

Spatial Frictions in Consumption and Retail Competition: Evidence from Swiss Scanner Data

Maximilian von Ehrlich¹, **Frédéric Kluser**¹ and Tobias Seidel²

¹Department of Economics
University of Bern

²Mercator School of Management
University of Duisburg–Essen

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Motivation
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Data
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Identification
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Results
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Conclusion
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Motivation



Motivation



Motivation

- Amenities (parks, playgrounds, workplace access, low crime, noise or pollution, rock concerts etc.) make a place attractive for households to locate.
- In quantitative spatial models, low amenities are compensated by high wages (e.g., [Ahlfeldt et al. 2015](#); [Monte et al. 2018](#)). But still a black box.
- Key Papers for us:
 - [Diamond \(2016\)](#) opens this black box and endogenizes amenities.
 - [Redding et al. \(2021\)](#) track non-commuting trips.
- We contribute empirically to a specific amenity – **the access to grocery retailers:**

Our Question: *How does a supermarket entry affect shopping trips?*

Why should we care about consumption access?

Overall Welfare Gains:

- General: [Marshall and Pires \(2018\)](#); [Arcidiacono et al. \(2020\)](#)
- Housing Prices: [Pope and Pope \(2015\)](#); [Hausman et al. \(2020\)](#)

Possible heterogeneous welfare effects:

- Low-income households are less mobile: [Eizenberg et al. \(2021\)](#)
- Food Deserts: [Allcott et al. \(2019\)](#); [Hut \(2020\)](#)

Policy Implications:

- Regional differences (beyond income)
- Zoning laws & transportation infrastructure

This Paper I

- We estimate the value of grocery shopping access.
- These effects are strong and vary between socio-demographic characteristics.

Approach:

- ① Study a unique data-set for Migros Cumulus owners in Switzerland (where they live, who they are, where they shop, and what they shop).
[▶ The Program](#) [▶ Representativeness](#)
- ② Exploit quasi-experimental variation in store openings (Migros and all other).
- ③ Identify heterogeneities: complementarities with the local economy and socio-demographics.
- ④ **TBD:** Capitalization? Welfare?

This Paper II

Findings:

- ① Average Migros expenditures and visits decline by **14%** and **10%** after a close own-chain opening within 5 minutes.
- ② Effects lower for main competitors (10% and 8%).
- ③ The effects become insignificant after 16 min. ▶ Catchment Areas
- ④ Socio-demographic and spatial variation:
Effect is stronger in rural and high-income areas, for older cardholders, and those having a family.

Contents

① Motivation

② Data

③ Identification

④ Results

⑤ Conclusion

Data

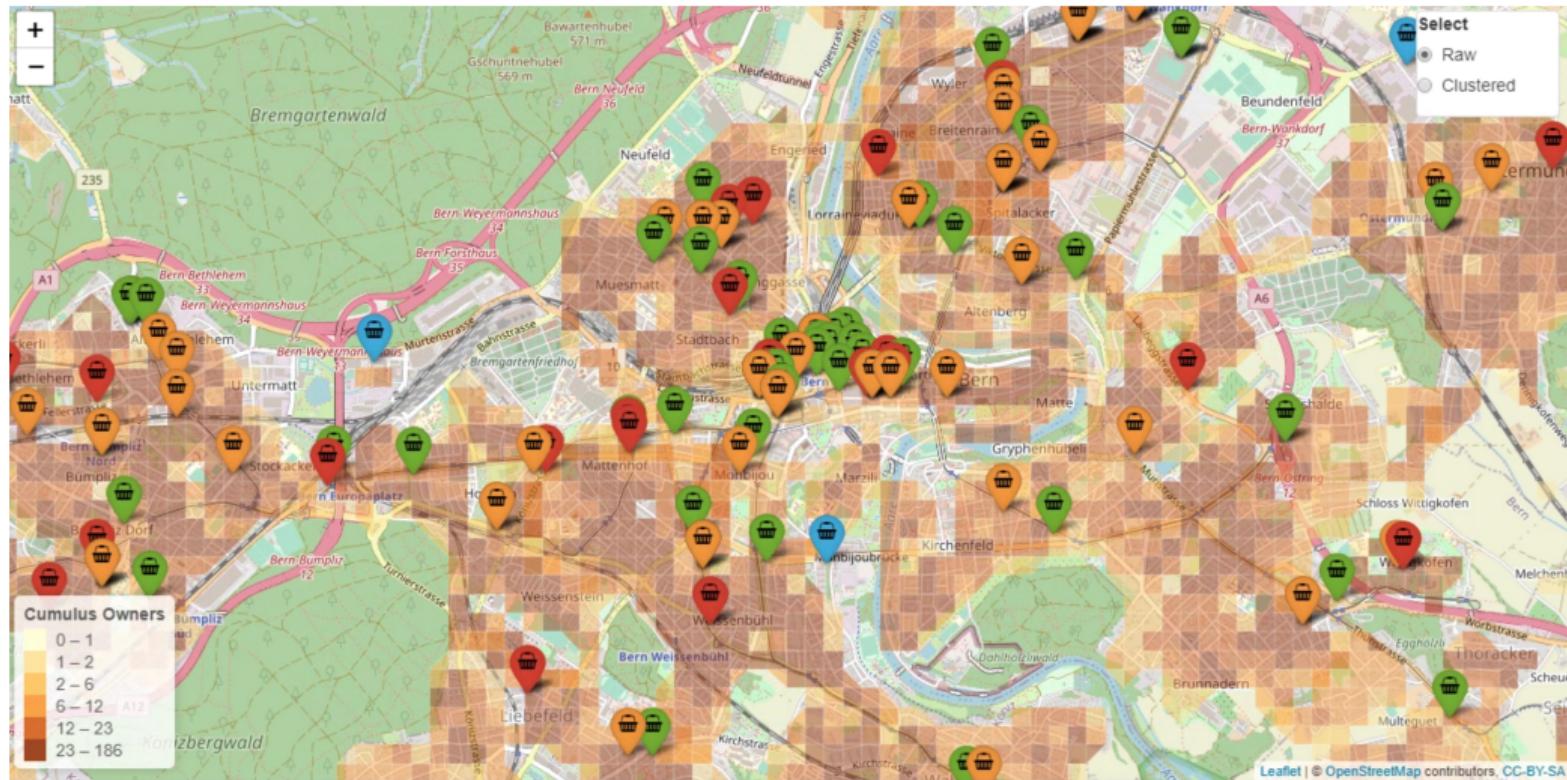
- **Transaction Data**

► Transactions ► Descriptives

- Geocoded, store–household matched transaction records from the largest retailer in Switzerland (Migros).
- 3 million households (85% of the population) and 695 supermarkets.
- 1.5 billion daily records for 40 goods' categories (2019Q1–2021Q2).
- Store (size, share of organic and budget products) and household characteristics (residence, age, family type)
- **Shop Openings:** Web scraped data from Migros. Checked with newspapers and data from one of the competitors.
- **search.ch and Google Maps:**
 - Travel times (car, public, bicycle, walking)
 - Locations of other stores and amenities (e.g., banks, restaurants, schools, etc.)
- **Federal Statistical Office:** Highly granular geospatial and sociodemographic data.

A Glimpse into our Data

► Descriptives



Data

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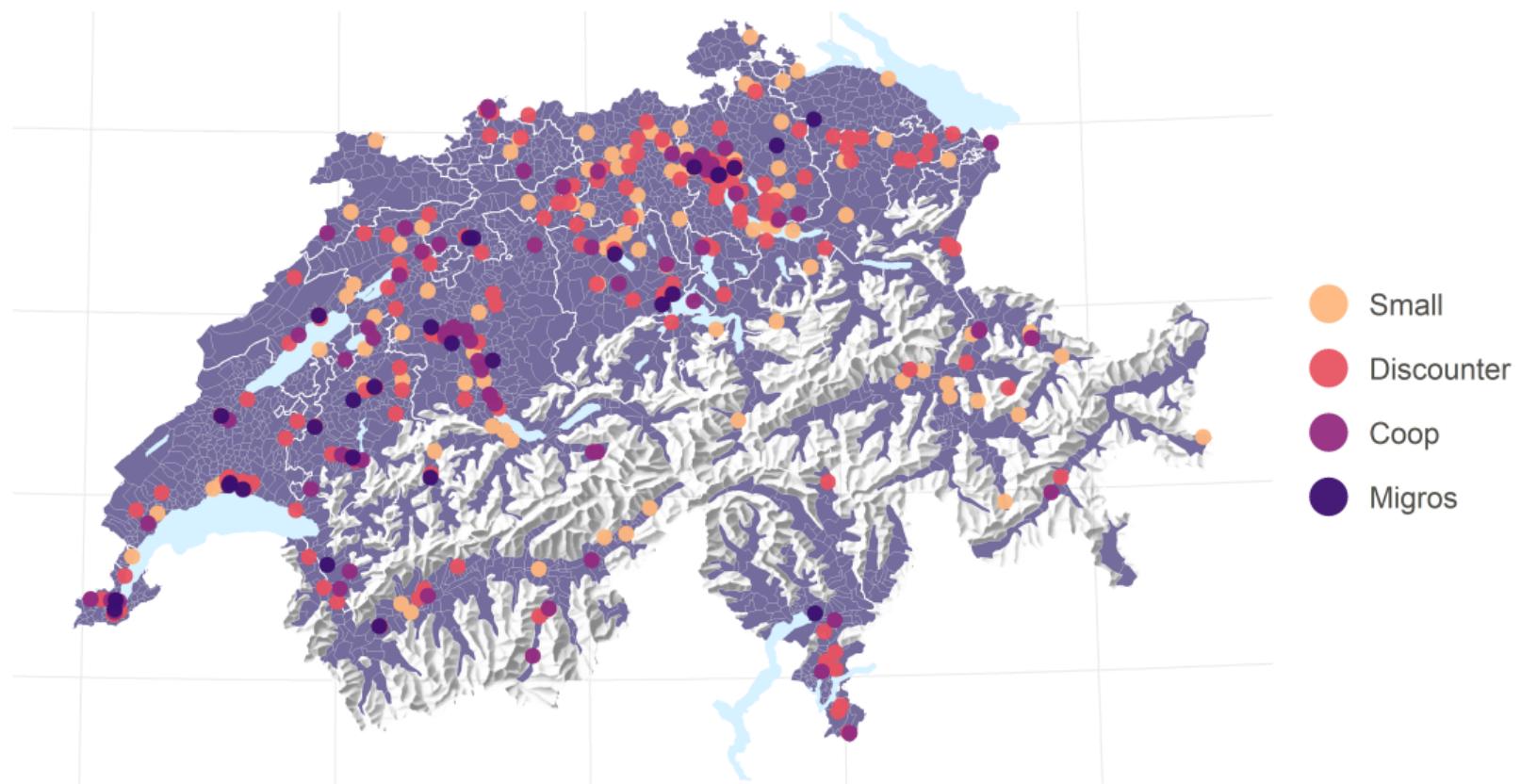


Figure 1: Treatment: 351 Store Openings in Space

Data

- **Transaction Data**

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Empirical Strategy

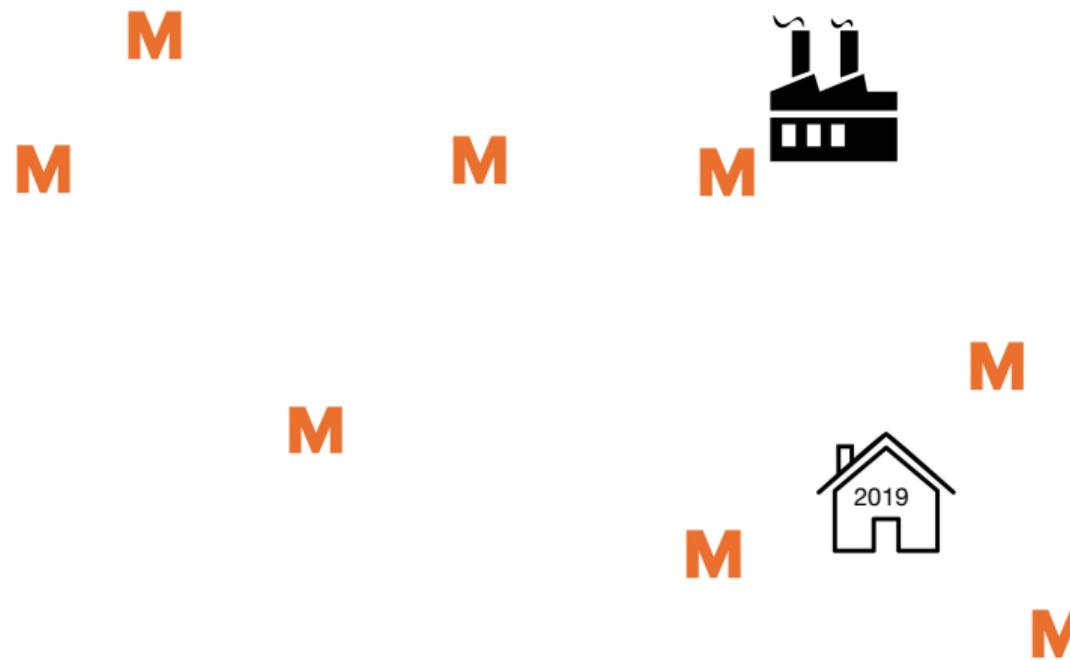
- *Goal:* Isolate a causal effect of store openings on household expenditures.
- *Method:* Exploit quasi-experimental variation from store openings (binary, staggered treatment).
- *Challenge:* Standard Two-way Fixed Effects (TWFE) has restrictive assumptions:
 - Parallel Trend
 - Homogenous Treatment Effects (TE)
- *Our Approach:* New Diff-in-Diff literature ([Wooldridge 2022](#))
 - Binary staggered Treatment
 - TE can vary across time and cohorts
 - Interact the treatment with a covariate
 - Assumption: Parallel trends and no-anticipation for not-yet-treated units

Data Cleaning

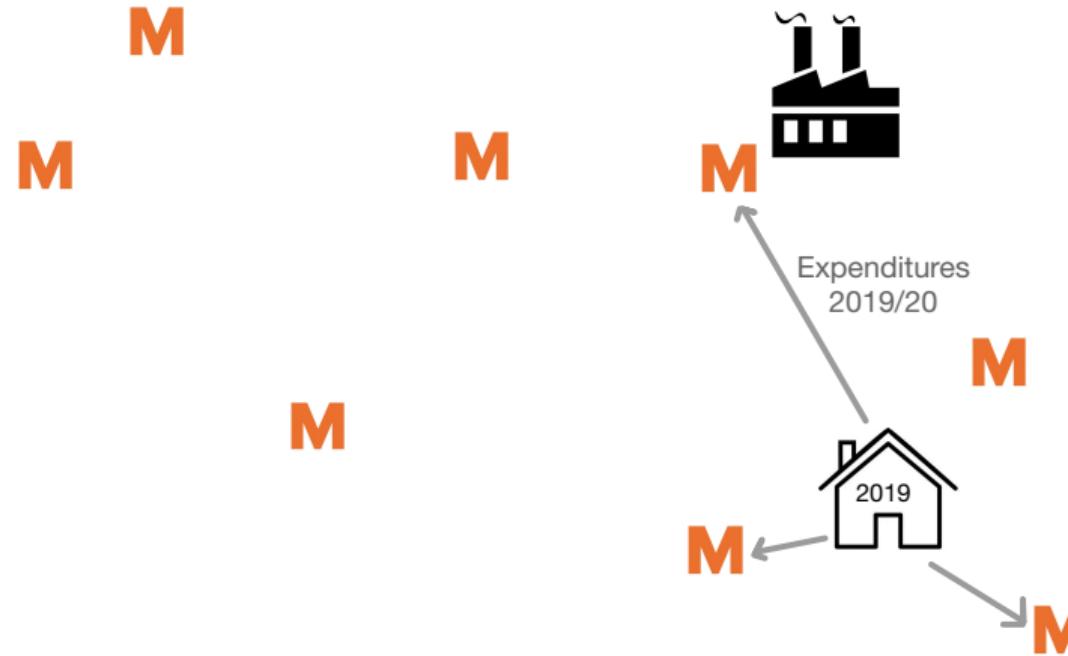
Data-related Issues:

- ① Multiple Openings.
- ② Household characteristics only observed in the last period, 06/2021.
But people move (10.3% p.a., BFS, 2022), change jobs, forgot to change their address, or use someone else's card.

