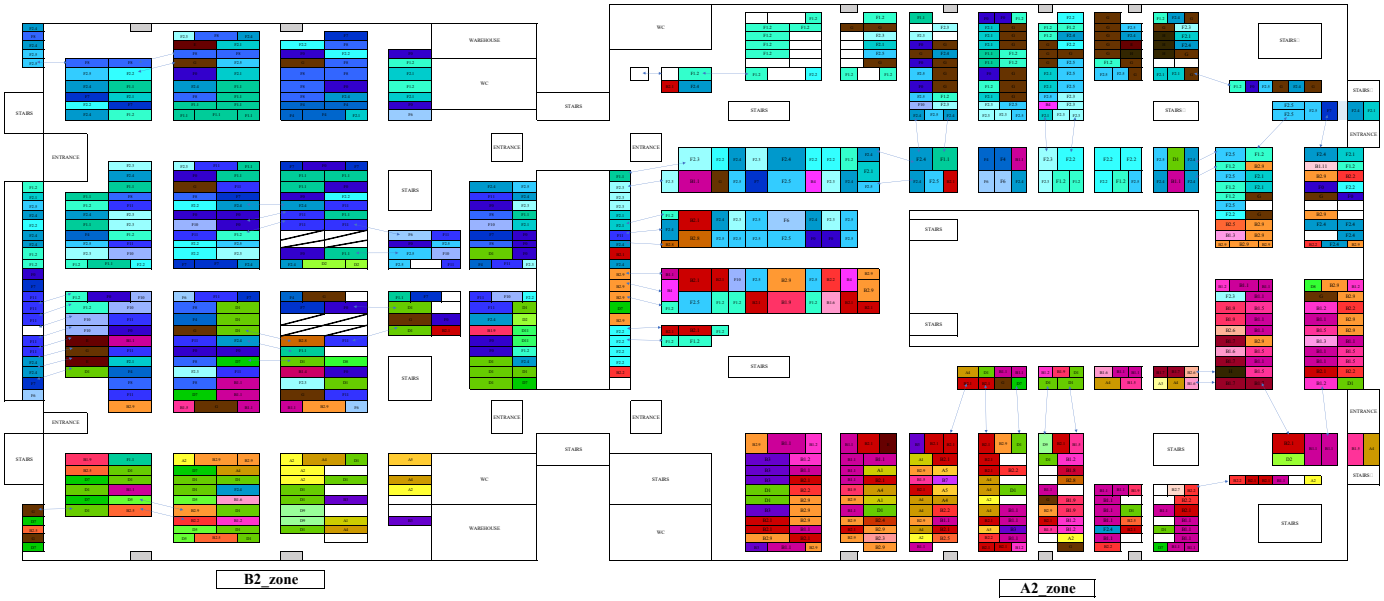


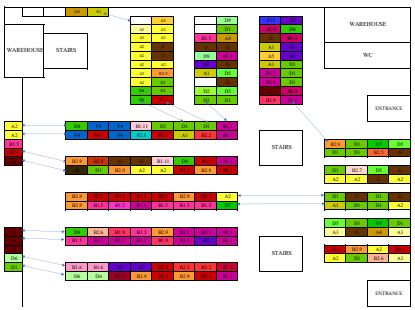


- Fabric for women's: Blue
- Fabric for men's: Light blue
- Kids: Yellow
- Young women's: Pink
- Mid-aged women's: Orange
- Men's: Green
- Warehouse/closed: Brown

Back

Map of main products in 2010





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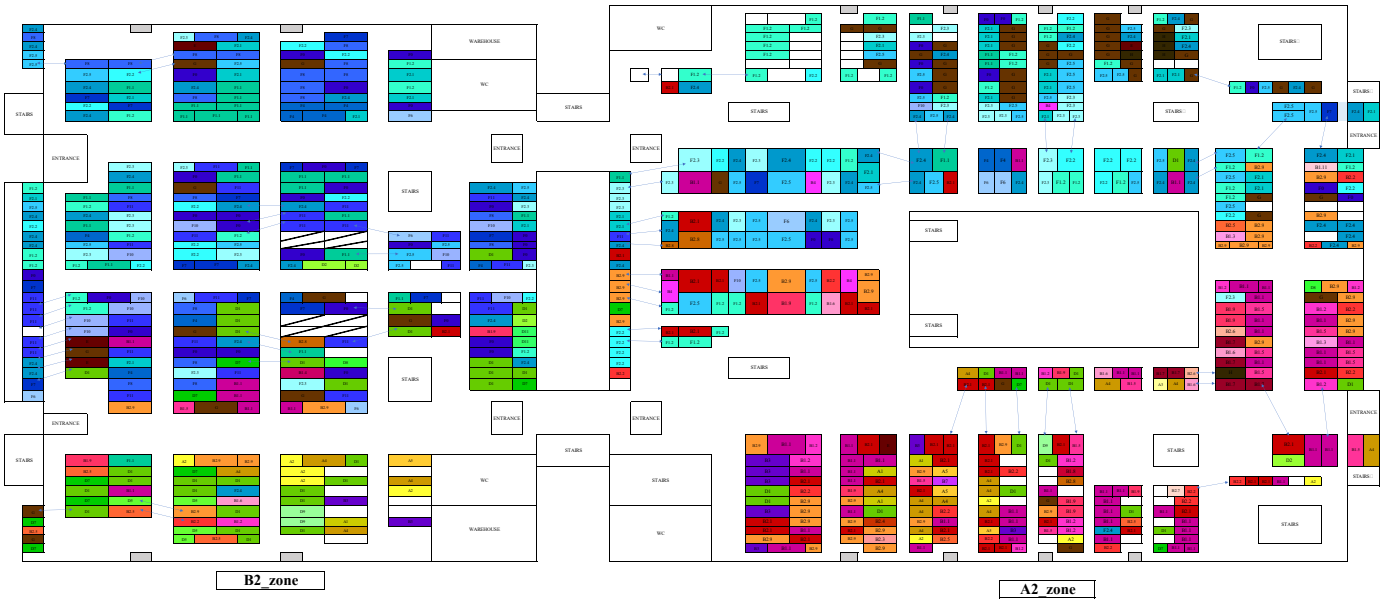
- Men's: Green
- Warehouse/closed: Brown

