UNIVERSITÄT BERN

CRED
CENTER FOR REGIONAL ECONOMIC DEVELOPMENT

Cross-Border Shopping: Evidence from Household Transaction Records

CRED Research Paper No. 42

Frédéric Kluser

University of Bern, CRED

First Version: February 13, 2023
This Version: March 31, 2023

Abstract

Cross-border shopping allows purchasing comparable goods at lower prices abroad. At the same time, it can reduce domestic consumption, sales, or tax collection. During the Covid-19 pandemic, many countries restricted cross-border movements to mitigate the virus's spread, thereby also prohibiting cross-border shopping. I exploit the random timing of the Swiss border closure using data on 600 million customer-linked transactions from the largest Swiss retailer to identify patterns in cross-border shopping. I find that grocery expenditures temporarily increased by 10-15% in border regions. Households drive up to 70 minutes to a location across the border, but the distance decay function is non-linear and marginal costs of traveling become negligible after 40 minutes.

Key words: economic geography, consumption, consumption access, consumption inequality, spatial competition

JEL classification: R1, R2, L14

CRED
Universität Bern
Schanzeneckstrasse 1
Postfach
CH-3001 Bern

Tel. +41 31 684 37 11
info@cred.unibe.ch
www.cred.unibe.ch

1. Introduction

Cross-border shopping has been a growing phenomenon in many countries, particularly along national borders, where consumers can purchase goods and services at lower prices from neighboring countries. This activity increases product variety for households living close to the border and pressures domestic prices. At the same time, it may have adverse effects on local employment, consumption, sales, or tax collection (see Leal et al. 2010; Knight and Schiff 2012, or Baggs et al. 2018). This paper examines patterns in cross-border shopping, analyzing the Swiss border closure during the Covid-19 pandemic to understand consumers' behaviors better. On March 16, 2020, the Swiss government mandated the immediate closure of all restaurants, bars, entertainment, and leisure facilities to mitigate the Covid-19 pandemic. Additionally, the Federal Council announced the closure of the borders to all neighboring countries and upheld this policy until June 2020.[1] Switzerland is a unique case to study cross-border shopping because of two reasons. First, members of the European Union surround it (except for the Principality of Liechtenstein), allowing Swiss citizens to purchase comparable products at lower prices in Germany, Italy, Austria, or France.[2] These countries share a common currency, facilitating comparisons for Swiss households and eliminating exchange rate differences.[3] Hence, the relative attractiveness of these countries for Swiss consumers depends solely on their variety and prices of grocery products. Second, the exact timing of the border closure was random for Swiss residents, and Burstein et al. (2022) show that the policy was highly effective, as cross-border shopping shares almost fell to zero until the reopening. I use a difference-in-differences framework to identify the causal effect of the border closure on grocery expenditures within Switzerland by comparing households living close to a national border to households residing further inland. The estimated increase in domestic grocery expenditures measures the magnitude of cross-border shopping during open borders. I use this setting to calculate the distance decay function (the decline in cross-border shopping with distance) and analyze heterogeneities across household characteristics. To this end, I merge the universe of customer-linked

[1]Shops selling essential products (including grocery stores and pharmacies) remained open while other stores had to close. The borders to Liechtenstein remained open while crossing between Lichtenstein and Germany or Austria was prohibited. Nonetheless, crossings remained possible for work-related reasons for the 370'000 workers commuting from neighboring countries into Switzerland and the 29'000 Swiss residents working abroad.

[2]Groceries in neighboring countries are 35-40% cheaper according to Eurostat. Further, importation into Switzerland is exempt from VAT for a total value below 300 CHF, as long as certain limits for meat, tobacco, etc., are met.

[3]The CHF/EUR exchange rate was stable throughout this period. Therefore, the border closure was the only shock at the time.

transactions from the largest Swiss retailer with administrative records on labor market income and household characteristics for the entire Swiss population. This transaction data contains 600 million shopping trips for 2.8 million households in 2020.

First, I show that the policy increases expenditures by 10-15% in border regions. Second, I find that the distance decay function is highly non-linear. The marginal costs of traveling become negligible after 40 minutes, such that households still engage in cross-border shopping for up to 70 minutes of driving time. Third, expenditures of larger households increase more in response to the policy, while I find no differences in income. Fourth, the effect vanishes immediately and entirely once the border reopens. Therefore, cross-border behaviors seem to be deeply rooted and resist temporary shocks.