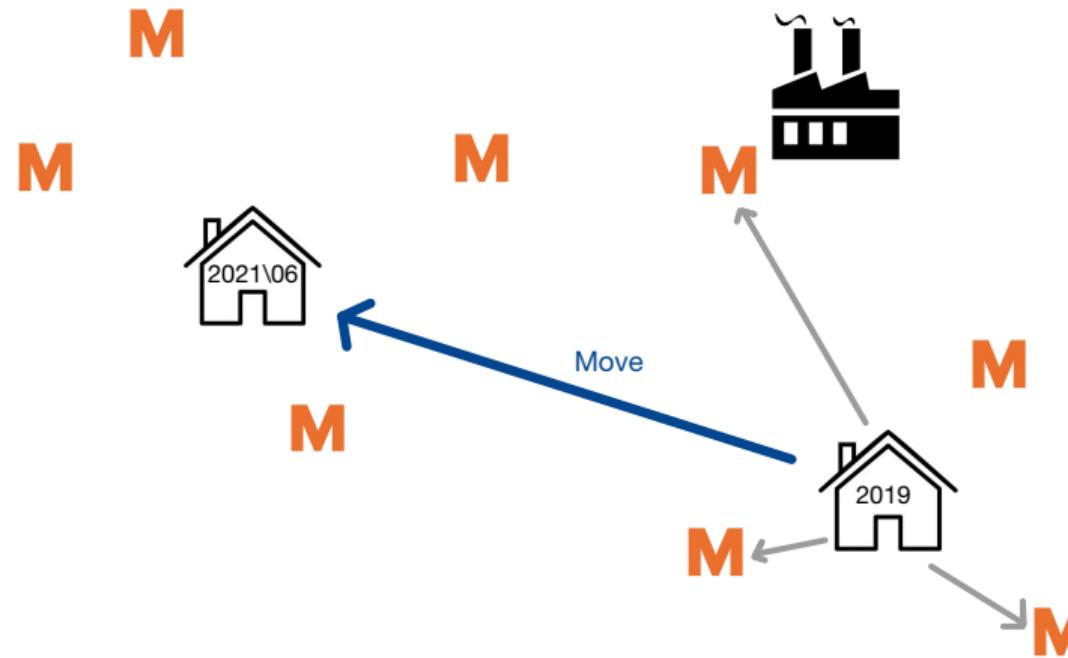
Data Cleaning: Illustration



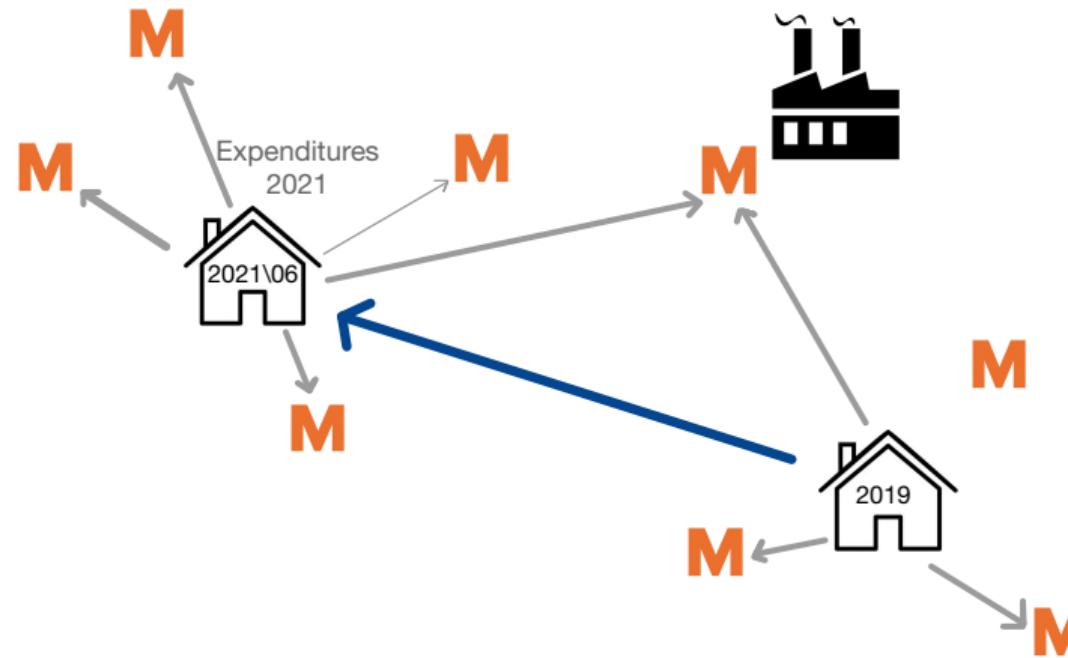
Data Cleaning: Illustration



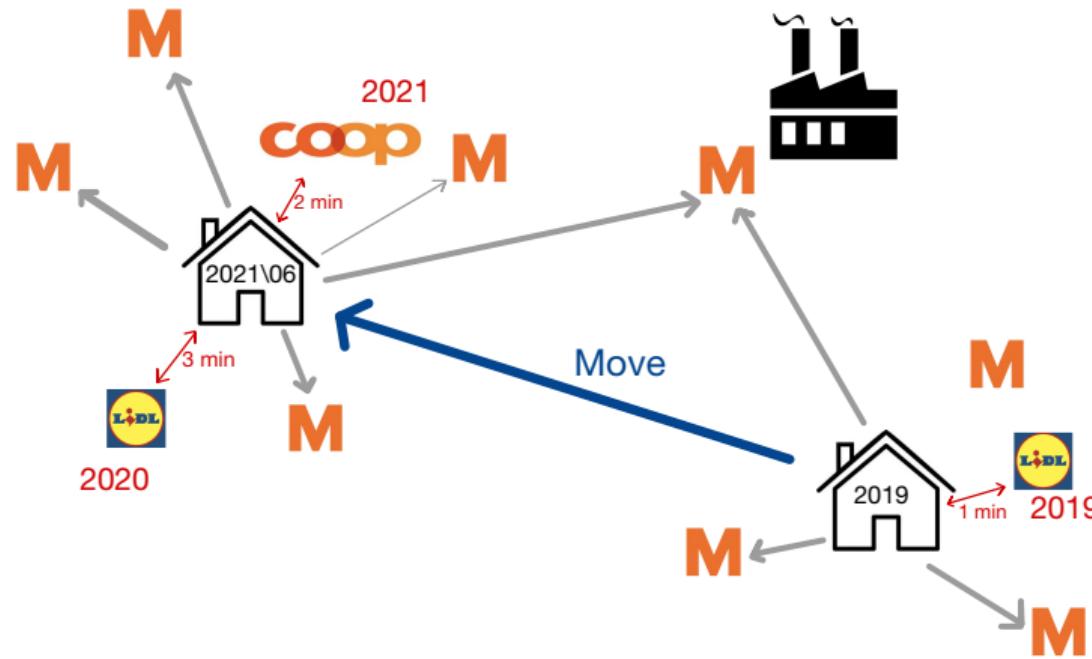
Data Cleaning: Illustration



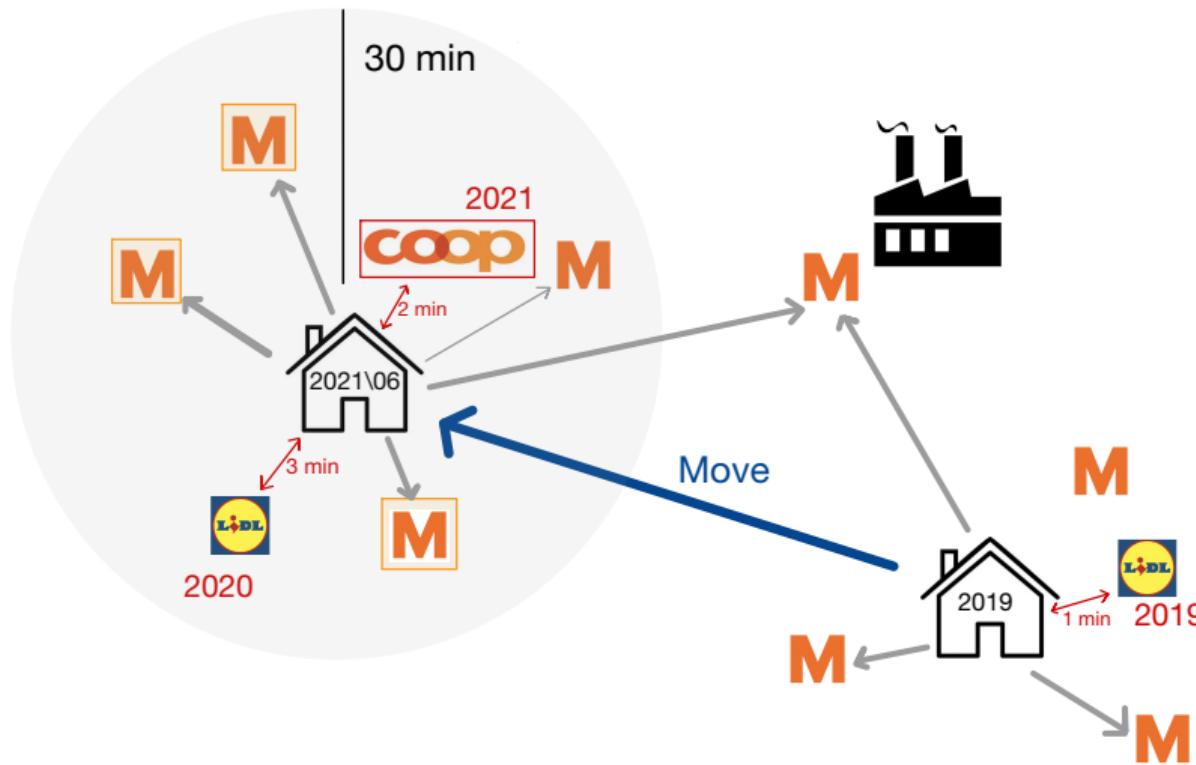
Data Cleaning: Illustration



Data Cleaning: Illustration



Data Cleaning: Illustration



Data Cleaning

Data-related Issues:

- ① Multiple Openings.
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But people move (10.3% p.a., BF S, 2022), change jobs, forgot to change their address, or use someone else's card.

Solutions:

- ① Take the closest one (Robustness: *once-treated units*).
- ② Only consider three favorite stores within 20 km from residence.
Drop households if their average distance to stores 01/2019 vs. 06/2021 is too large.

Final Dataset: 23 million observations, 800'000 households.

Empirical Strategy: Staggered Diff-in-Diff w/Covariate (Wooldridge, 2022)

$$\ln(Y_{imt}) = \alpha_i + \gamma_t + \delta_{g,t}(T_{it} \times g_i \times \gamma_t \times \tilde{X}_i) + \beta_{g,t}(T_{it} \times g_i \times \gamma_t) + \xi_t(\gamma_t \times X_i) + \epsilon_{imt}, \quad (1)$$

- Y_{imt} : Expenditures (or visits) of household i at home location m in year-month t .
- T_{it} : Treatment Dummy whether household i was treated in period $j \leq t$.
- α_i , γ_t and g_i : unit, time and cohort fixed effects.
- We cluster standard errors at the household level.
- X_i : time-constant covariates:
 - ① Parametric log-function of travel times (driving time, road distance, public transport).
 - ② Non-parametric bins of travel time (driving time $\{0, 2, 5, 10, 15, 20, 30\}$).
 - ③ Heterogeneities (spatial, socio-demographic).

Empirical Strategy: Static Model

Aggregate the cohort-period coefficients to an average treatment effect:

$$\beta_{ATT} = \sum_{t \times g, t \geq g}^{T, G} W_g \beta_{g,t}, \quad \delta_{ATT} = \sum_{t \times g, t \geq g}^{T, G} W_g \delta_{g,t},$$

where δ_{ATT} is the robust distance decay or heterogeneity parameter of interest.

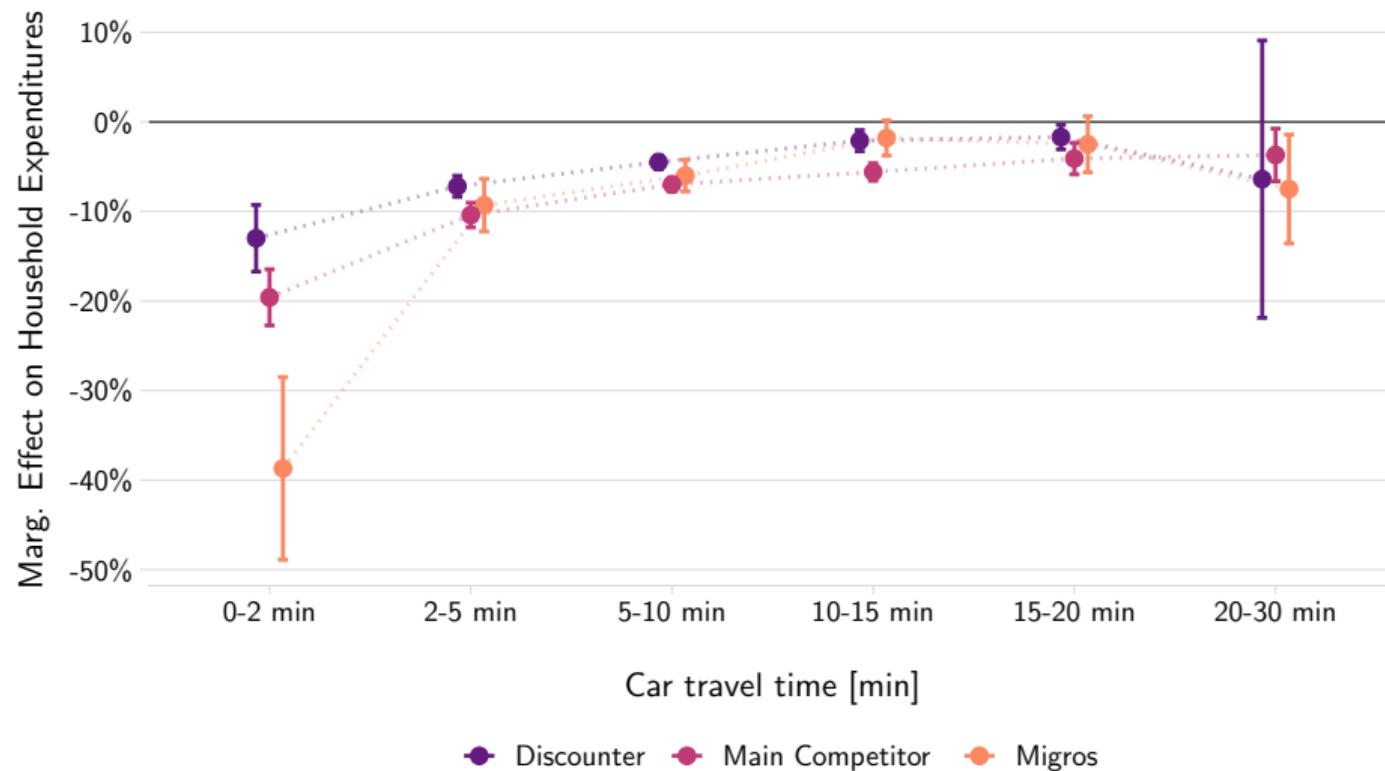
Empirical Strategy: Dynamic Model

Aggregate the cohort-period coefficients w/o interaction to an average treatment effect for every event period of interest:

$$\ln(Y_{imt}) = \alpha_i + \gamma_t + \sum_{\substack{k=-10 \\ k \neq -1}}^{10} \beta_k T_{it}^k + \epsilon_{imt}, \quad (2)$$