Back

Map of main products in 2023 winter



- Fabric for women's: Blue
- Fabric for men's: Light blue
- Kids: Yellow
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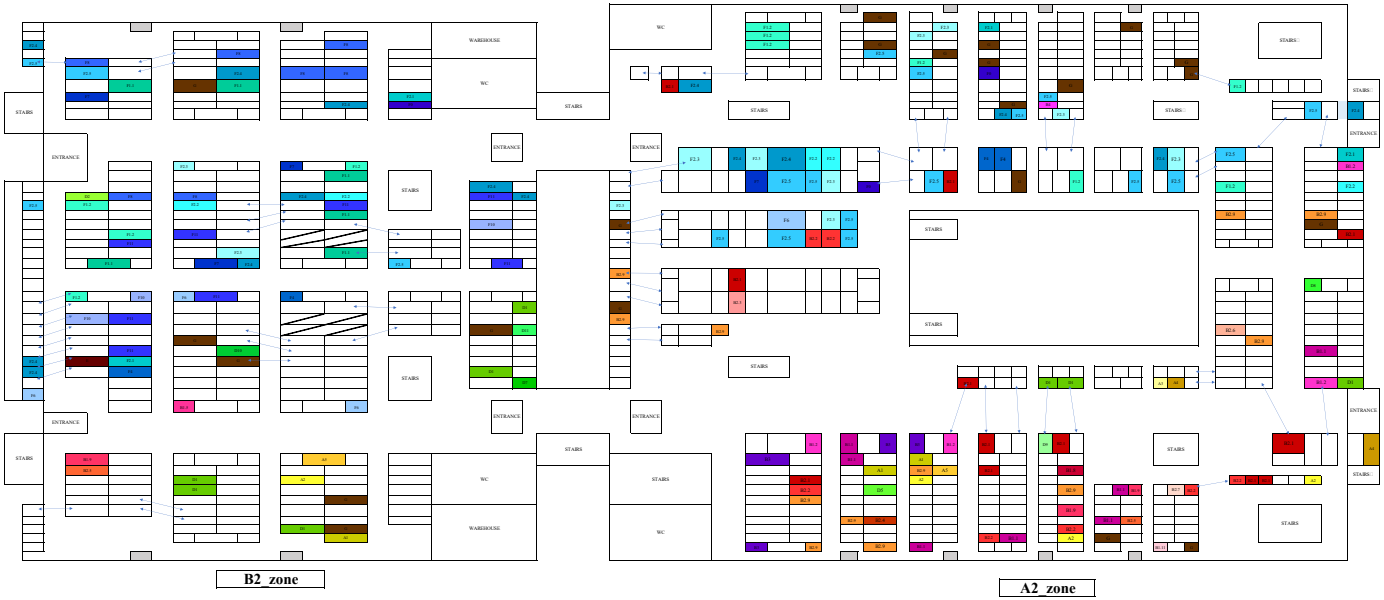
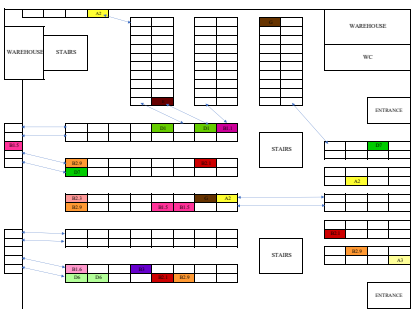
- Mid-aged women's: Orange
- Men's: Green
- Warehouse/closed: Brown

Back

Map of main products in 2023

Slots with non-missing 1994 product info only





- Fabric for women's: Blue
- Fabric for men's: Light blue
- Kids: Yellow
- Young women's: Pink
- Mid-aged women's: Orange
- Men's: Green
- Warehouse/closed: Brown

Back

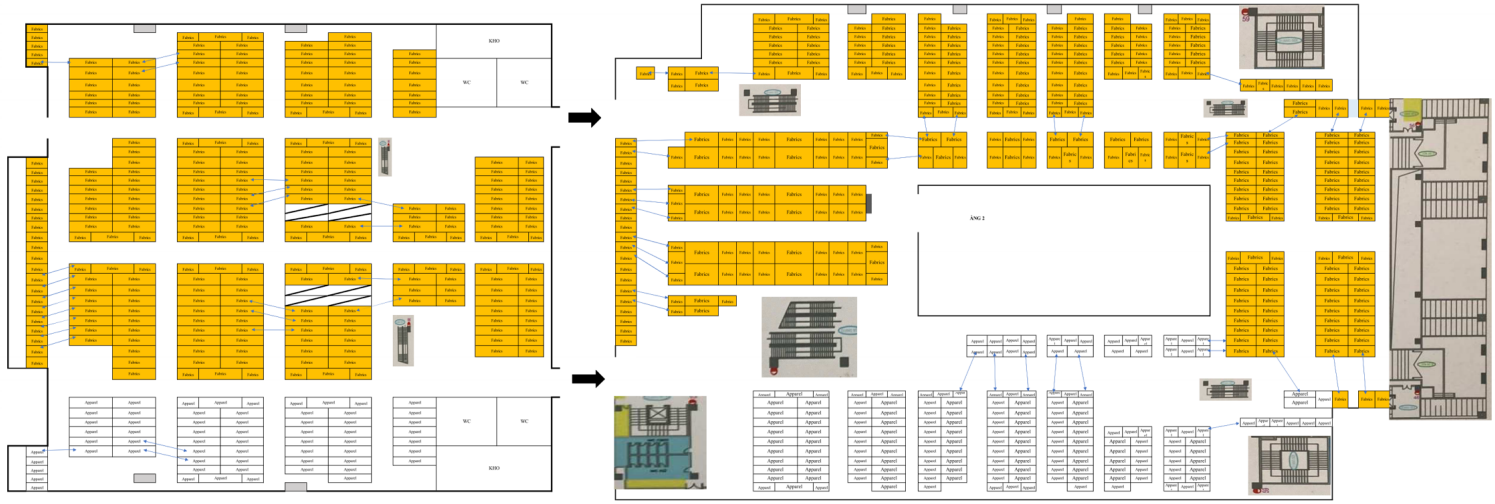
Fabric-area slots converted by apparel

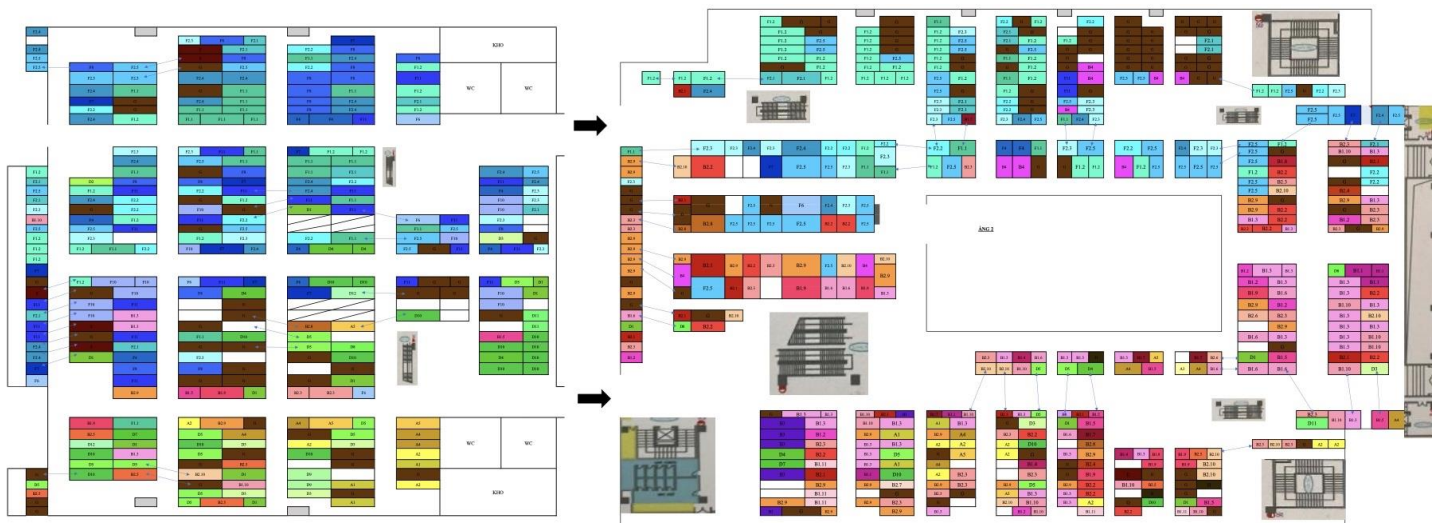
Fabric area (1997-2011)