This paper contributes to the previous research on cross-border shopping. Chandra et al. (2014) find that an appreciation of the US dollar increases the propensity to cross into Canada (and vice versa) and Campbell and Lapham (2004) analyze the retailers' response. Further, Asplund et al. (2007) show that Danish tax cuts reduce alcohol sales in Sweden and Friberg et al. (2022b) estimate a hump-shaped demand elasticity for the effect of foreign price changes on store sales in Norway. While these papers shed light on broader patterns of cross-border shopping, I use customer-linked transaction data to analyze individual behavior and differences in travel costs. Following a similar approach, Friberg et al. (2022a) use Norway's Covid-19-related border closure to show that cross-border shopping reduces national tax revenues. Further, Burstein et al. (2022) develop a binary choice model and find substantial welfare gains from cross-border shopping for two counterfactuals: the appreciation of the Swiss Franc in 2015 and the border closure in 2020. Compared to these studies, I analyze the latter shock to estimate a causal distance decay function from customer-linked transactions with high spatial precision. To the best of my knowledge, this is the first study deriving rich socioeconomic heterogeneities in cross-border shopping.

2. Data

I combine unique transaction data with administrative data on a 100×100 meter spatial resolution for 2020. The first ingredient for this paper are customer-store-linked grocery expenditures collected through the loyalty program of the largest Swiss retailer, *Migros*, which holds a market share of 32.7%. This program allows participating customers to record their expenditures for exclusive discounts. It counts 2.8 million registered customers accounting for 85% of Swiss households, and captures 79% of the retailer's sales. Migros charges the same prices throughout the country, independently of local purchasing power, wages, and costs. Stores of similar size also generally offer similar goods, except for local products.[4]

The data set contains 600 million customer-linked purchases and provides information on individual characteristics, including the location of their residence on the 100 × 100 meter grid, their age, gender, and household type. In my analysis, I exclude customers that likely moved during my sample period or scarcely used their cards and aggregate individual shopping trips into weekly baskets.[5] This procedure generates 99 million weekly baskets for 1.7 million customers.

I enrich the purchase data with individual-level administrative records for the entire Swiss population. The Population and Households Statistics (STATPOP) includes individual and household characteristics, and the Old-Age and Survivors Insurance (AHV) adds labor market income for every citizen from tax records. I combine the two data sets on the grid level by identifying unique grid cell and age combinations. This approach matches 483'000 customers uniquely to a household, representing 29% of regular customers and 12% of Swiss households and accounting for 27 million transactions.

Table 1 shows summary statistics. The average matched household has 2.6 members and an income of 52'000 CHF (adjusted for the square root of household size). The mean cardholder is 57.6 years old. Further, the average household makes four transactions and spends 63 CHF per week. Expenditures increase with household size and income, while they are hump-shaped for age.

Finally, I calculate car travel times to foreign shopping locations as follows. (i) I scrape the location and Google review counts of all foreign supermarkets within 20 km of the Swiss border from *Google Maps*. This results in 117 cross-border locations with 2 million inhabitants and a grocery supply featuring 1'787 stores, of which 691 have at least 100 Google ratings. (ii) As cross-border shoppers likely focus on larger stores, I define a cross-border location as a foreign municipality with at least one store that has more than 100 Google Ratings.[6] (iii) I calculate the car travel time from every raster cell to all these locations and select the shortest for each cell.[7]

[4]We discuss this transaction data and its representativeness more extensively in Kluser et al. (2022).

[5]I define a *scarce* or irregular customer as one who spends less than 5 CHF per week.

[6]My results are robust if I define cross-border locations alternatively as (i) locations with at least three stores with 100 Google maps reviews or as (ii) locations with at least three stores with 500 Google maps reviews.

[7]All travel times are calculated from a national online mapping service, *search.ch*.