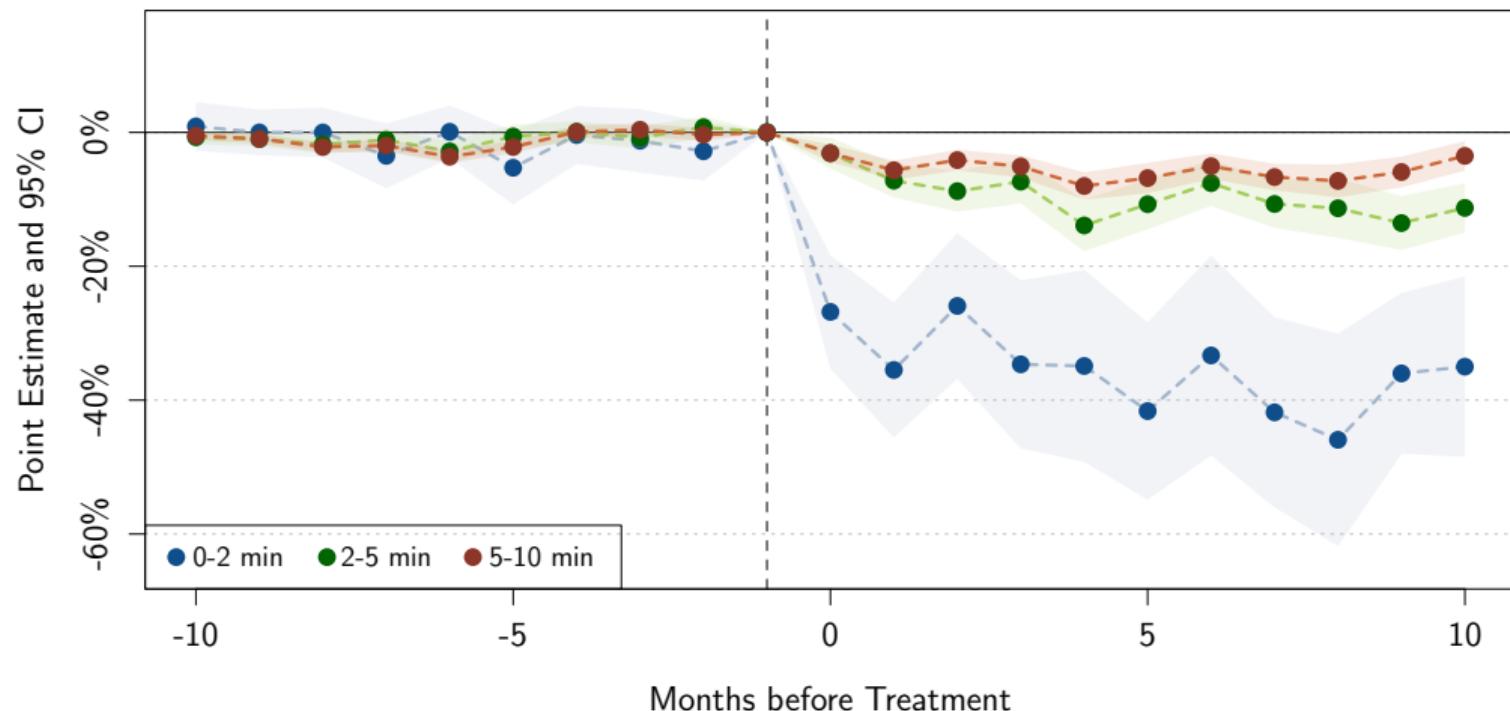
where $T_{i,t}^k$ is the *time-to-treatment* variable.

Static Effects: Distance Decay

[▶ Catchment Areas](#)[▶ Parametric Table](#)

Dynamic Effects: Migros

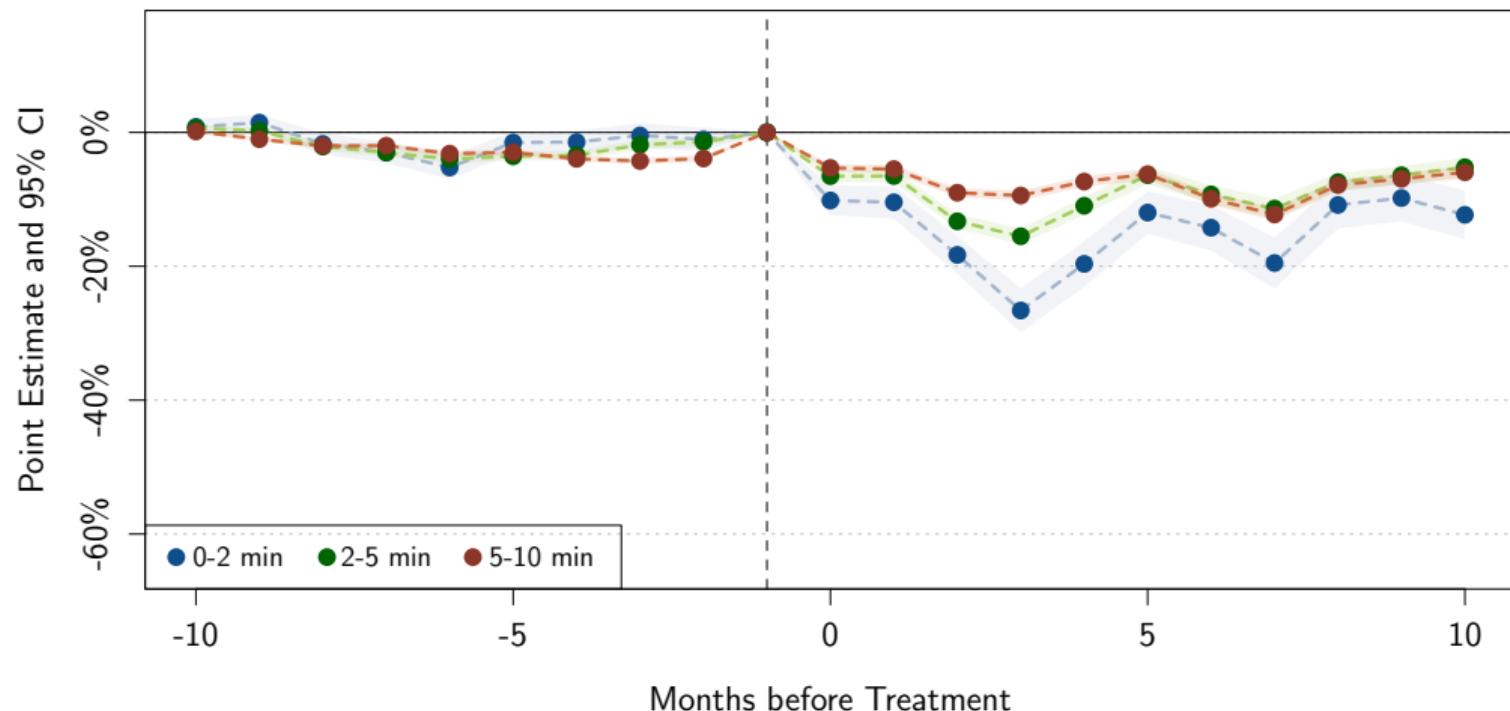
ATT: $-32.4\%^{***}$ (2 min), $-11.6\%^{***}$ (2–5 min), -2.3% (5–10 min)



Dynamic Effects: All Competitors

ATT: $-13.4\%^{***}$ (2 min), $-6.9\%^{***}$ (2–5 min), $5.5\%^{***}$ (5–10 min)

▶ Coop ▶ Lidl ▶ Aldi



Heterogeneities: Socio-Demographics (0-10 minutes)

Model:	In (Household Expenditures) <i>Level-Mean: 232 CHF</i>			In (No. of Trips) <i>Level-Mean: 20</i>		
	Own (1)	Main Competitor (2)	Discounter (3)	Own (4)	Main Competitor (5)	Discounter (6)
Treat × In (Age)	-0.023 (0.020)	0.02 (0.011)	0.017 (0.089)	-0.034*** (0.014)	0.018*** (0.008)	0.018*** (0.006)
Treat × Family Dummy	-0.001 (0.011)	0.009 (0.006)	-0.113*** (0.010)	0.004 (0.008)	0.004 (0.004)	-0.065*** (0.007)
Treat × In (mun. income)	-0.243*** (0.034)	0.191*** (0.021)	-0.028 (0.020)	-0.174*** (0.024)	0.150*** (0.015)	-0.020 (0.014)
Treat × Urban Dummy	-0.165*** (0.022)	0.144*** (0.008)	0.037*** (0.007)	-0.134*** (0.016)	0.104*** (0.005)	0.031*** (0.005)
Household and Month FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1,055,100	2,393,850	3,454,440	1,055,100	2,393,850	3,454,440

Heterogeneities: Spatial Amenities (200m, 0-10 minutes)

Model:	In (Household Expenditures)						
	Own (1)	Main Competitor (2)	Discourter (3)	Own (4)	Main Competitor (5)	Discourter (6)	
	(Measure: Dummy if Any)			(Measure: In (Continuous Count))			
Treat × Stores in 200 m	-0.014 (0.011)	-0.108*** (0.09)	0.003 (0.014)	0.039 (0.023)	-0.003 (0.006)	-0.013*** (0.003)	
Treat × Restaurants in 200 m	0.002 (0.296)	0.048*** (0.016)	0.007 (0.056)	-0.045*** (0.016)	-0.022 (0.035)	-0.009*** (0.002)	
Treat × Cafes in 200 m	-0.013 (0.022)	-0.133*** (0.037)	-0.047*** (0.006)	-0.020*** (0.009)	-0.006*** (0.002)	-0.004*** (0.001)	
Treat × Post Offices in 200 m	-0.020*** (0.009)	0.039*** (0.008)	0.024*** (0.009)	-0.071*** (0.022)	-0.002 (0.002)	0.005 (0.003)	
Treat × Banks in 200 m	-0.056 (0.039)	0.056 (0.039)	-0.023*** (0.007)	-0.031*** (0.008)	0.028*** (0.011)	-0.007*** (0.003)	
Household and Month FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1,055,100	2,393,850	3,454,440	1,055,100	2,393,850	3,454,440	

Heterogeneities: Products (Migros, 0-10 minutes)

[Main Competitor](#)
[Discounter](#)

Model:	In (Household Expenditures) <i>Level-Mean: 232 CHF</i>				
	(Meat) (1)	(Vegetables) (2)	(Convenience) (3)	(Other Food) (4)	(Household) (5)
A. Migros					
Treat × Urban	-0.092*** (0.016)	-0.127*** (0.043)	-0.108 (0.331)	-0.098*** (0.029)	-0.066*** (0.016)
Treat × Family	0.017** (0.005)	0.013 (0.009)	-0.009 (0.009)	0.000 (0.009)	0.033*** (0.006)
Treat × ln (Age)	-0.056*** (0.009)	-0.085*** (0.009)	-0.016 (0.015)	-0.018 (0.014)	-0.007 (0.015)
Treat × ln (Mun. Income p.c.)	-0.118*** (0.030)	0.016 (0.012)	-0.098*** (0.031)	-0.098*** (0.029)	-0.152*** (0.034)
Household and Month FE	Yes	Yes	Yes	Yes	Yes
Observations	978,572	980,679	981,804	1,008,907	874,578

Robustness

- Compare TWFE results to different robust Diff-in-Diff estimators. ▶ Heterogenous Results
- Only once-treated units ▶ Once-treated
- Only pre-Covid-19 period ▶ pre-pandemic
- Alternative treatment definition ▶ relative treatment
- Formally check parallel trend ([Rambachan and Roth, 2021](#)). ▶ Sensitivity

Conclusion

We have now a better understanding of consumption in space.

Outlook:

① Effects of entries on **rent prices**: ► Illustration

- Check for capitalization of our results into rents.
- *Hypothesis:* Rents should increase stronger in areas where residents have high preferences for short-distance shopping.

② Calculate **welfare effects**: ► Illustration

- Simple model to calculate heterogeneous preferences from our empirical results.