↓ deregulation (2012)

2023

- Fabric (for men's; for women's; for others')
- Kids
- Young women's
- Mid-aged women's
- Men's
- Warehouse/closed





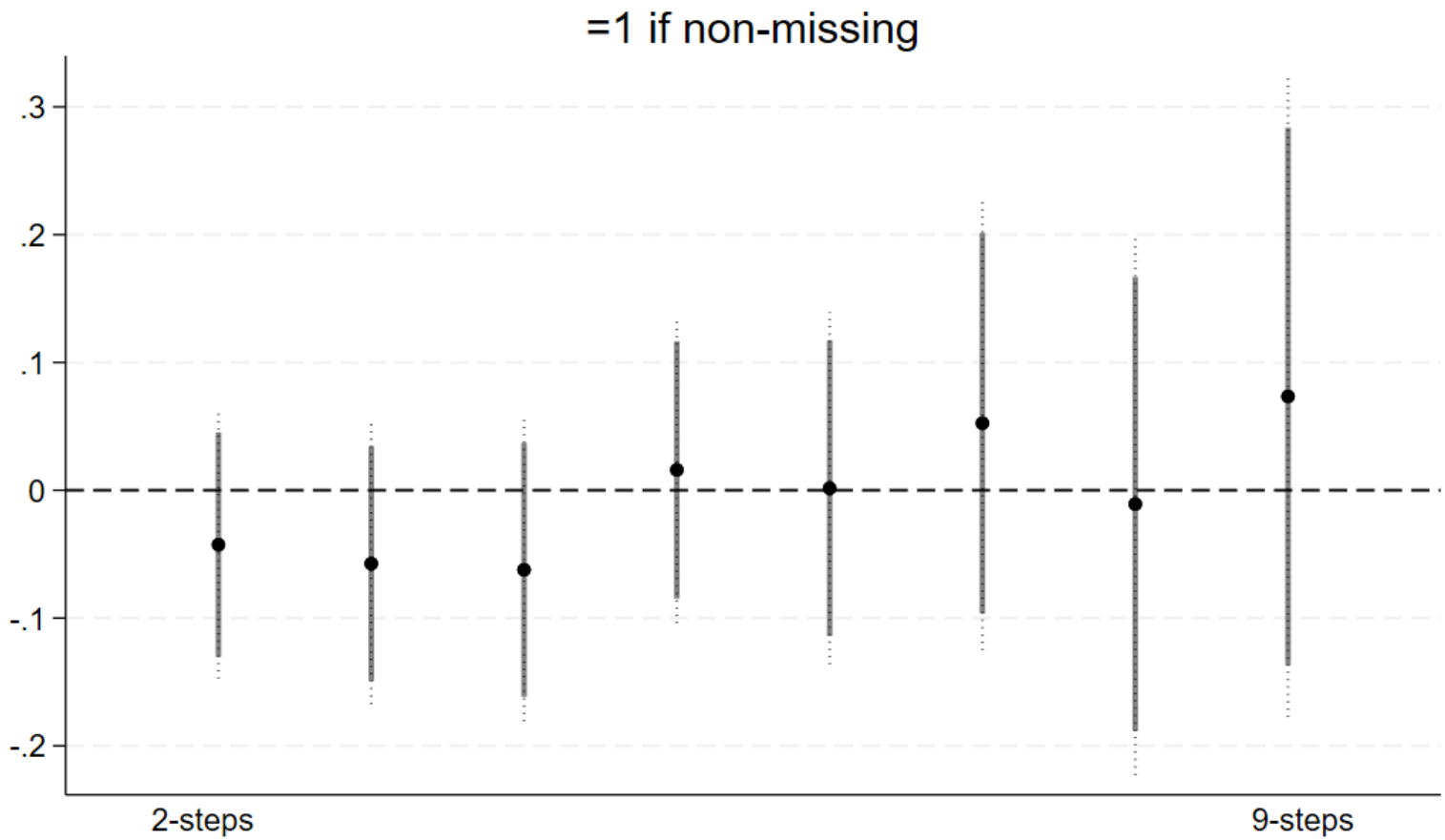
Back

Sample selection check

	Non-missing 1994 information		
Best corner slot	0.156***	0.156***	0.158***
	(0.033)	(0.033)	(0.033)
Second-best corner slot	0.040	0.039	0.048
	(0.042)	(0.042)	(0.042)
Fabric area	-0.017	-0.012	0.019
	(0.033)	(0.035)	(0.037)
3F	-0.133***	-0.119**	-0.108**
	(0.037)	(0.051)	(0.050)
Average distance to other slots		0.001	0.001
		(0.002)	(0.002)
Fabric area slot eroded by apparel			-0.104***
			(0.037)
Observations	1046	1046	1046
Mean	0.229	0.229	0.229

Back

Sample selection check (cont.)



Back

Procedures for simulation to estimate CI

Following Duranton & Overman (2005) and Nakajima & Teshima (2019).

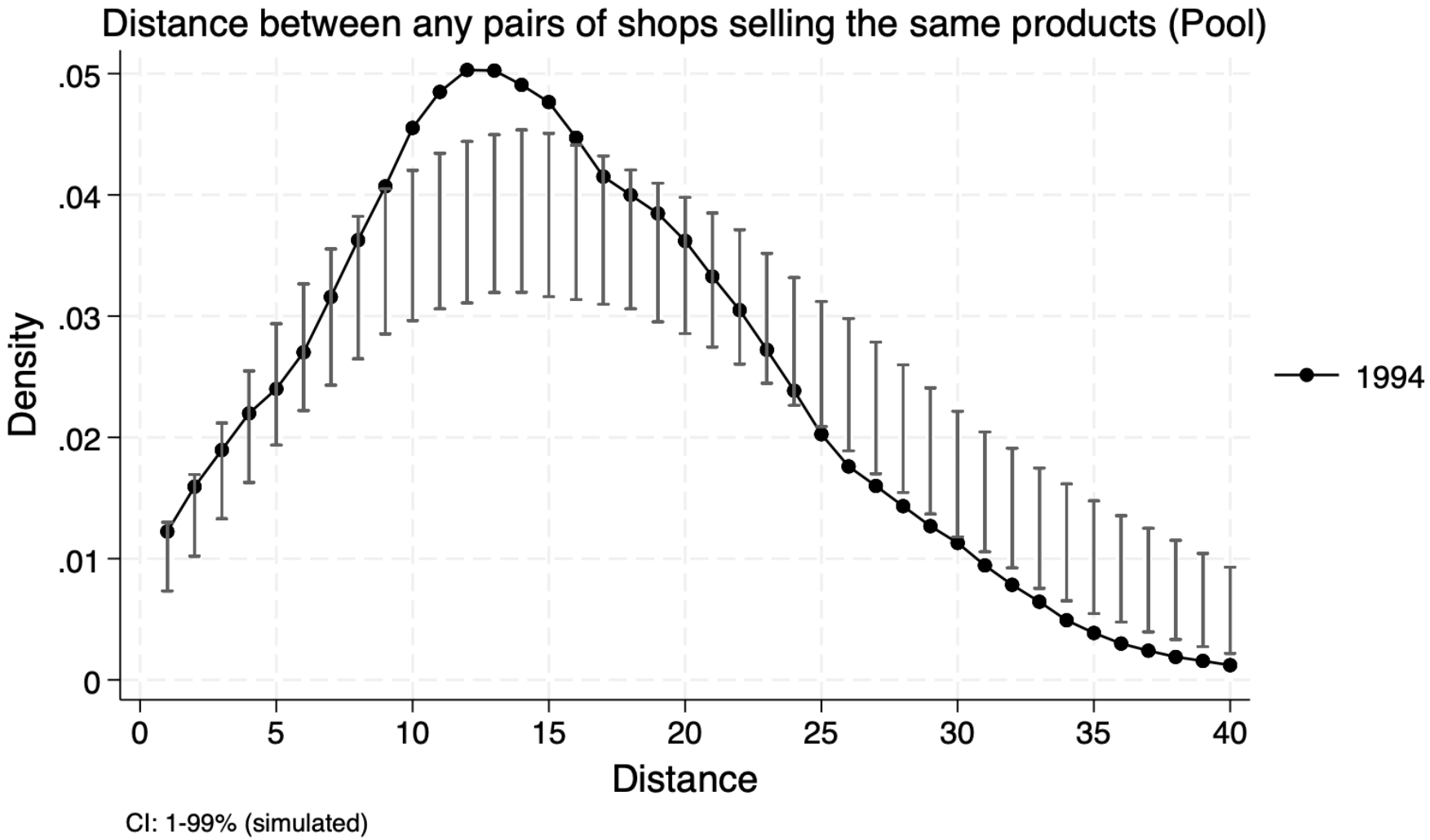
In each lottery segment h (floors $\times$ fabric/apparel $\times$ 3 slot ranks):