Table 1: Summary statistics

	Matched Customers					All Transactions				
	Mean	SD	p1	Median	p99	Mean	SD	p1	Median	p99
Costumers										
Weekly Expenditures	63	58	2	46	253	60	56	2	43	247
Weekly Shop Visits	4.4	2.9	1.1	3.7	14.1	4.5	3.1	1.1	3.8	14.7
Cardholder's Age	58	18	23	57	92	55	17	23	55	91
Income Total	89'013	124'117	0	71'900	424'250					
Income Adjusted	52'502	68'818	0	44'989	238'464					
Household Size	2.6	2.3	1.0	2.0	6.0					
Expenditures by household size										
(0,1]	38	35	2	30	162					
(1,2]	58	49	2	46	213					
(2,4]	78	66	3	62	276					
(4,10]	89	77	3	70	317					
Expenditures by income quintile										
(0,36]	59	54	2	44	241					
(36,59]	58	55	2	42	244					
(59,80]	57	52	2	42	233					
(80,109]	66	57	2	51	248					
(109,11'650]	78	67	2	61	283					
Expenditures by age quintile										
(16,36]	57	52	2	42	222					
(36,45]	80	67	3	63	279					
(45,53]	80	69	3	61	294					
(53,60]	69	62	2	52	268					
(60,104]	51	46	2	39	209					
Households	483'574					1'739'927				
Observations	27'563'708					99'175'829				

Notes: The table shows summary statistics for the transaction data set and the subsample of matched customers. I adjust total household income by the square root of household size.

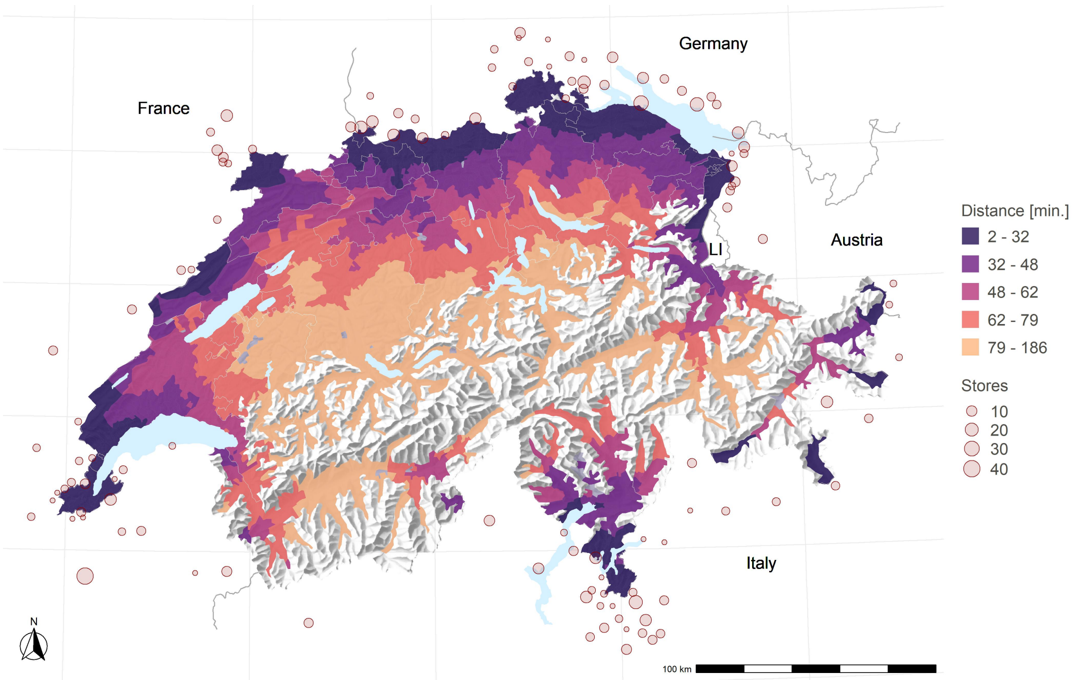
3. Empirical Strategy

I study the impact of the border closure by comparing households living within a 30-minute car drive from a cross-border location (the first quintile) to those living far enough inland such that they typically do not shop abroad. Hence, I choose a comparison distance of 80 minutes (the fifth quintile) and drop all individuals living within the doughnut area in between to ensure a clean control group.[8] Figure 1 shows these travel distance bins to the closest foreign location across

[8] The results are robust if I use alternative comparison distances of 90 or 100 minutes. If a fraction of control units would still react to the border closure, my results would provide a lower bound of the effect.

Switzerland, resulting in 348'000 treated and control households.