Questions & Answers

Cumulus

- ▶ The Loyalty Program
- ▶ Revenue Share
- ▶ Market Shares

Transactions

- ▶ per Week Day
- ▶ per Household Type
- ▶ per Product Group

Final Data

- ▶ Summary Households
- ▶ Summary Openings
- ▶ Summary Amenities

Treatment-Definition

- ▶ Share at Favorite Stores
- ▶ Treatment Composition
- ▶ Treatment Distance

Results

- ▶ Parametric Decays
- ▶ Dynamics Coop
- ▶ Dynamics Lidl
- ▶ Dynamic Aldi
- ▶ Product Types (Coop)
- ▶ Product Types (Discounters)

Robustness

- ▶ Other estimators (Migros)
- ▶ Other estimators (Competitors)
- ▶ Only pre-pandemic
- ▶ Only once-treated
- ▶ Alternative Treatment
- ▶ Sensitivity

Miscellaneous

- ▶ Catchment Areas
- ▶ Heterogeneous Catchments
- ▶ Welfare Measure
- ▶ Rents

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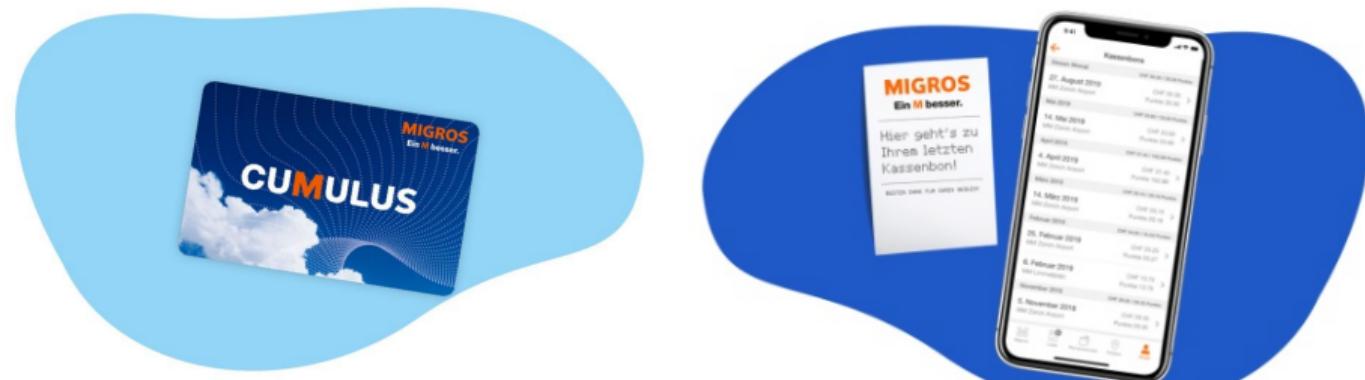
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Cumulus: The Loyalty Program

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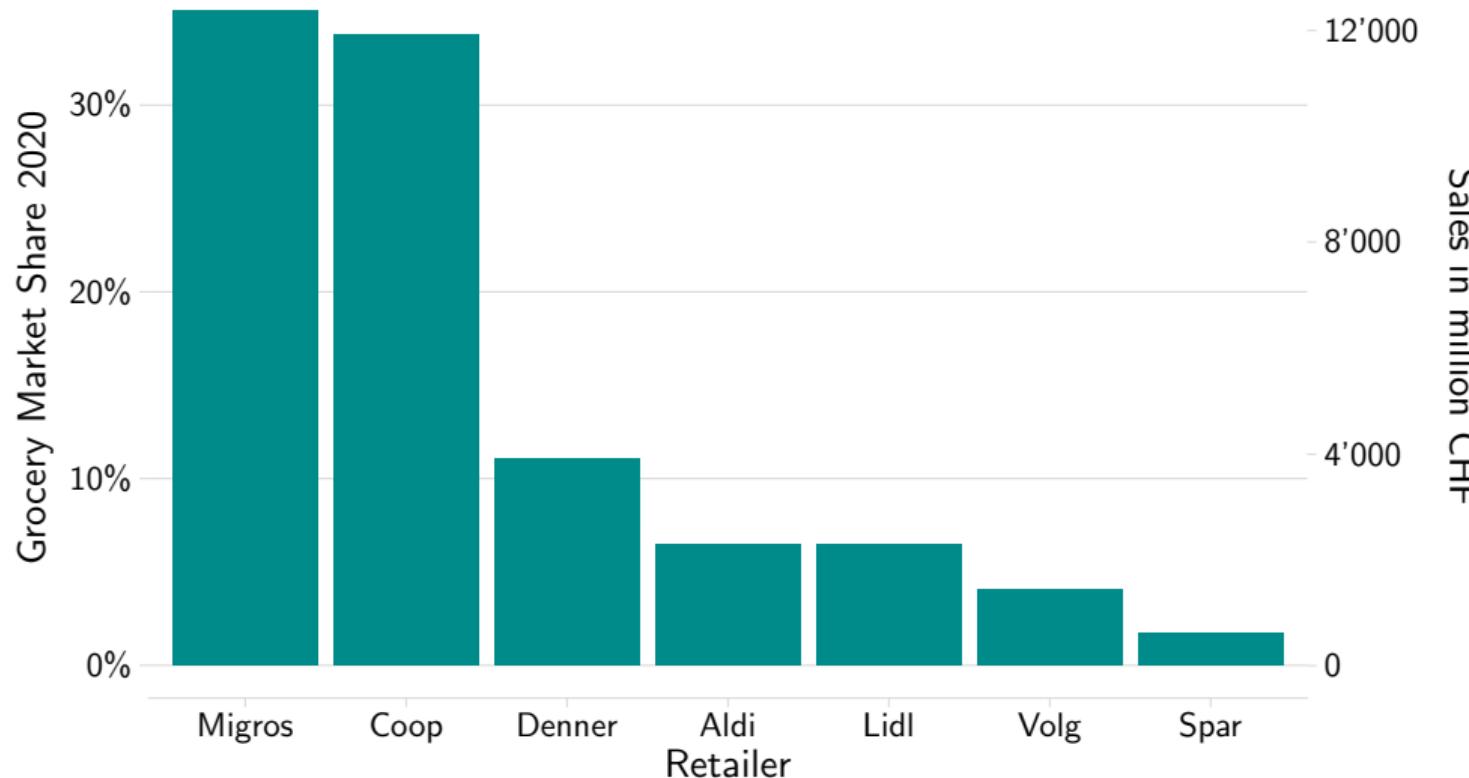
- Scan card at checkout to collect points.
- Collect points to get discounts and exclusive offers.



Representativeness: Grocery Market Share

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▶ Q&A

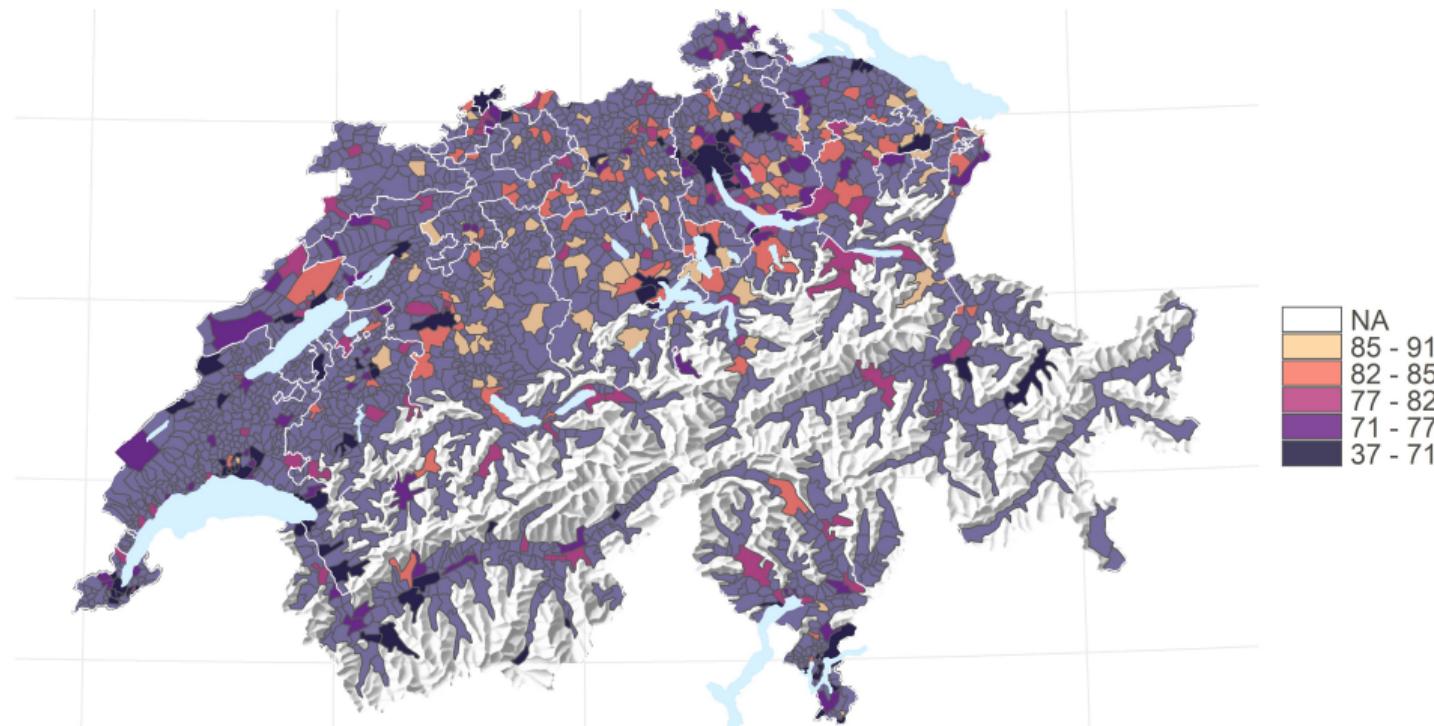


Representativeness: Share of Total Store Sales

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▶ Q&A

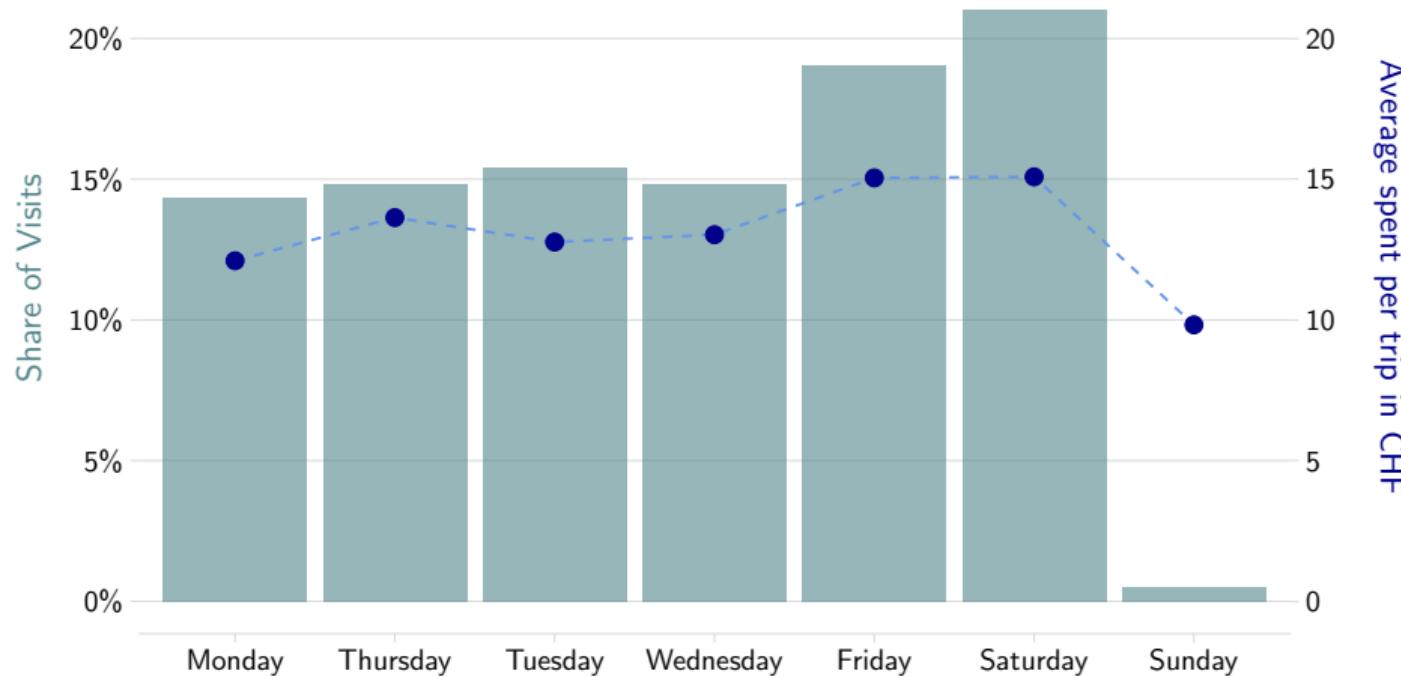
Share of the Cumulus program relative to total Sales. Mean: 70%, Median: 74%.



Transactions: Week Day

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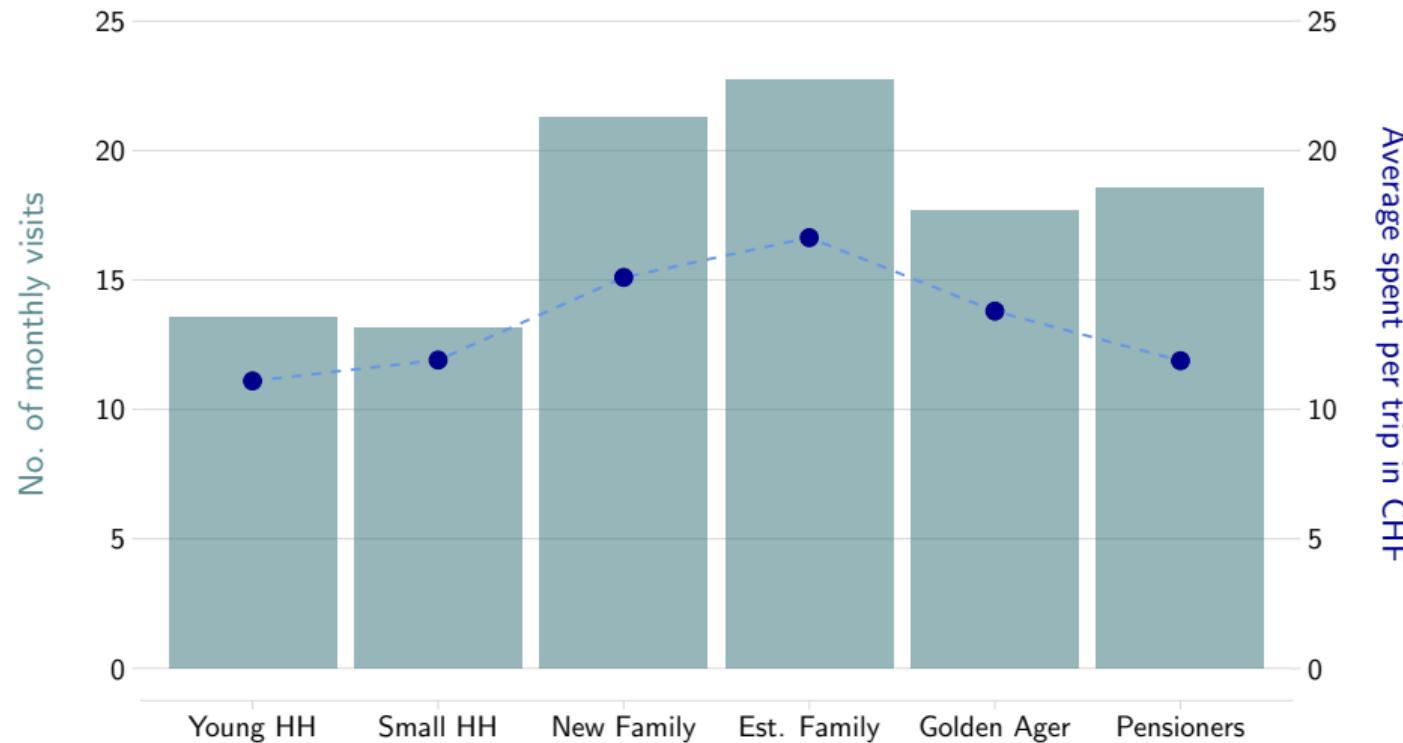
▶ Q&A