- Identify the set of firms that sold product k in 1994 and obtained a slot in this segment by the lottery: $n_{k,h}$ firms
- S_h: set of all possible slots in this segment
  - Include slots where 1994 product info of the owner is missing.
  - Adjustment: Exclude slots in fabric area converted to apparel by 2023. Map Sample selection

Simulation: 1000 times

- At each simulation
  - Randomly assign $n_{k,h}$ firms to S_h for each segment h.
  - Using simulated firm-slot matches from all h, estimate distance distribution (kernel density over distance d=1,...40.)
- For each d, take 1 and 99 percentile of simulated density. Back

Initial distance: CI simulated with no restriction areas



Back

Initial distance: CI simulated with no restriction areas

Back

Summary statistics (balanced-panel sample)

Slots with non-missing 1994 prod info, prod observed in 1994 only

	count	mean	min	max
=1 if slot i sells product k in 1994	12098	0.029	0	1
=1 if slot i sells product k in 1997	12006	0.029	0	1
=1 if slot i sells product k in 2010	12052	0.028	0	1
=1 if slot i sells product k in 2023	12098	0.026	0	1
=1 if slot is best corner	12098	0.35	0	1
=1 if slot is second best corner	12098	0.15	0	1
=1 if slot i is in fabric zone	12098	0.63	0	1
=1 if slot i is on the third floor	12098	0.11	0	1
Share of 2-step neighbors selling product k pre-lottery	10534	0.029	0	1
Share of 3-step neighbors selling product k pre-lottery	11592	0.027	0	1
Share of 6-step neighbors selling product k pre-lottery	12052	0.028	0	1
Share of 9-step neighbors selling product k pre-lottery	12098	0.029	0	1
Number of 2-step neighbors with pre-lottery product info	12098	2.02	0	6
Number of 3-step neighbors with pre-lottery product info	12098	3.36	0	10
Number of 6-step neighbors with pre-lottery product info	12098	8.49	0	22
Number of 9-step neighbors with pre-lottery product info	12098	15.9	1	39

Back

Summary statistics (all available sample)

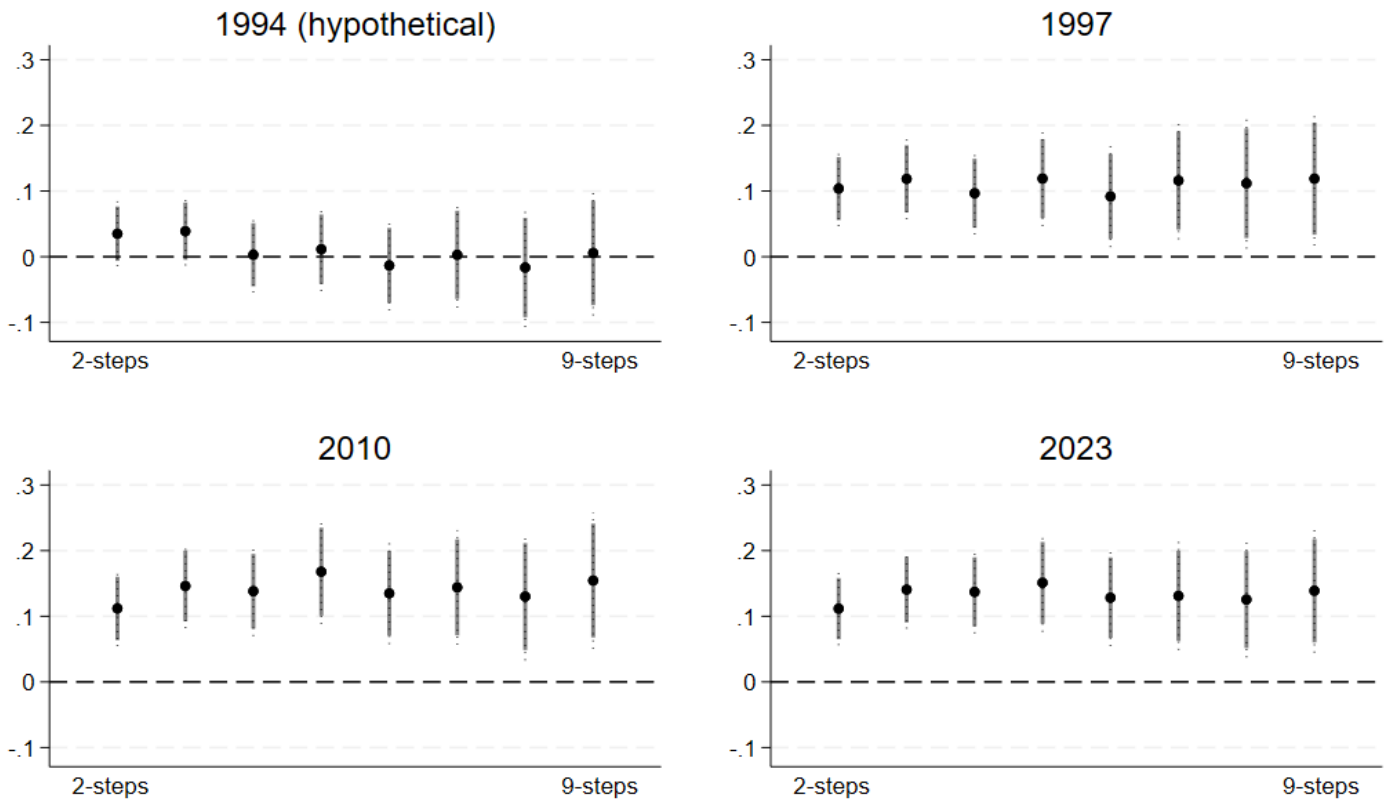
Including slots with prod info in 1997-2023, all products.