Figure 1: Distance to the closest cross-border shopping location



Notes: The figure shows the quintiles of car driving times to the closest cross-border shopping location on the municipality level. The dots show all 117 cross-border locations within 20 km from the Swiss border. The dots' size indicates the number of supermarkets at this location.

I use a difference-in-differences model to estimate the average treatment effect. Since all political regulations, grocery supply adaptations, and consumers' behavioral changes affect both groups, I attribute any deviation after the intervention to cross-border shopping. Therefore, I estimate the following model:

$$\ln(Y_{it}) = \alpha_i + \gamma_t + \sum_{k=1}^{52} \beta_k (D_i \times T_k) + \epsilon_{it}, \tag{1}$$

where Y_{it} are the grocery expenditures of household i in week t. α_i and γ_t are the household- and week-specific fixed effects, controlling for unobserved heterogeneity. D_i is an indicator variable that equals one if household i is in the treatment group, T_k indicates the week of the year 2020, and β_k are the associated pre- and post-treatment coefficients. Treatment starts in week twelve, and I normalize coefficients to the average in the pre-treatment period. To analyze the effect's decay with distance, I use a static version of the model, including travel time:

$$\ln(Y_{it}) = \alpha_i + \gamma_t + \beta_d(D_i \times Post_t \times \delta_i) + \epsilon_{it}, \tag{2}$$

where δ_i is the time household i drives to the closest cross-border location. Additionally, I add time-constant categorical covariates x_i for household income and size as well as regions to analyze heterogeneities in the decay function:

$$\ln(Y_{it}) = \alpha_i + \gamma_t \times x_i + \beta_{d,x}(D_i \times Post_t \times \delta_i \times x_i) + \epsilon_{it}. \tag{3}$$

In model (3), I include week-group fixed effects to allow for group-specific trends. This ensures that I compare households to similar units in the control group and is essential, for example, if richer households dine out more often.

4. Results and Discussion

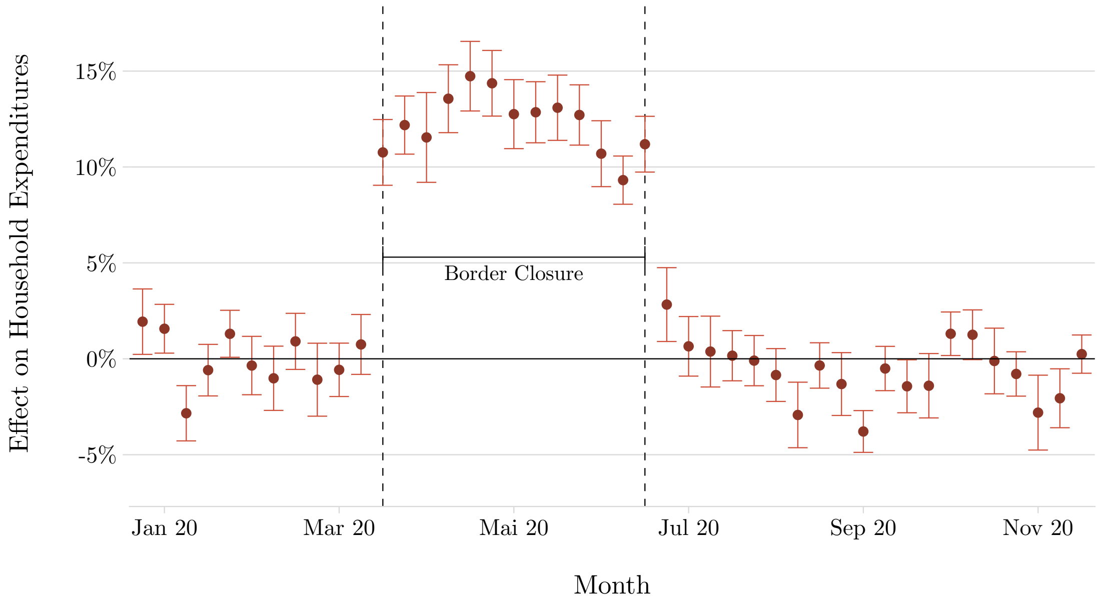
I report my empirical findings in three parts, discussing (i) the dynamic treatment effects, (ii) the effect's decay with distance, and (iii) socioeconomic heterogeneities of the decay function.