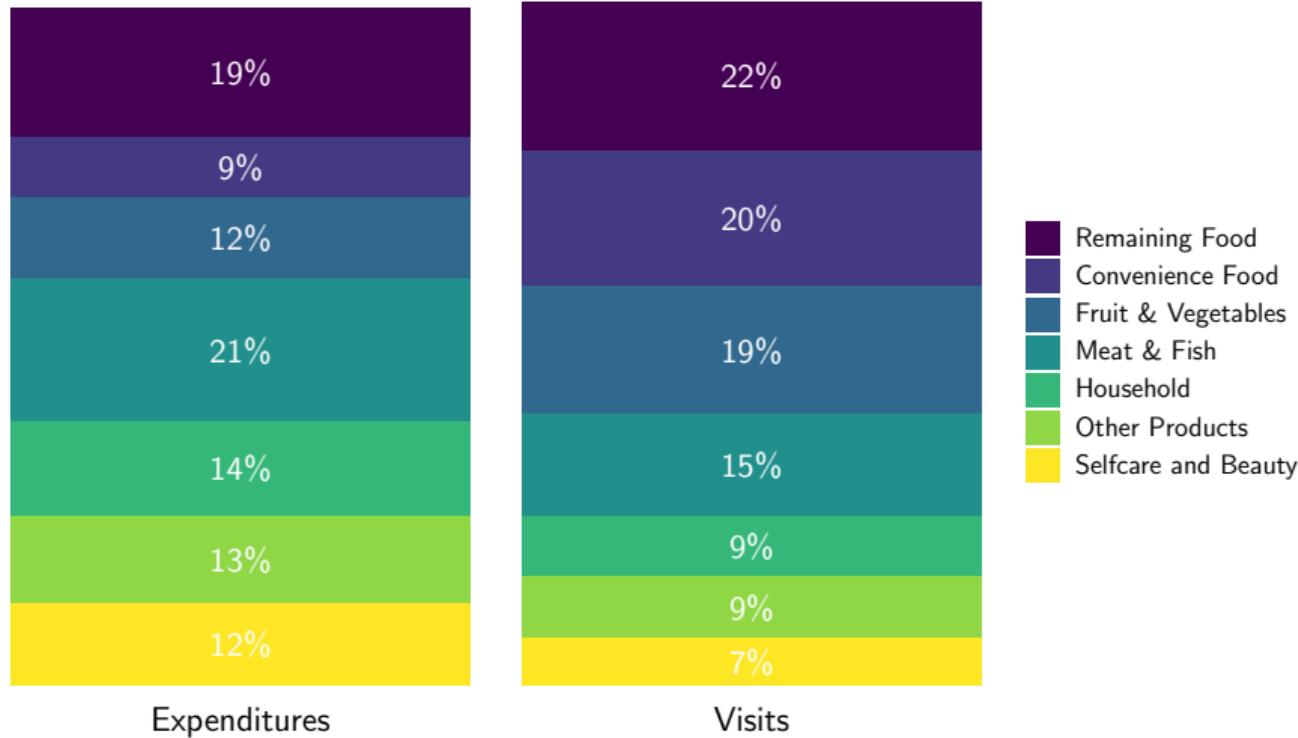
Transactions: Household Types

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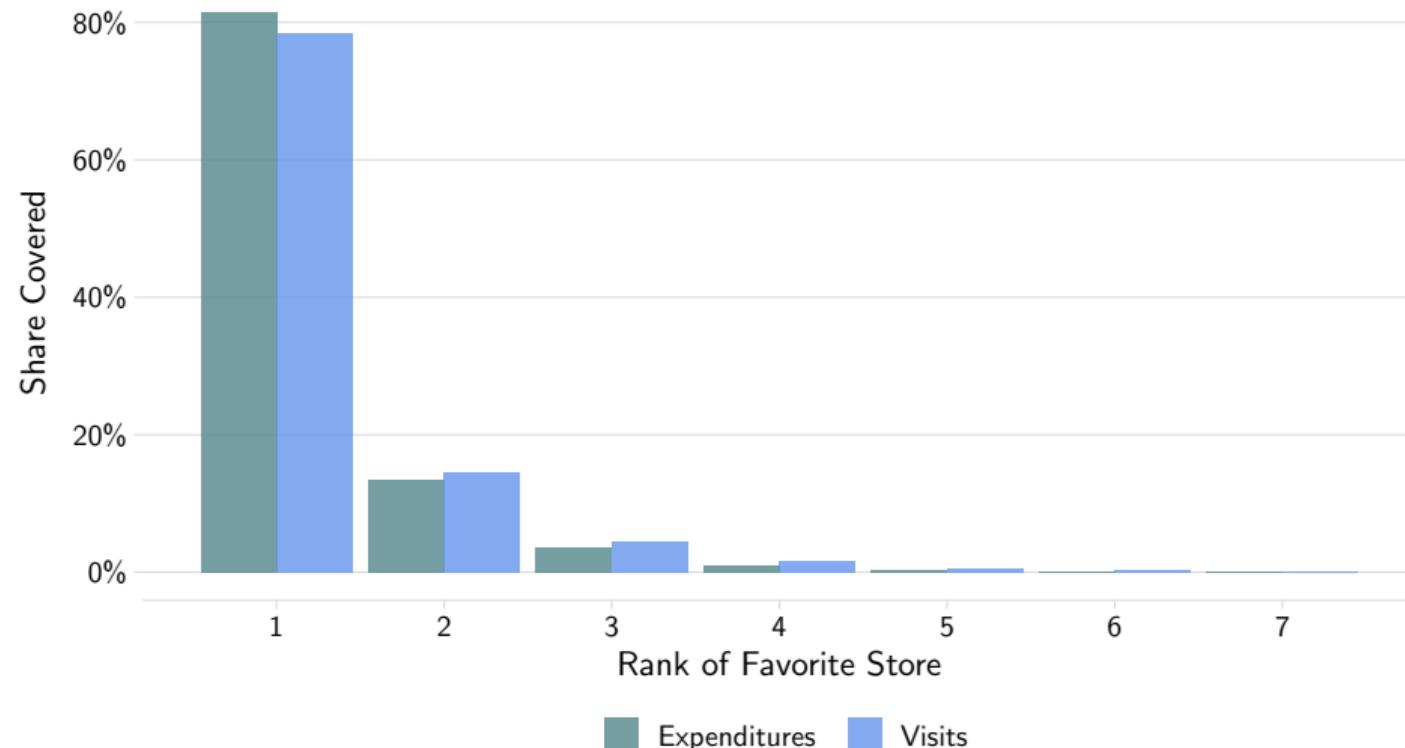
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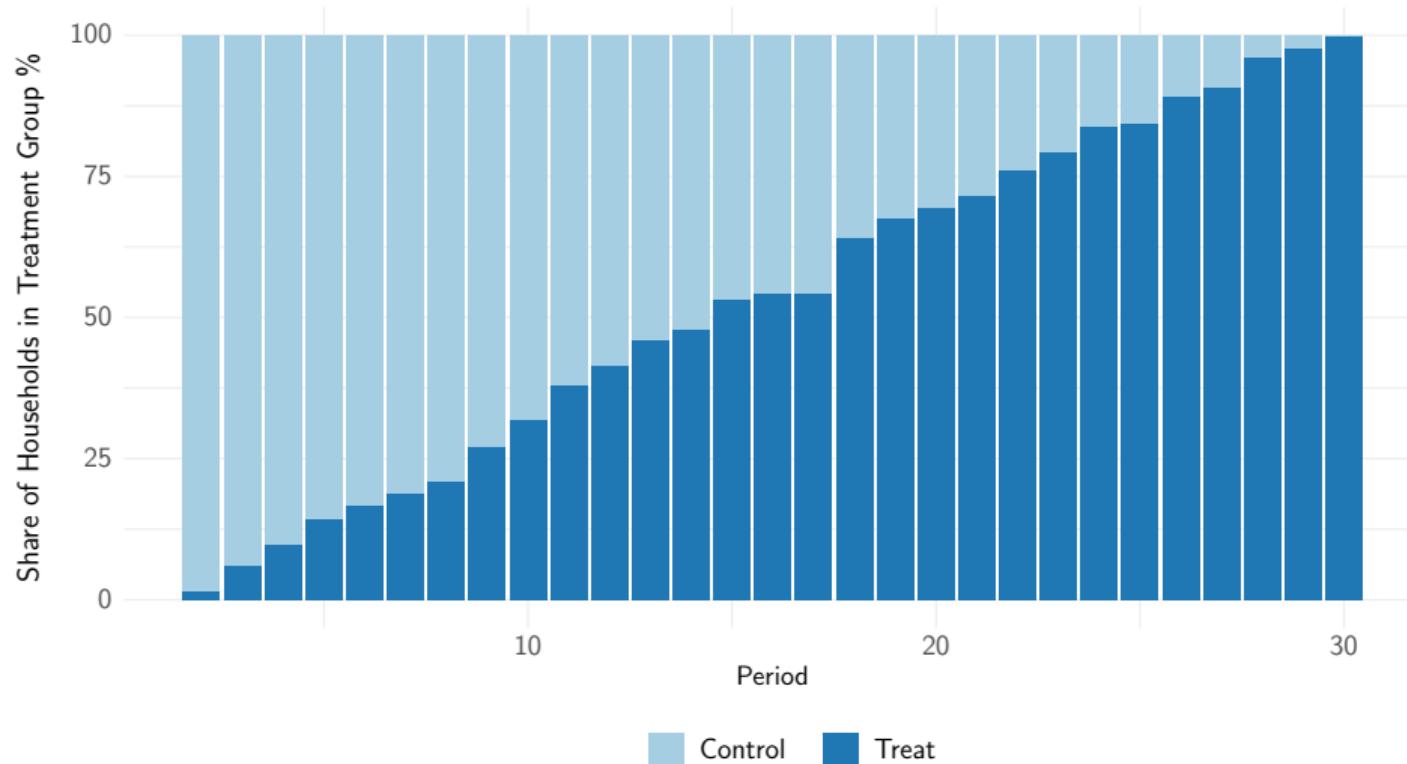
Transactions: Products

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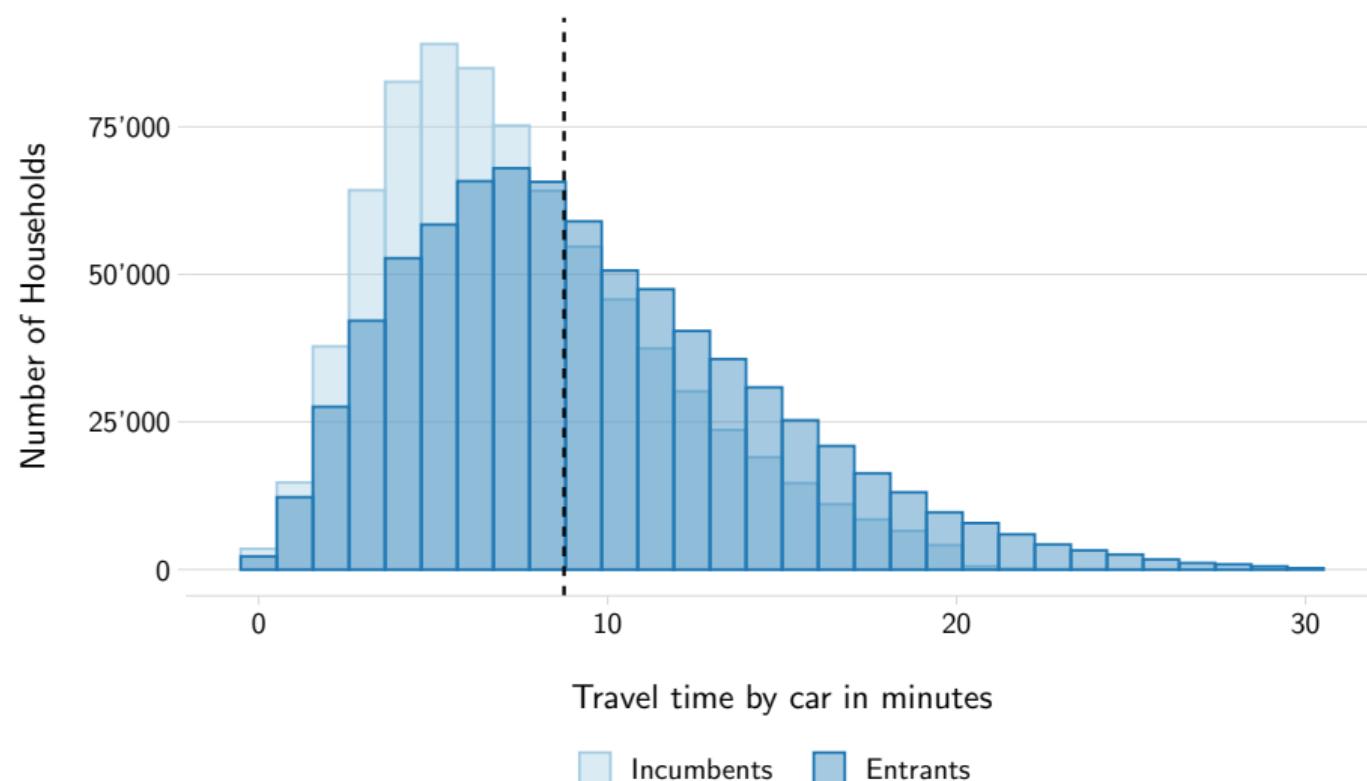
Transactions: Favorite Stores

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Treatments: Composition

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Treatments: Relative Distance

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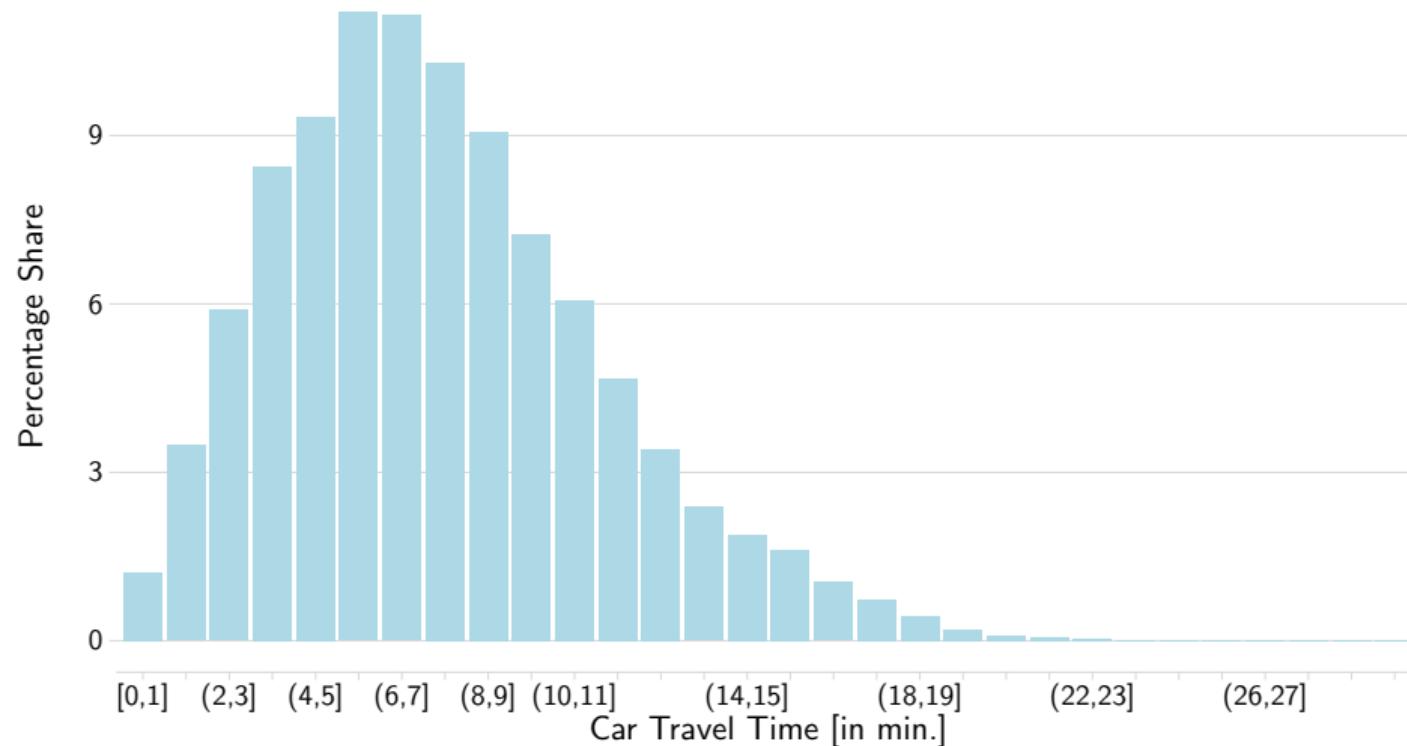
Summary Statistics I