	count	mean	min	max
=1 if slot i sells product k in 1994	16043	0.022	0	1
=1 if slot i sells product k in 1997	53924	0.024	0	1
=1 if slot i sells product k in 2010	61305	0.021	0	1
=1 if slot i sells product k in 2023	63074	0.019	0	1
=1 if slot is best corner	63806	0.24	0	1
=1 if slot is second best corner	63806	0.13	0	1
=1 if slot i is in fabric zone	63806	0.59	0	1
=1 if slot i is on the third floor	63806	0.19	0	1
Share of 2-step neighbors selling product k pre-lottery	49288	0.022	0	1
Share of 3-step neighbors selling product k pre-lottery	57157	0.022	0	1
Share of 6-step neighbors selling product k pre-lottery	63379	0.022	0	1
Share of 9-step neighbors selling product k pre-lottery	63806	0.022	0	1
Number of 2-step neighbors with pre-lottery product info	63806	1.68	0	7
Number of 3-step neighbors with pre-lottery product info	63806	2.85	0	11
Number of 6-step neighbors with pre-lottery product info	63806	7.79	0	23
Number of 9-step neighbors with pre-lottery product info	63806	15.0	1	41

Back

Effect of initial coincidental agglom.: robustness

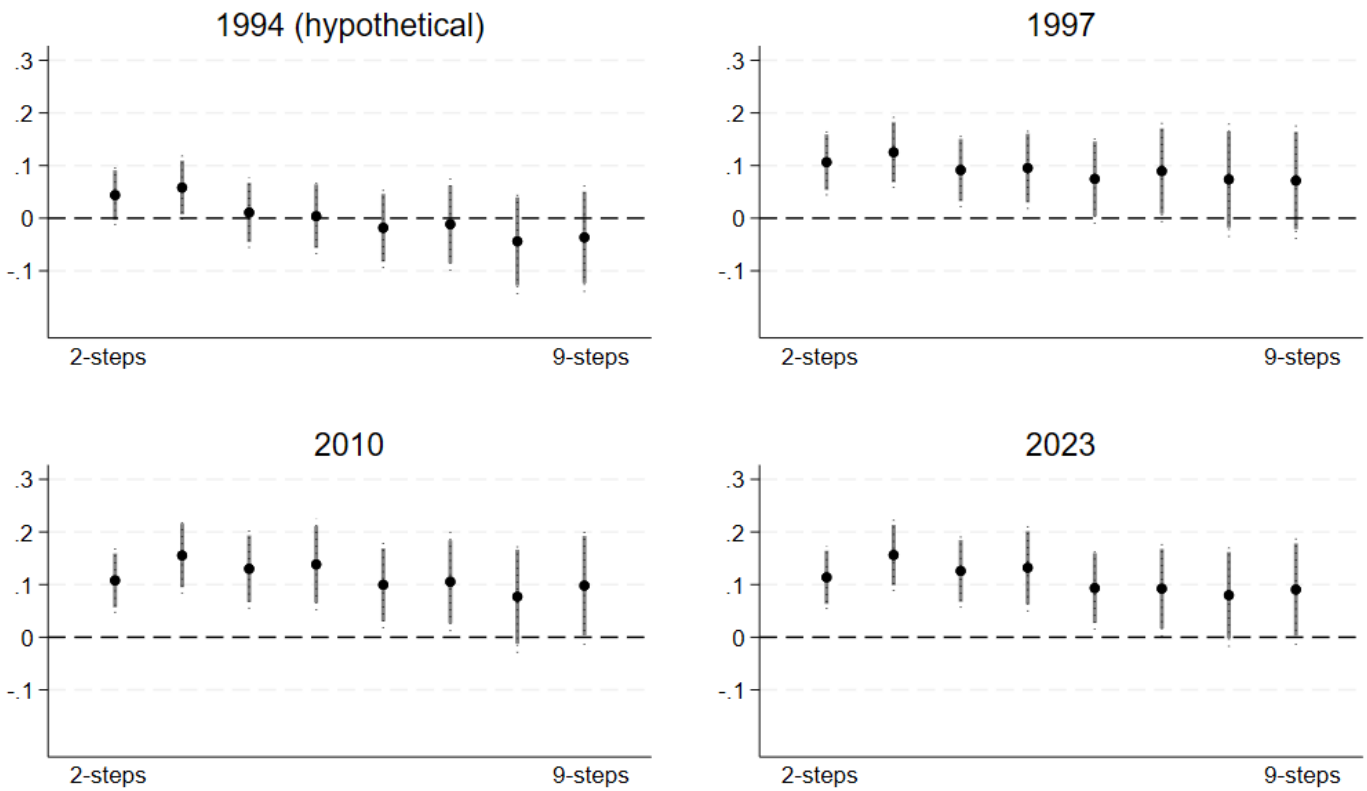
- Add the interactions of the # of neighbor slots with non-missing 1994 info and the largely categorized product FE.
- Control for potential effects of firm closures happening more in certain products that have lower demand.



Back

Effect of initial coincidental agglom.: robustness

- Excluding areas initially designated as fabric zone but converted to apparel



Back

Effect of initial coincidental agglom.: Winter prod

3-step neighbors

	(1) 1994 product	(2) 1997 product	(3) 2010 product	(4) 2023 product
Panel A: Using sample of slots with non-missing 1994 info				
Share of neighbors selling k in 1994	0.038	0.104***	0.123***	0.116***
	(0.026)	(0.030)	(0.031)	(0.029)
Observations	11592	11546	11546	11592
Panel B: Using sample of all available slots with info in each year				
Share of neighbors selling k in 1994		0.094***	0.104***	0.088***
		(0.015)	(0.014)	(0.013)
Observations		38778	41676	40802