4.1. Dynamic treatment effects

First, I find that the border closure temporarily increases grocery expenditures by 10-15% at the border. Figure 2 shows that this shift is immediate and remains constant as long as the border is impassable.

After the reopening, expenditures immediately drop to the previous level. Hence, households did not adjust their cross-border shopping patterns through the Covid-19 pandemic and switched back to their old behavior as soon as possible. This result suggests that cross-border shopping follows deeply-rooted routines that withstand temporary shocks. There may even be a temporary catch-up effect, as some coefficients in the weeks after the reopening are below zero. Additionally, I expect no violation of the parallel trend assumption as the pre-treatment coefficients in Figure 2 are insignificant.

Figure 2: Dynamic treatment effects



Notes: The figure shows the border closure's effect on household expenditures within a 30-minute car ride from a cross-border location compared to households living further away than 80 minutes. Standard errors are clustered at the zip code level. The regression estimates model (1) and uses 16.6 million observations.

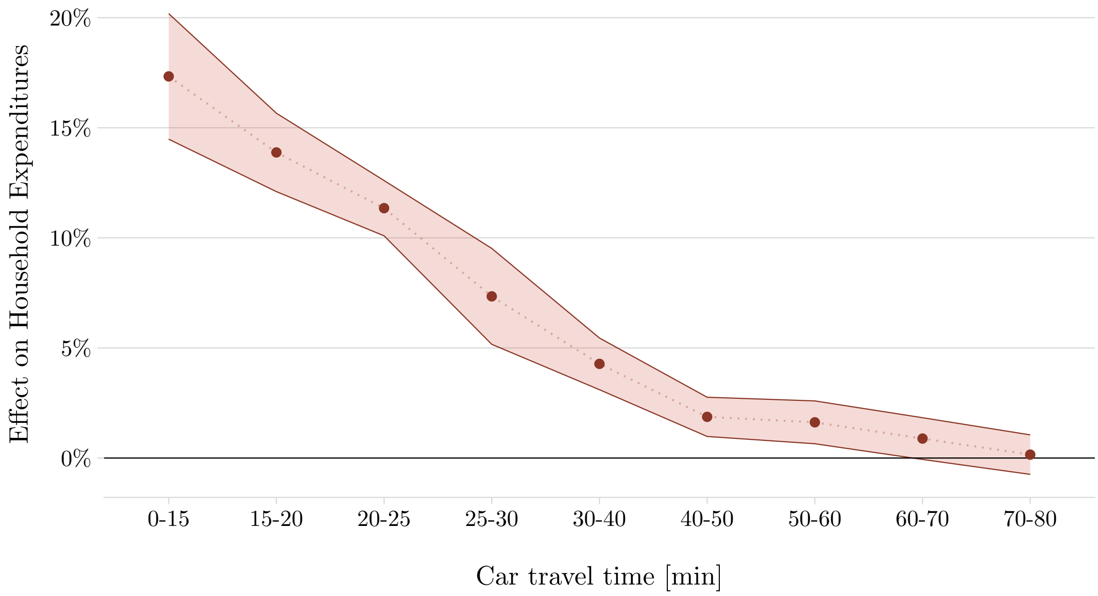
4.2. The distance decay function

Second, I quantify the decay of cross-border shopping with distance by analyzing the effect for larger distance bins. Figure 3 shows that the effect decreases with distance from the border. Households living within 15 minutes of a cross-border destination increase their expenditures by 17% during the border closure. The effect first declines linearly with distance before flattening out and becoming insignificant after 70 minutes. Therefore, these results indicate that after 40 minutes of driving, the marginal costs of traveling are negligible for the next half hour. One potential explanation may be trip-chaining. Shopping abroad generates high fixed costs, and consumers can combine cross-border shopping with, for example, visits to leisure activities. Further, average fuel usage falls with distance as drivers can easier maintain a consistent speed over a long trip, and consumers may experience reduced congestion if they effectively use highways for longer distances.