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Panel A. Households: Distance to closest store opening

Variable	Mean	SD	Min	p25	p50	p75	Max	Households	Obs.
<i>Transactions (per month)</i>									
No. of Trips	26	17	1	14	23	34	284	772,523	23M
Expenditures	361	290	0	149	292	501	13203	772,523	23M
<i>Households</i>									
Age of cardholder	58	16	2	46	58	71	121	772,523	-
Family dummy	0.3	0.46	0	0	0	1	1	772,523	-
Mun. income (tCHF)	34	11	14	28	32	37	403	772,523	-
Urban share in data	0.29	0.45	0	0	0	1	1	772,523	-
Urban share in population	0.3	0.46	0	0	0	0	1	3,867,390	-
<i>Distance to favorite stores</i>									
By road (km)	4.6	3.8	0	1.7	3.5	6.6	28	772,523	-
By car (min.)	5.6	5.1	0	5.7	8.7	12.6	30	772,523	-

Summary Travel Times

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Summary Statistics II

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Panel B. Households: Distance to closest store opening

Urban	Road Distances (in km)					Car travel time (in minutes)				
	Migros	Coop	Lidl	Aldi	Denner	Migros	Coop	Lidl	Aldi	Denner
High density	2.4	3.0	2.0	2.0	2.3	7.9	8.9	7.2	7.5	7.8
Medium density	3.8	3.8	2.5	2.8	4.2	9.0	8.6	7.6	7.8	8.8
Low density	8.1	5.2	8.2	9.6	7.1	13.3	9.6	13.8	16.2	11.8

Summary Statistics III

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[▶ Q&A](#)

Panel C. Entrants: Location characteristics entrants

Amenity	Local economy within 100m				Local economy within 200m			
	Mean	SD	Min	Max	Mean	SD	Min	Max
<i>Population</i>								
Population	226	445	4	3'091	718	1'390	4	9'085
Employment	143	172	0	1'749	505	571	0	4'059
Firms	26	33	4	257	83	117	4	812
<i>No. of amenities</i>								
All	6.8	80.3	1	57	16.1	26.3	1	204
Stores	0.9	2.2	0	15	1.7	3.7	0	27
Cafés	0.7	1.7	0	13	2.1	5.8	0	49
Restaurants	1.7	2.5	0	17	4.5	7.9	0	49
Schools	0.2	0.0	0	8	0.7	0.0	0	17

Results: Parametric Distance Decay

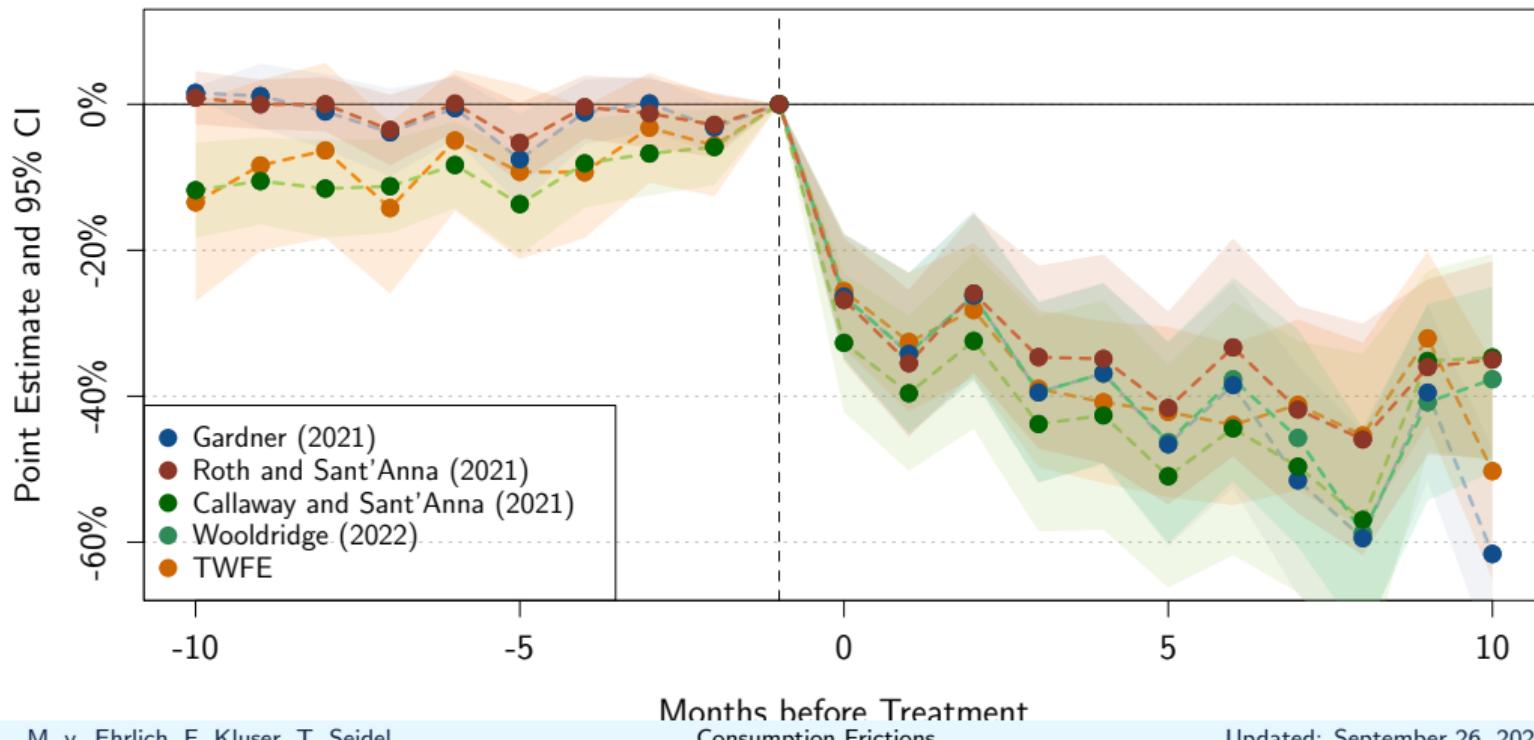
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	In (Expenditures) Level-Mean: 232 CHF			In (No. of visits) Level-Mean: 20		
	(1)	(2)	(3)	(4)	(5)	(6)
<i>A. Own-Chain Opening</i>						
Entry at mean	-0.054*** (0.006)	-0.058*** (0.005)	-0.064*** (0.004)	-0.031*** (0.005)	-0.035*** (0.003)	-0.043*** (0.003)
Entry × ln (road distance in km)	0.082*** (0.006)			0.066*** (0.004)		
Entry × ln (car distance in min)		0.110*** (0.008)			0.089*** (0.006)	
Entry × ln (public dist. in min)			0.124*** (0.008)			0.095*** (0.006)
Household and Month FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1,769,520	1,769,520	1,769,520	1,769,520	1,769,520	1,769,520

Other Estimators

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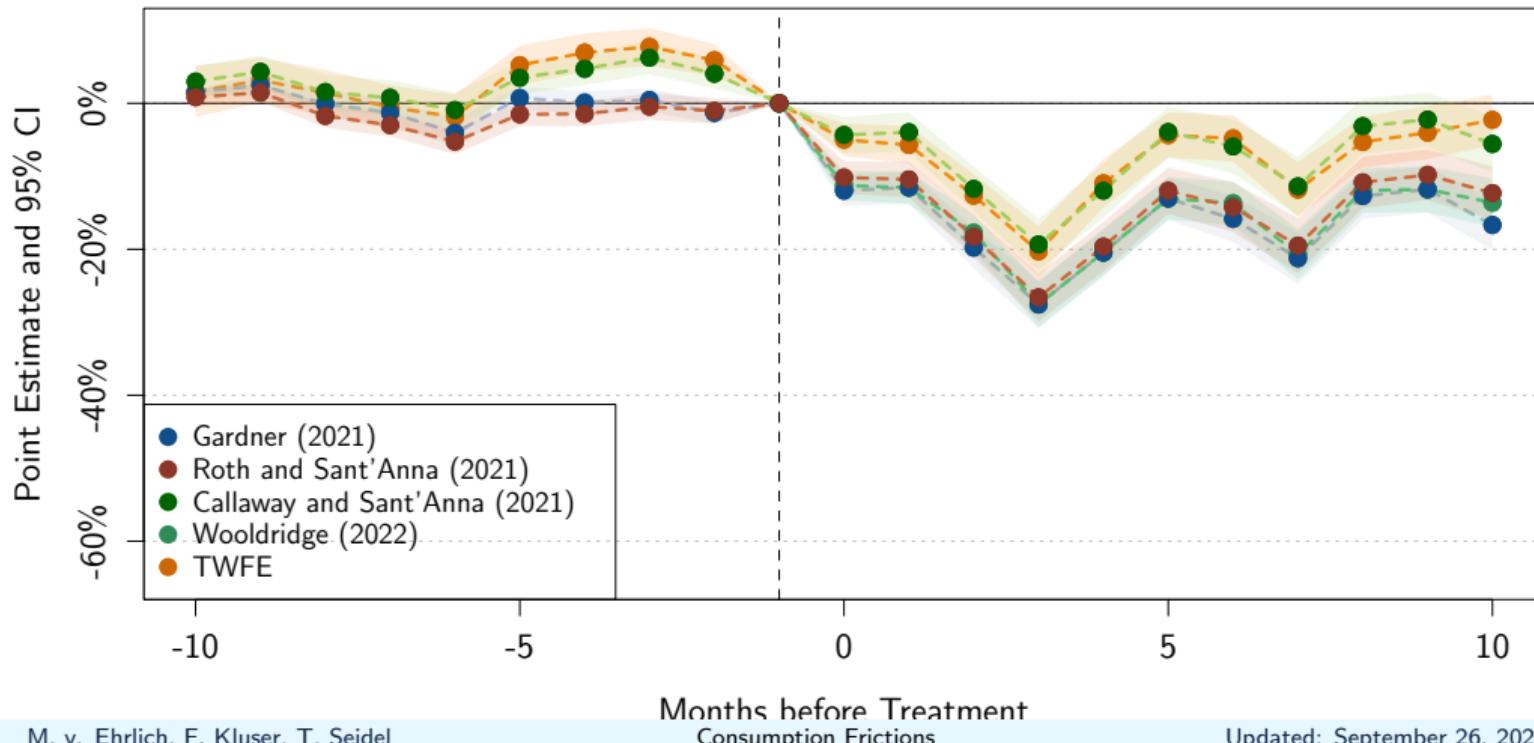
for Migros entries within 2 minutes.



Other Estimators

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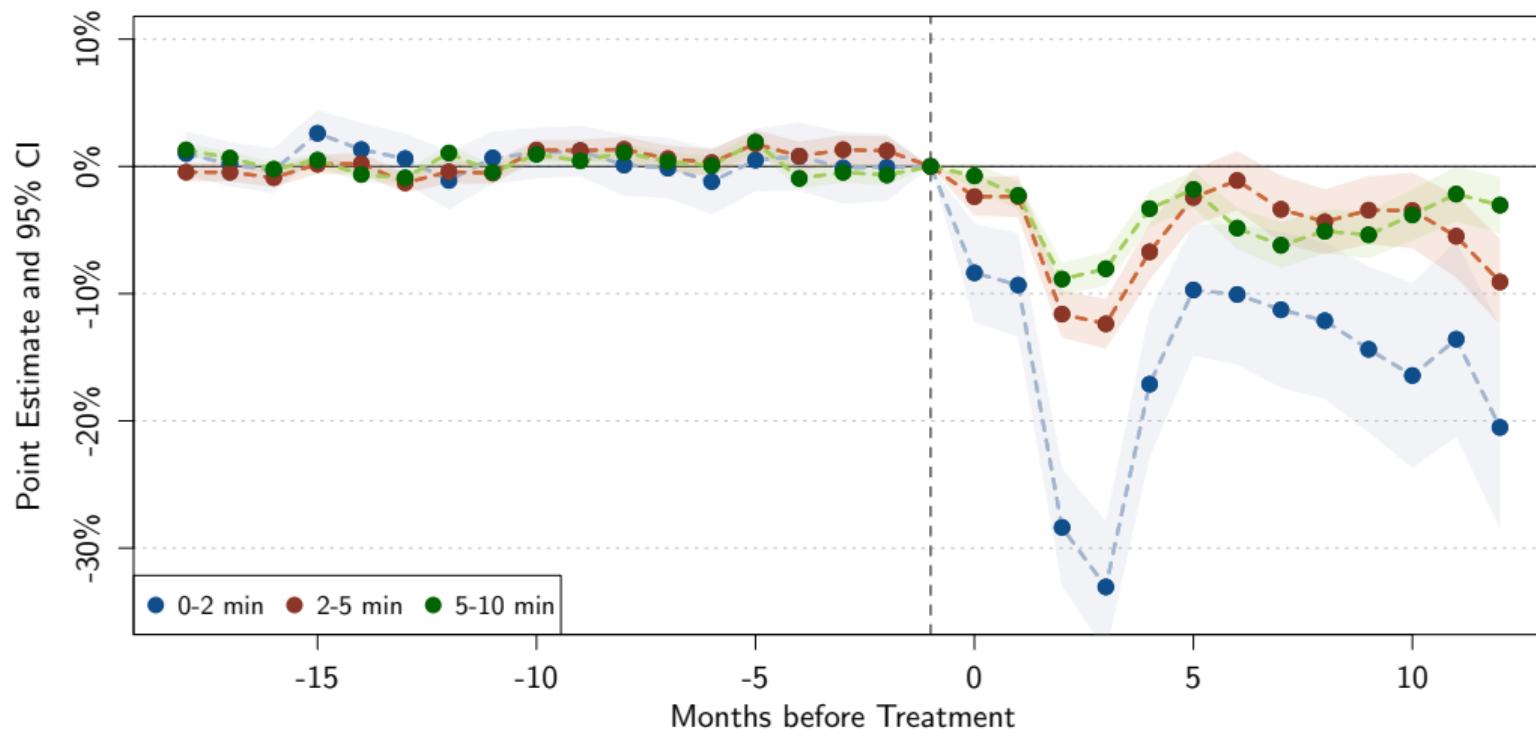
for Competitor entries within 2 minutes.