Back

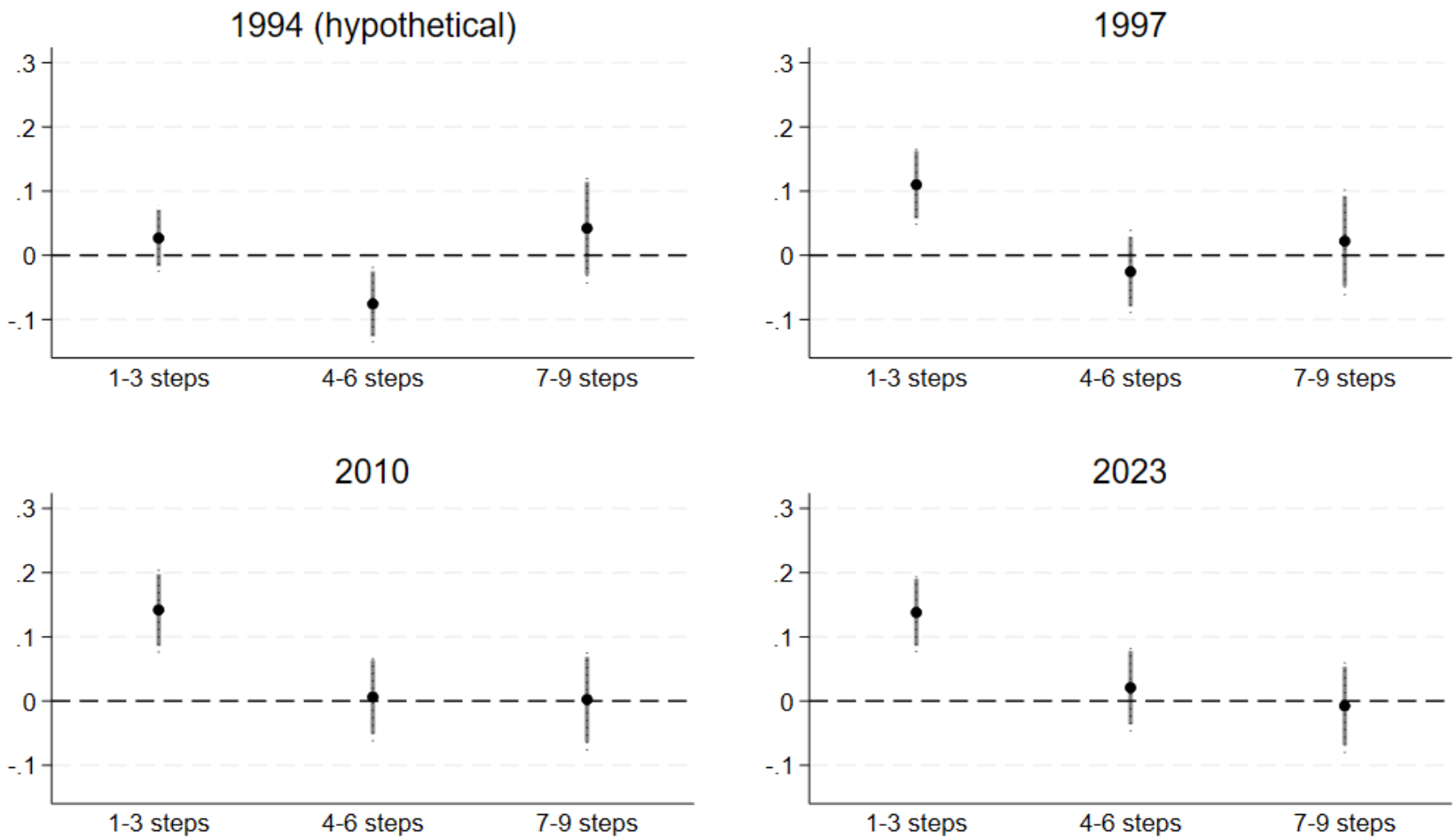
Effect of initial coincidental agglom.: Spatial cluster

3-step neighbors

	(1) 1994 product	(2) 1997 product	(3) 2010 product	(4) 2023 product
Panel A: Using sample of slots with non-missing 1994 info				
Share of neighbors selling k in 1994	0.039	0.118***	0.146***	0.141***
	(0.024)	(0.028)	(0.030)	(0.028)
Observations	15372	15311	15311	15372
Panel B: Using sample of all available slots with info in each year				
Share of neighbors selling k in 1994		0.100***	0.117***	0.099***
		(0.015)	(0.014)	(0.012)
Observations		50386	55327	56486