4.3. Heterogeneities

Third, while the transportation and time costs are likely similar between households, consumers may benefit differently from cross-border shopping based on their socioeconomic and cultural backgrounds. Figure 4 illustrates that cross-border shopping increases with household size. For exam-

Figure 3: Decay of the treatment effect

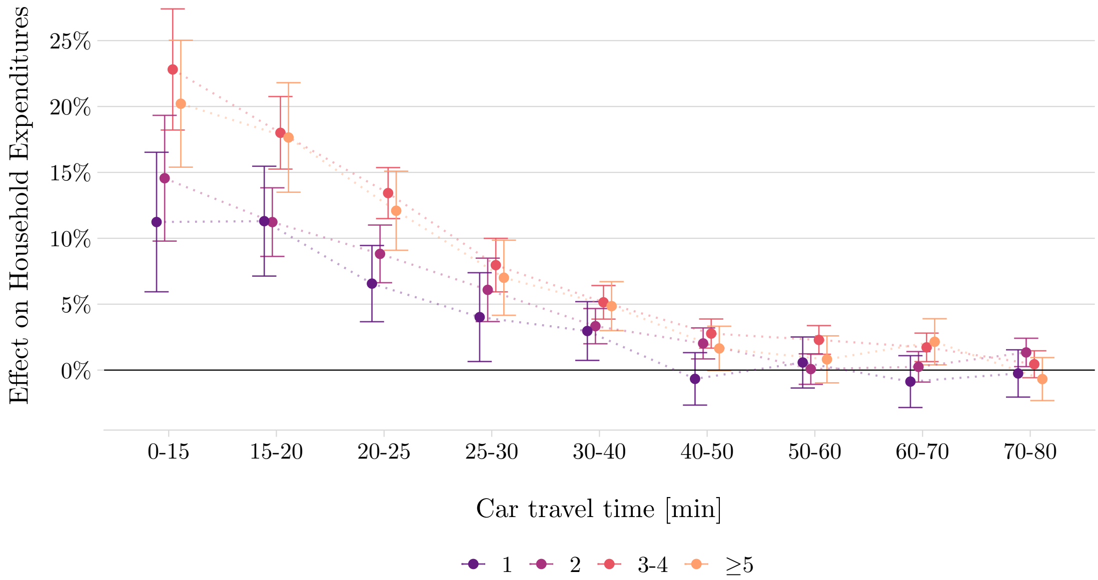


Notes: The figure shows the border closure's effect on household expenditures for different distance bins compared to households living further away than 80 minutes. Standard errors are clustered at the zip code level. The regression estimates model (2) and uses 23 million observations.

ple, within a 15-minute drive from a cross-border location, a single household increases her grocery expenditures by 10% in response to the border closure. At the same time, I observe for large households with at least three members an effect of over 20%.

Economies of scale likely drive this for larger households, as they spend more money on groceries and consume larger quantities. Hence, buying in bulk at lower prices abroad is particularly attractive for them. Likewise, one could expect poorer households to engage in more cross-border shopping as they spend a higher share of their income on groceries. Accordingly, their expenditures should react stronger, but I find no significant differences between income categories. This may be because bulking is limited for a given household size, especially as I observe the strongest responses for perishable goods, which are harder to store. Finally, I find stronger effects in the Italian-speaking region, where grocery expenditures rose by 27%. In comparison, the effect is around 10% and 15% in German- and French-speaking areas. As prices of consumption goods are similar across the neighboring countries, cultural differences likely play a noteworthy role.

Figure 4: Decay of the treatment effect: by household size



Notes: The figure shows the border closure's effect on household expenditures for different distance bins and household size quintiles compared to households living further away than 80 minutes. Household size is measured by the number of people living in this household according to administrative data. Standard errors are clustered at the zip code level. The regression estimates model (3) and uses 4.9 million matched observations.

5. Conclusion

Overall, price differences between neighboring countries induce households to shop abroad and generate welfare gains for them. I analyze the Covid-19 induced border closure in Switzerland as a natural experiment and show that cross-border shopping is a widespread and persistent phenomenon in Switzerland, and diverse socioeconomic groups are willing to drive up to 70 minutes to take part in it. My findings indicate further that larger households engage in more cross-border shopping, while I find no differences between income groups. Thus, policymakers should consider these heterogeneities and be conscious of negative impacts on retail sales, employment, or housing prices through cross-border shopping when setting, for example, a VAT or taxing fuel.

Acknowledgements

I thank Martina Pons, Dino Collalti, Maximilian von Ehrlich, and Costanza Naguib for their support and helpful comments. Support for this project from Migros and the Swiss National Science Foundation with grant ref. 187443 (NRP 77) is gratefully acknowledged.