Dynamic Effects for Coop

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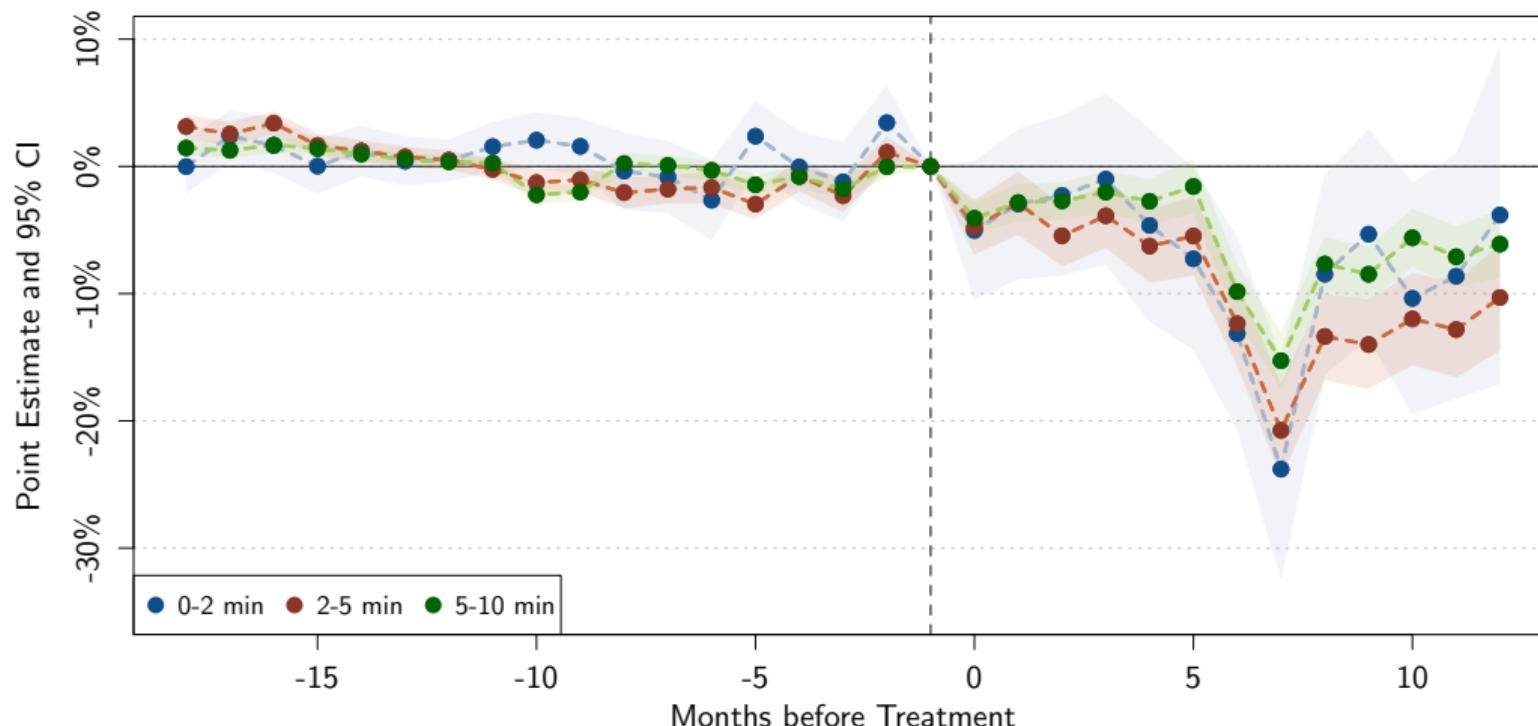
Estimated with [Roth and Sant'Anna \(2022\)](#). 4'948 households and 69 treatments.



Dynamic Effects for Lidl

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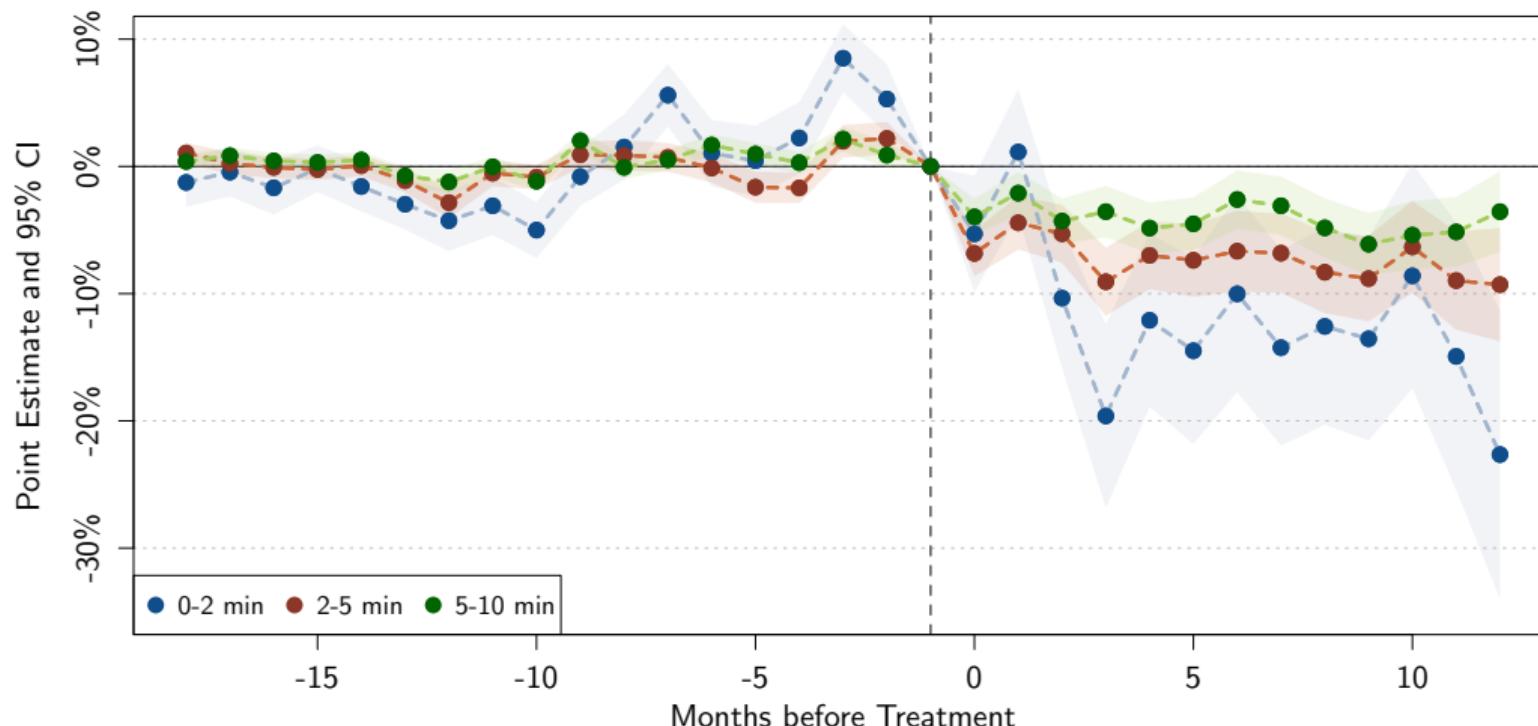
Estimated with [Roth and Sant'Anna \(2022\)](#). 2'985 households and 29 treatments.



Dynamic Effects for Aldi

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Estimated with [Roth and Sant'Anna \(2022\)](#). 3'395 households and 30 treatments.



Heterogeneities: Products (Coop, 0-10 minutes)

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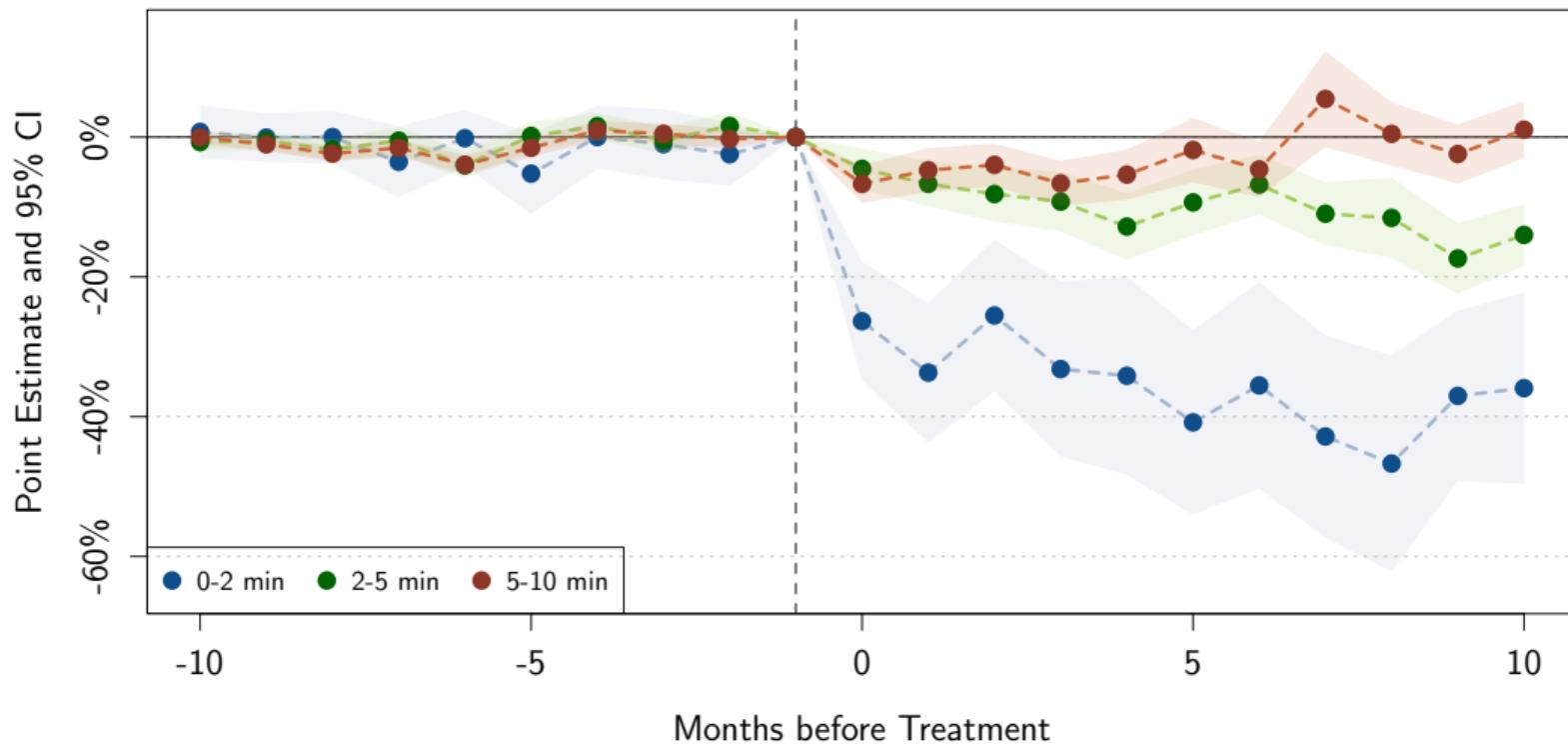
Model:	In (Household Expenditures) Level-Mean: 232 CHF				
	(Meat)	(Vegetables)	(Convenience)	(Other Food)	(Household)
	(1)	(2)	(3)	(4)	(5)
<i>B. Competitor</i>					
Treat × Urban	0.021*** (0.003)	0.081*** (0.007)	0.049 (0.079)	0.076*** (0.006)	0.025*** (0.004)
Treat × Family	-0.015*** (0.005)	-0.016*** (0.005)	-0.009 (0.005)	-0.020 (0.028)	-0.012*** (0.006)
Treat × ln (Age)	0.020*** (0.009)	0.026*** (0.009)	-0.016 (0.015)	0.011 (0.008)	0.016 (0.009)
Treat × ln (Mun. Income p.c.)	0.096*** (0.018)	0.114*** (0.018)	0.093*** (0.018)	0.121*** (0.016)	0.052*** (0.020)
Household and Month FE	Yes	Yes	Yes	Yes	Yes
Observations	2,104,136	2,224,679	2,236,269	2,299,588	1,995,241

Heterogeneities: Products (Discounters, 0-10 minutes)

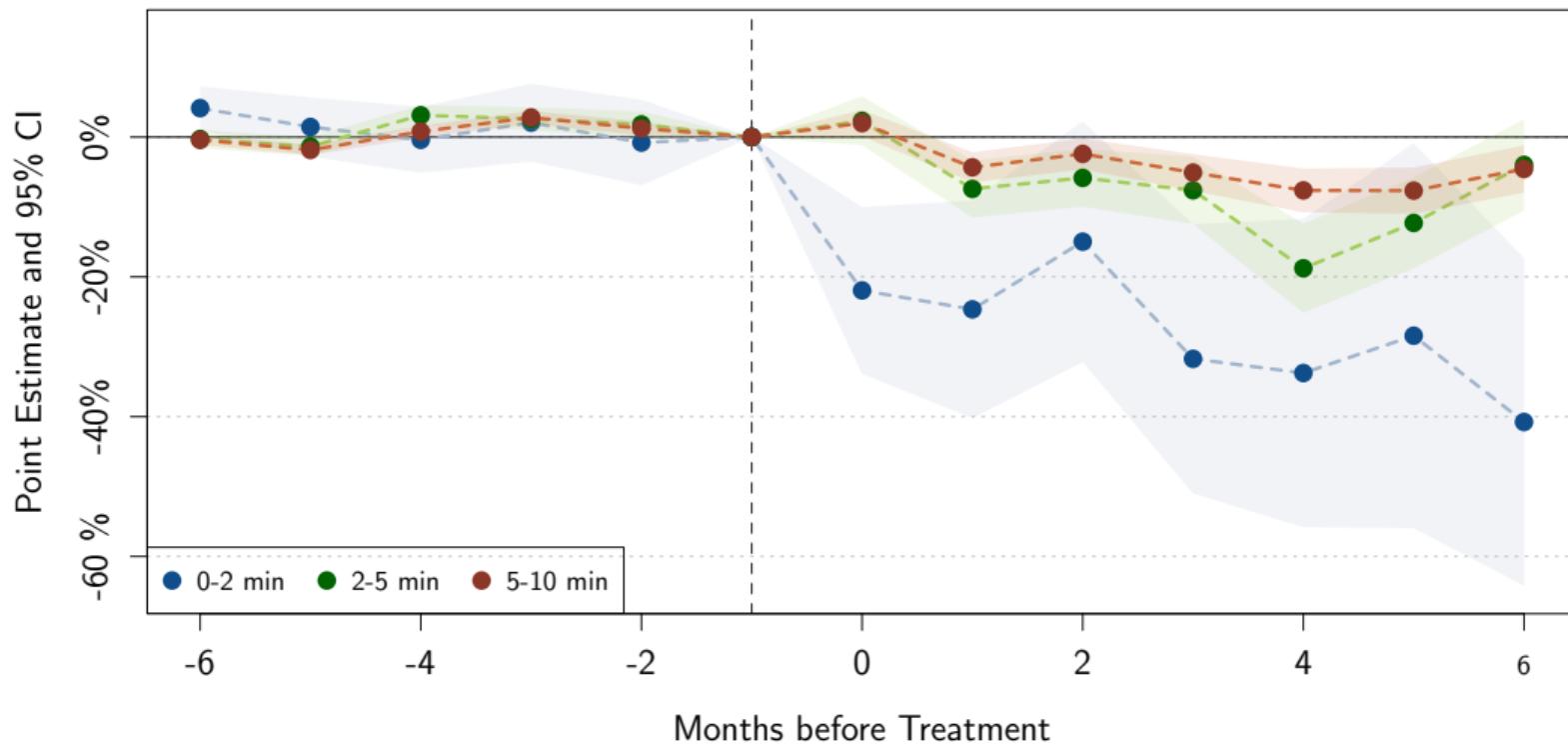
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Model:	In (Household Expenditures) Level-Mean: 232 CHF				
	(Meat)	(Vegetables)	(Convenience)	(Other Food)	(Household)
	(1)	(2)	(3)	(4)	(5)
<i>C. Discounter</i>					
Treat × Urban	0.043 (0.181)	0.021 (0.019)	0.007 (0.214)	0.014*** (0.006)	-0.008 (0.006)
Treat × Family	-0.062*** (0.005)	-0.073*** (0.005)	-0.058*** (0.005)	-0.082*** (0.004)	-0.063*** (0.005)
Treat × ln (Age)	0.025*** (0.002)	-0.001 (0.146)	-0.051 (0.832)	0.000 (0.015)	-0.002 (0.005)
Treat × ln (Mun. Income p.c.)	0.011* (0.006)	0.025*** (0.006)	-0.028 (0.018)	0.003 (0.032)	0.013* (0.013)
Household and Month FE	Yes	Yes	Yes	Yes	Yes
Observations	3,025,961	3,210,795	3,226,958	3,316,685	2,862,061