Back

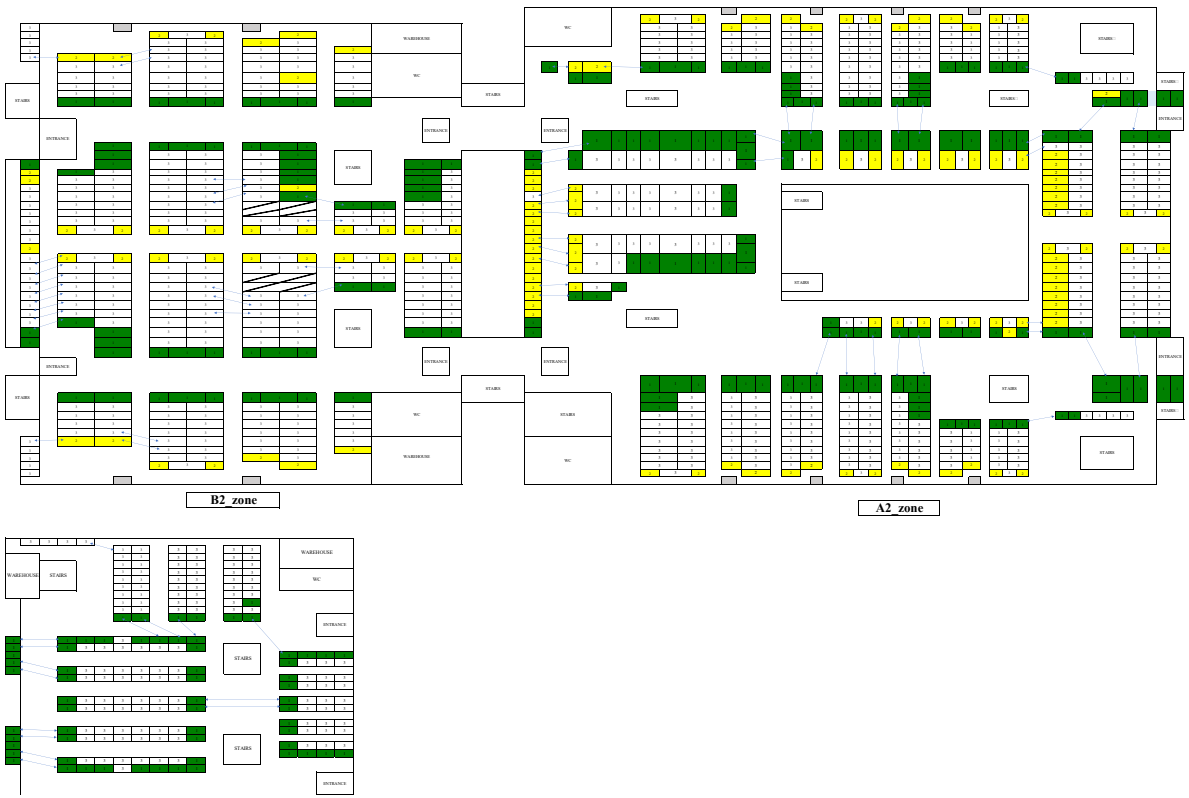
Non-cumulative rings



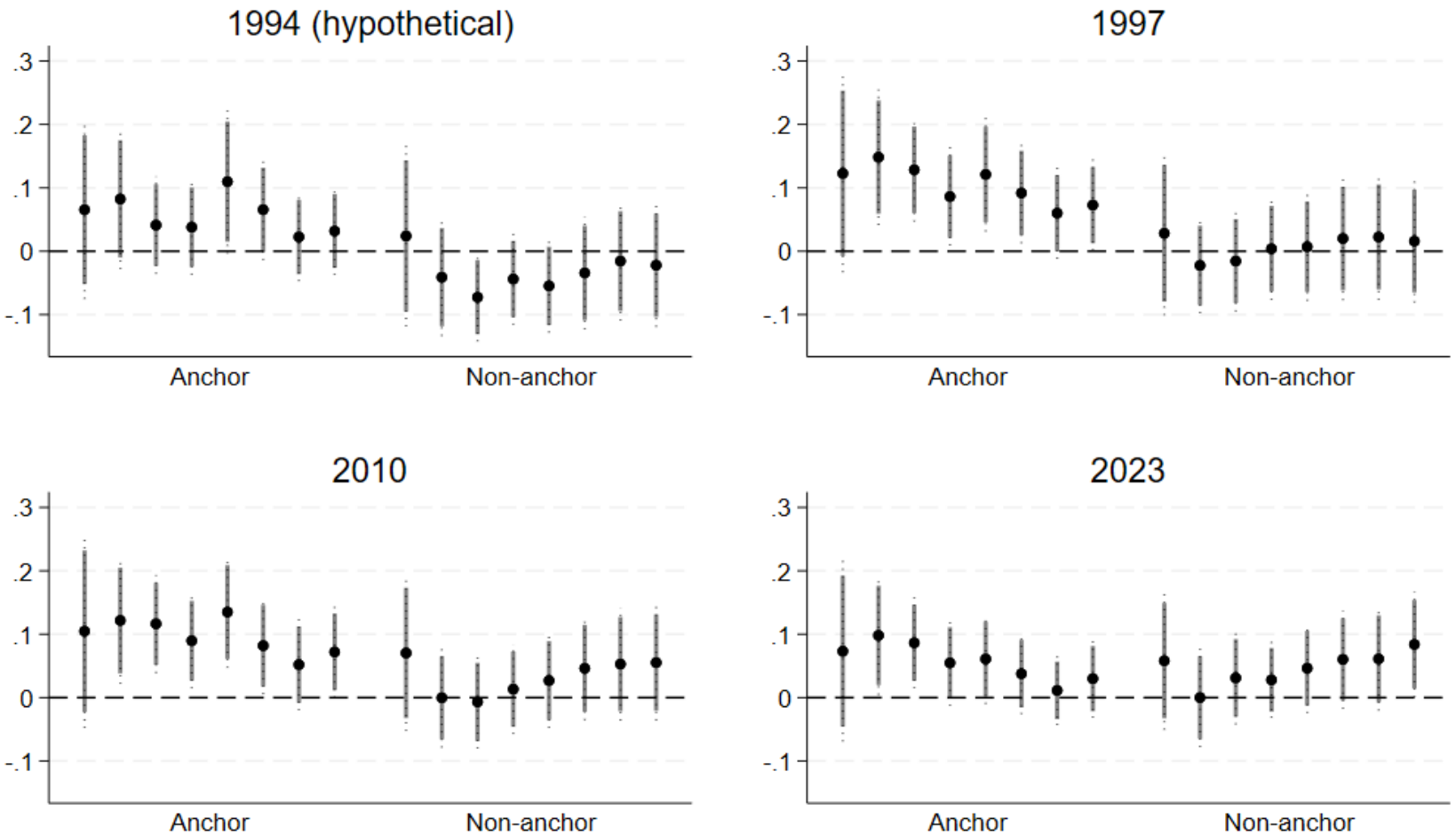
Back

Effects of leading shops

- Corner slots: visible, influential, likely high-performing store owners pre-lottery.
- Anchor store theory (Konishi, 2005)
- Dedicated corner-slot lottery identifies exogenous anchors.
- Stronger effects by anchors?



Effect of initial coincidental agglomeration: by anchor/non-anchor



Summary statistics by anchor/non-anchor

Slots with available pre-lottery info only

	count	mean	min	max
Share of 2-step anchor neighbors selling product k pre-lottery	5290	0.028	0	1
Share of 3-step anchor neighbors selling product k pre-lottery	6670	0.027	0	1
Share of 6-step anchor neighbors selling product k pre-lottery	9108	0.027	0	1
Share of 9-step anchor neighbors selling product k pre-lottery	11270	0.027	0	1
Number of 2-step anchor neighbors with pre-lottery product info	12098	0.82	0	6
Number of 3-step anchor neighbors with pre-lottery product info	12098	1.36	0	6
Number of 6-step anchor neighbors with pre-lottery product info	12098	3.34	0	11
Number of 9-step anchor neighbors with pre-lottery product info	12098	6.05	0	18
Share of 2-step non-anchor neighbors selling product k pre-lottery	7682	0.030	0	1
Share of 3-step non-anchor neighbors selling product k pre-lottery	9154	0.029	0	1
Share of 6-step non-anchor neighbors selling product k pre-lottery	11592	0.030	0	1
Share of 9-step non-anchor neighbors selling product k pre-lottery	12098	0.030	0	1
Number of 2-step non-anchor neighbors with pre-lottery product info	12098	1.20	0	6
Number of 3-step non-anchor neighbors with pre-lottery product info	12098	2.00	0	10
Number of 6-step non-anchor neighbors with pre-lottery product info	12098	5.15	0	22
Number of 9-step non-anchor neighbors with pre-lottery product info	12098	9.87	1	33

Summary statistics for product switch

	count	mean
=1 if slot i added product k that was unsold pre-lottery by year 1997	16043	0.0060
=1 if slot i added product k that was unsold pre-lottery by year 2010	16043	0.0072
=1 if slot i added product k that was unsold pre-lottery by year 2023	16043	0.0079
=1 if slot i continued product k that was sold pre-lottery in year 1997	16043	0.016
=1 if slot i continued product k that was sold pre-lottery in year 2010	16043	0.014
=1 if slot i continued product k that was sold pre-lottery in year 2023	16043	0.011
=1 if slot i dropped product k that was sold pre-lottery by year 1997	16043	0.0053
=1 if slot i dropped product k that was sold pre-lottery by year 2010	16043	0.0069
=1 if slot i dropped product k that was sold pre-lottery by year 2023	16043	0.0098

Back

Decomposition

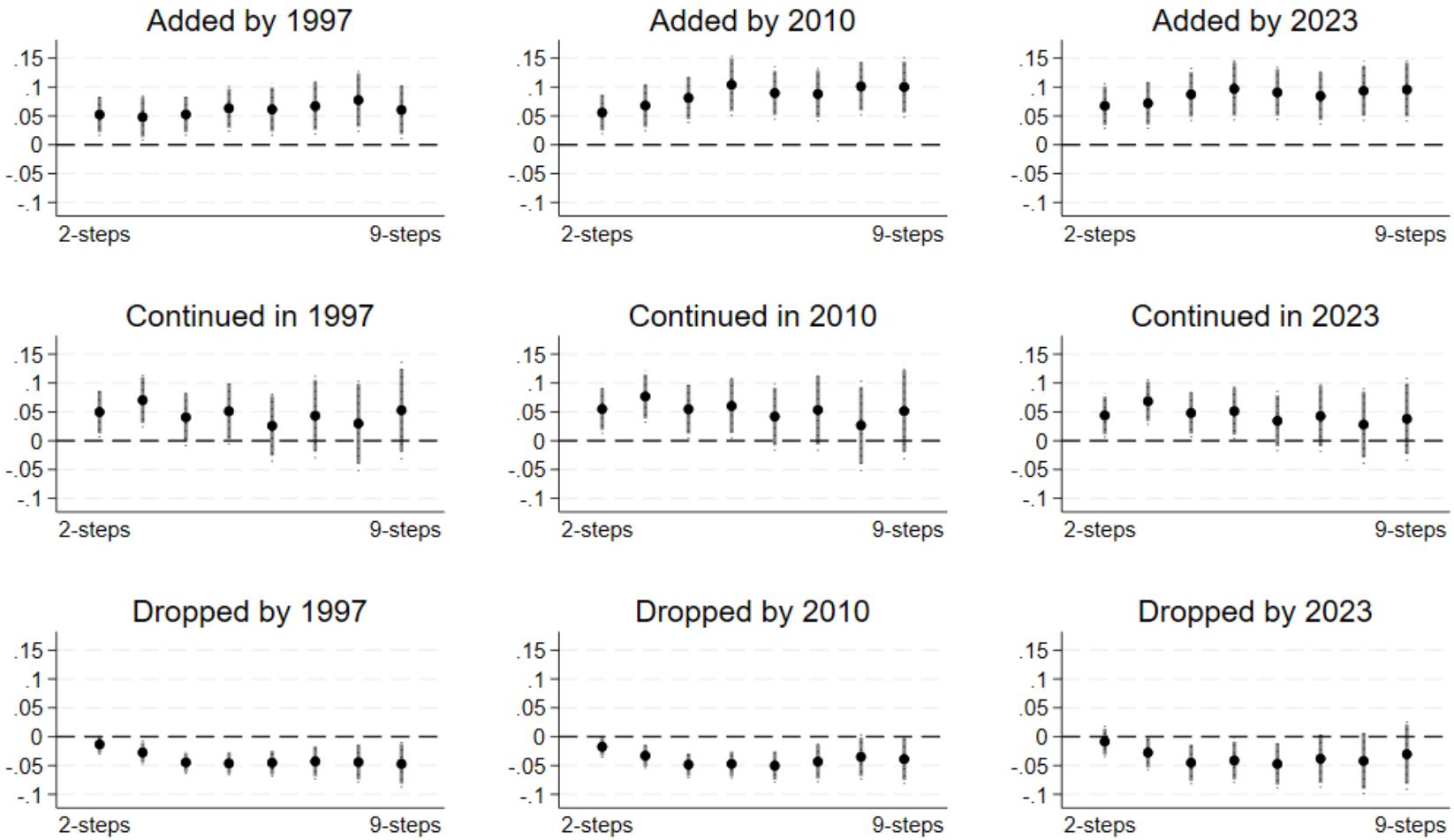
Decompose $\text{Total}_{i,k}$ into mutually exclusive 4 cases:

1. (Early within-owner switch/continuation) Product k is sold at slot i in 1997 by the lottery-assigned owner
2. (Late within-owner switch) Product k is newly introduced at slot i in 1998-2023 by the lottery-assigned owner
3. (Early ownership change) Product k is sold at slot i in 1997 by a new owner
4. (Late ownership change) Product k is sold at slot i in 1998-2023 by a new owner

Back

Product switching within owners

Added/continued/dropped compared to product set in 1994

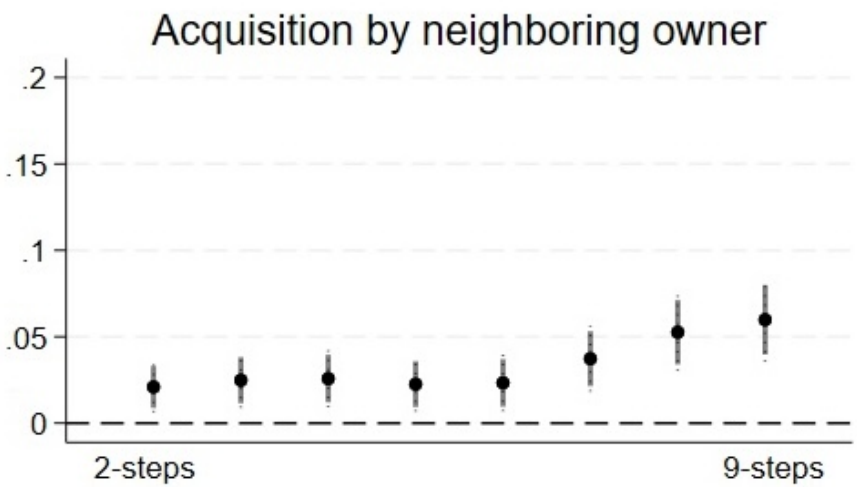


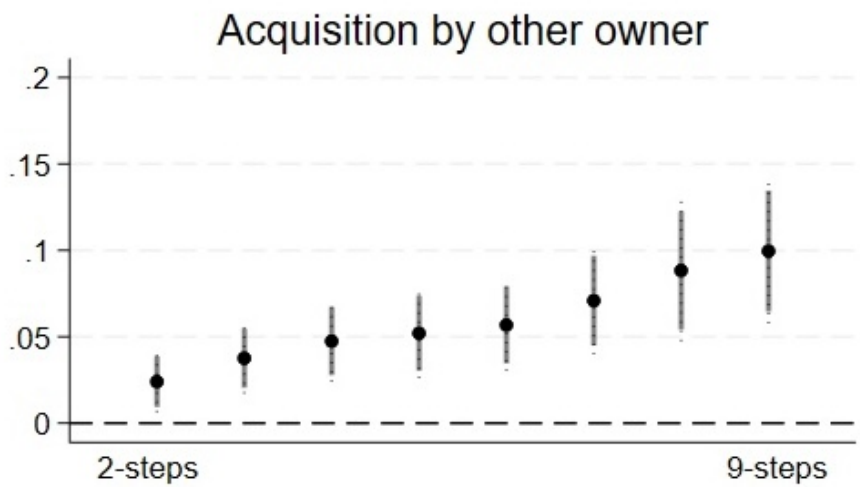
Basic stats Back

Acquisition by adjacent owners

We combine Early ownership transfer and Late ownership transfer and then decompose them into:

1. **Acquisition by neighboring owners:** product k sold in 1997-2023 by a new owner who acquired the slot and who also held an adjacent slot obtained through the lottery;
2. **Acquisition by other owner:** product k sold in 1997-2023 by a new owner who acquired the slot but did not hold an adjacent lottery-assigned slot.





Back

Summary statistics for spillover analysis

Slots with 2023 owner info only

Slots without pre-lottery info included Back

	count	mean	min	max
Share of 2-step neig of -i slots (based on 1997 ownership) selling k in 1997	2013	0.022	0	1
Share of 3-step neig of -i slots (based on 1997 ownership) selling k in 1997	2013	0.023	0	1
Share of 6-step neig of -i slots (based on 1997 ownership) selling k in 1997	2135	0.023	0	1
Share of 9-step neig of -i slots (based on 1997 ownership) selling k in 1997	2135	0.023	0	0.5
=1 if slot i has no -i slots (based on 1997 ownership) in 2-steps	27450	0.93	0	1
=1 if slot i has no -i slots (based on 1997 ownership) in 3-steps	27450	0.93	0	1
=1 if slot i has no -i slots (based on 1997 ownership) in 6-steps	27450	0.92	0	1
=1 if slot i has no -i slots (based on 1997 ownership) in 9-steps	27450	0.92	0	1
Share of 2-step neig of -i slots (based on 2023 ownership) selling k in 2023	4392	0.017	0	0.8
Share of 3-step neig of -i slots (based on 2023 ownership) selling k in 2023	4392	0.018	0	0.6
Share of 6-step neig of -i slots (based on 2023 ownership) selling k in 2023	4392	0.018	0	0.6
Share of 9-step neig of -i slots (based on 2023 ownership) selling k in 2023	4392	0.018	0	0.6
=1 if slot i has no -i slots (based on ownership in 2023) in 2-steps	55693	0.92	0	1
=1 if slot i has no -i slots (based on ownership in 2023) in 3-steps	55693	0.92	0	1
=1 if slot i has no -i slots (based on ownership in 2023) in 6-steps	55693	0.92	0	1
=1 if slot i has no -i slots (based on ownership in 2023) in 9-steps	55693	0.92	0	1