Declaration of competing interest

The author declares that he has no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

The data that has been used is confidential and the author does not have permission to share the data. Programming files are available upon request.

Funding

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

References

Asplund, M., Friberg, R., Wilander, F., 2007. Demand and distance: Evidence on cross-border shopping. J. Publ. Econ. 91, 141–157. doi:10.1016/j.jpubeco.2006.05.006.

Baggs, J., Fung, L., Lapham, B., 2018. Exchange rates, cross-border travel, and retailers: Theory and empirics. J. Int. Econ. 115, 59–79. doi:10.1016/j.jinteco.2018.08.008.

Burstein, A., Lein, S., Vogel, J., 2022. Cross-border shopping: evidence and welfare implications for Switzerland. Working Paper .

Campbell, J., Lapham, B., 2004. Real Exchange Rate Fluctuations and the Dynamics of Retail Trade Industries on the U.S.-Canada Border. Am. Econ. Rev. 94. doi:10.1257/0002828042002723.

Chandra, A., Head, K., Tappata, M., 2014. The Economics of Cross-Border Travel. Rev. Econ. Stat. 96, 648–661. doi:10.1162/REST_a_00404.

Friberg, R., Halseth, E.M.S., Steen, F., Ulsaker, S.A., 2022a. The Effect of Cross-Border Shopping on Commodity Tax Revenue: Results from a Natural Experiment. NHH Dept. of Economics Discussion Paper 09. doi:10.2139/ssrn.4142274.

Friberg, R., Steen, F., Ulsaker, S.A., 2022b. Hump-Shaped Cross-Price Effects and the Extensive Margin in Cross-Border Shopping. Am. Econ. J.: Microecon. 14, 408–438. doi:10.1257/mic.20190302.

Kluser, F., Seidel, T., von Ehrlich, M., 2022. Spatial frictions in consumption and retail competition. CRED Working Paper 40.

Knight, B., Schiff, N., 2012. Spatial Competition and Cross-Border Shopping: Evidence from State Lotteries. Am. Econ. J.: Econ. Polic. 4, 199–229. doi:10.1257/pol.4.4.199.

Leal, A., López-Laborda, J., Rodrigo, F., 2010. Cross-Border Shopping: A Survey. Int. Adv. Econ. Res. 16, 135–148. doi:10.1007/s11294-010-9258-z.

Online Appendixes

Appendix A. Supplementary Material

This supplementary material provides additional information on the data, supports and deepens some of the arguments made in the paper, and provides robustness checks.

Appendix A.1. Data

Prices:

Table A.1 shows how much a certain grocery category is cheaper in neighboring countries than in Switzerland. Food and beverages take up the largest share of grocery expenditures, and cross-border commuters save between 35% and 40% on these categories. Regarding other consumption goods like clothing or household appliances, the price differences are generally smaller but similar across neighboring countries.

Table A.1: Foreign relative to Swiss prices 2020

Category	Germany	France	Italy	Austria
Food and beverages	-40.4%	-35.9%	-38.2%	-37.6%
Clothing	-20.9%	-13.3%	-18.8%	-15.4%
Household appliances	-14.2%	-11.5%	-19.8%	-18.4%

Notes: The table shows the relative prices of four grocery product categories relative to Swiss prices. Based on Eurostat's price level indices 2020 (EU28 = 100).

Cross-border locations:

Table A.3 displays the largest identified cross-border locations, showing the number of stores with a certain minimum amount of Google ratings. A municipality with a large number of stores typically also has many larger stores with more than 100 or 500 Google reviews. This is further supported by the fact that the associated correlations reported in Table A.2 between the different measures are very high and lie between 0.86 and 0.92.

Table A.2: Correlation of store numbers

	Population	Stores	Stores 100	Stores 500
Population	1.00	0.86	0.85	0.83
Stores	0.86	1.00	0.90	0.86
Stores 100	0.85	0.90	1.00	0.92
Stores 500	0.83	0.86	0.92	1.00

Notes: The table correlations between the number of smaller and larger stores as well as the population in a foreign municipality.