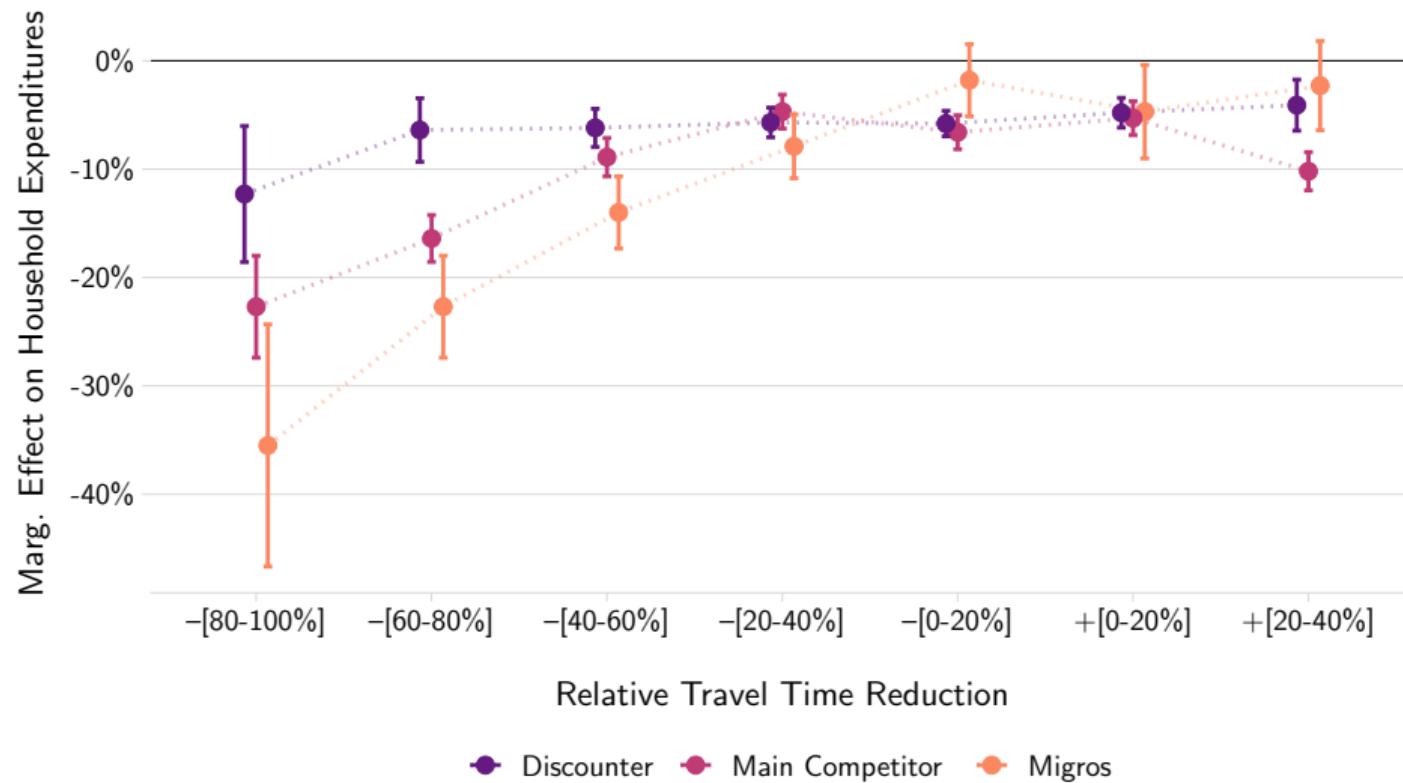
Robustness: Only once-treated units (Migros)

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Robustness: Only pre-pandemic (Migros)

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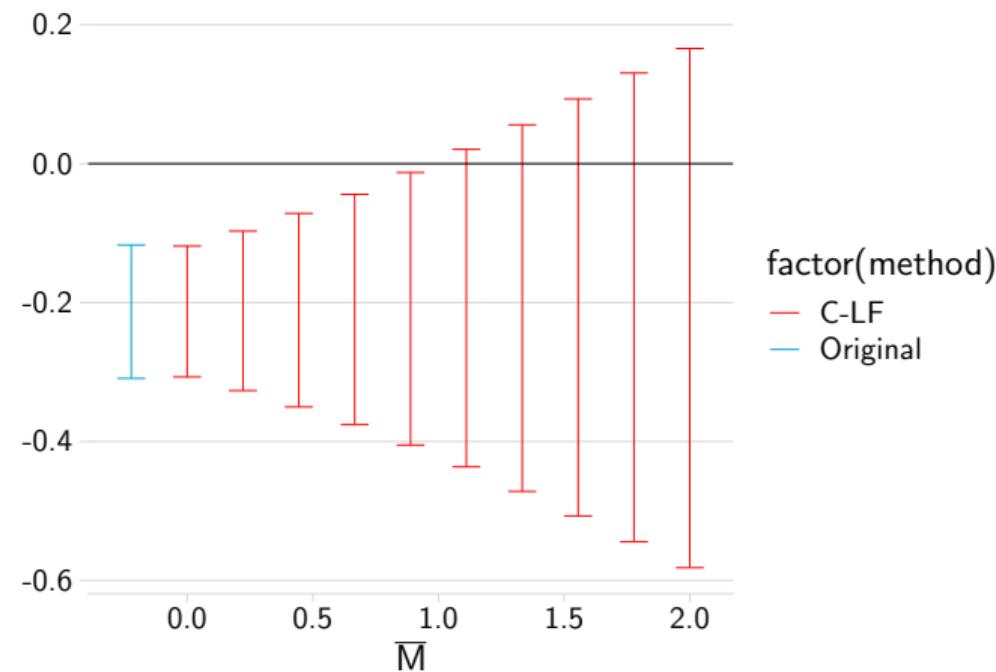
Robustness: Relative Distance Reduction

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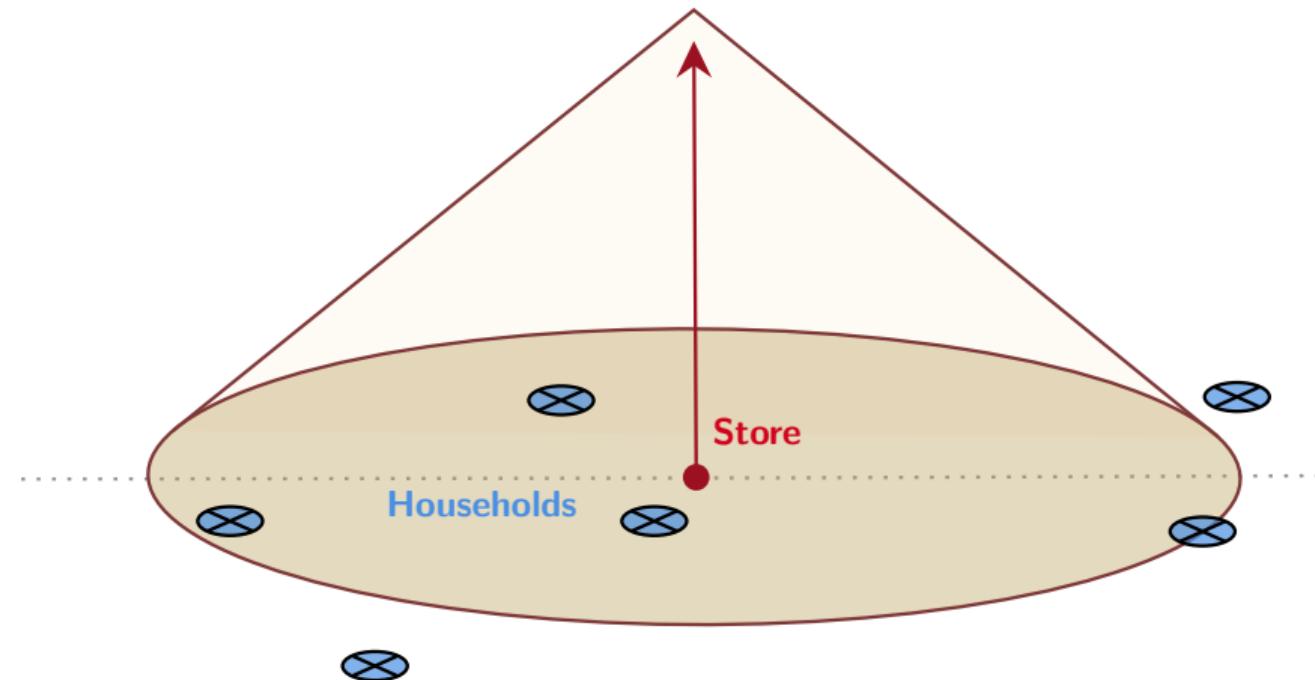
Sensitivity (Rambachan and Roth, 2021)

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test for the initial post-treatment period. Migros entries, 2 minutes, TWFE estimator.



Illustrate Homogeneous Catchment Areas

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Illustrate Heterogeneous Catchment Areas

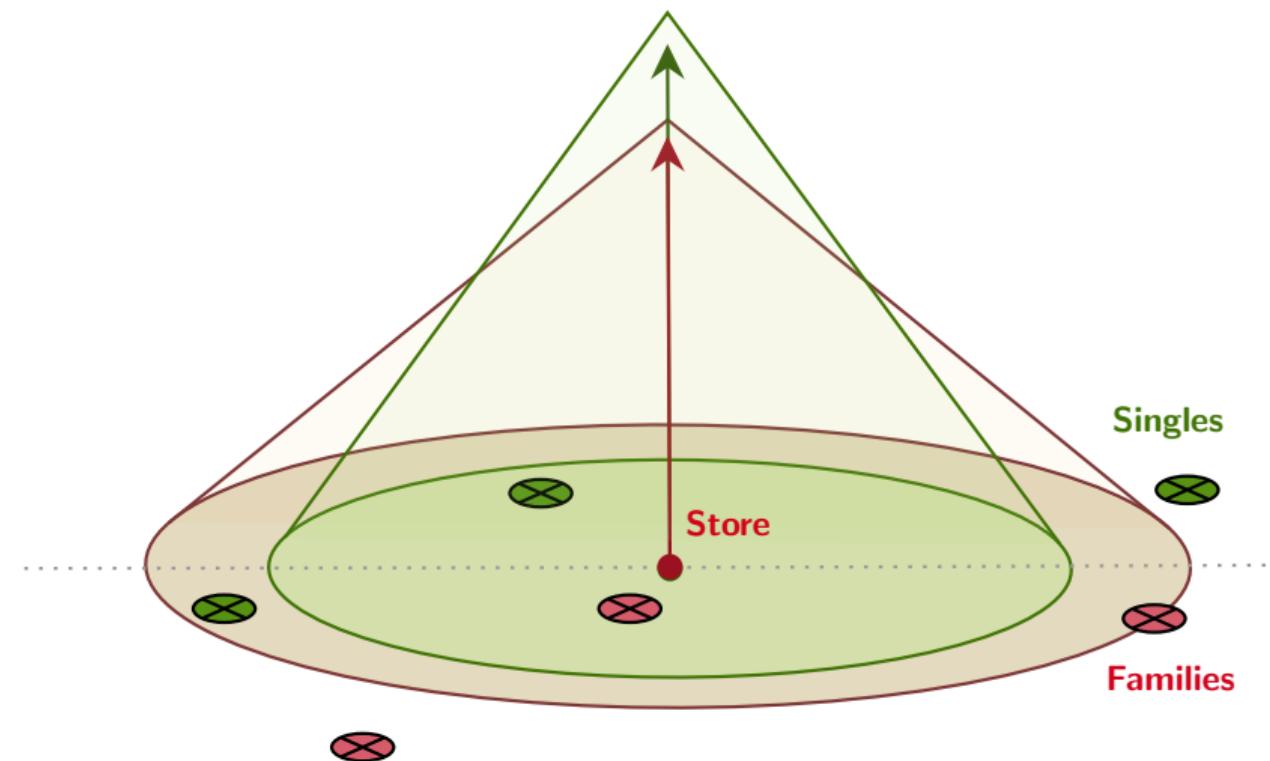
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Illustration: Welfare Measure

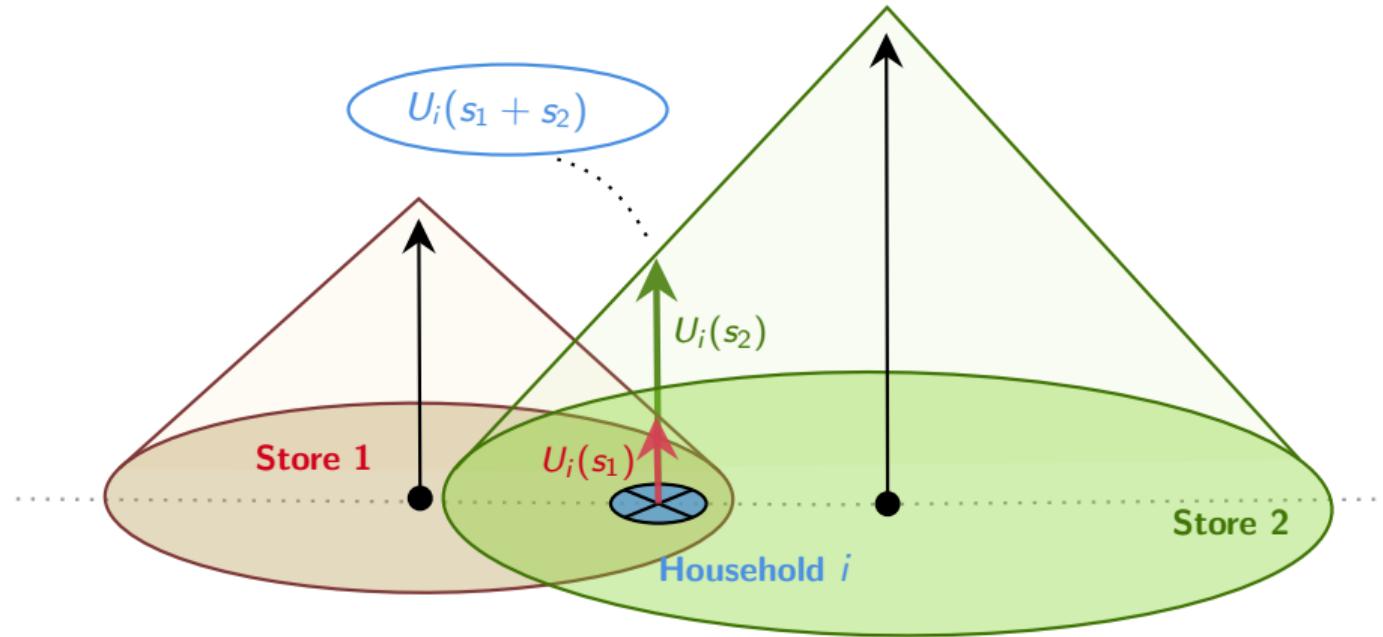
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Illustration: Effect on Rents

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