Table A.3: Cross-border locations

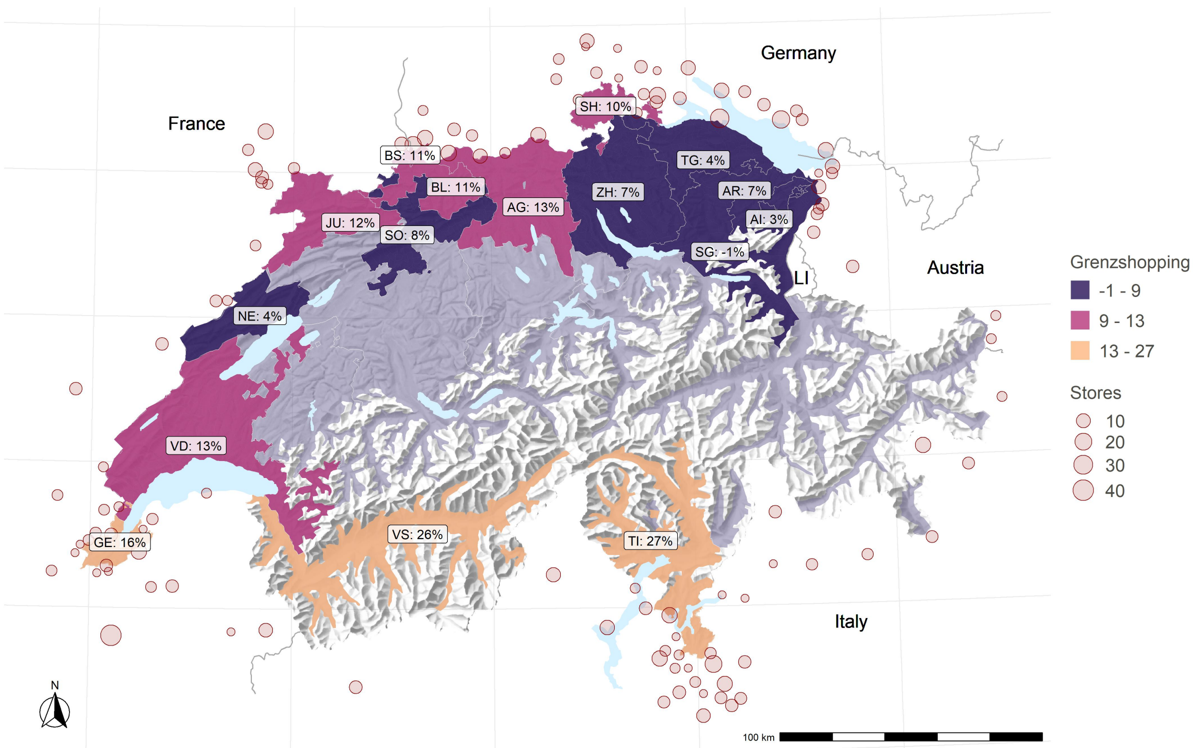
	Location	Country	Pop	Number of Stores			Rank		
				Google Reviews			*Google Reviews*		
				-	100	500	-	100	500
1	Annecy	FR	131'766	79	29	11	1	1	3
2	Como	IT	84'808	76	21	14	2	4	1
3	Konstanz	GER	84'446	71	29	14	3	1	1
4	Singen	GER	48'033	50	18	10	4	5	4
5	Annemasse	FR	36'582	49	13	5	5	13	15
6	Aosta	IT	34'052	47	7	3	6	30	34
7	Livigno	IT	6'363	47	14	5	6	12	15
8	Varese	IT	80'588	46	15	7	8	8	8
9	Friedrichshafen	GER	61'561	45	23	10	9	3	4
10	Sondrio	IT	21'457	40	3	1	10	67	67
11	Cantù	IT	40'031	39	12	6	11	16	10
12	Belfort	FR	45'458	37	15	4	12	8	22
13	Lindau	GER	25'547	36	15	9	13	8	6
14	Domodossola	IT	17'930	35	11	4	14	18	22
15	Lörrach	GER	49'295	33	15	7	15	8	8
16	Weil am Rhein	GER	30'009	31	18	9	16	5	6
17	Saronno	IT	39'332	30	9	6	17	24	10
18	Waldshut-Tiengen	GER	24'067	30	13	6	17	13	10
19	Stockach	GER	17'118	29	11	5	19	18	15
20	Radolfzell	GER	31'582	28	7	4	20	30	22
21	Überlingen	GER	22'684	27	13	4	21	13	22
22	Rheinfelden	GER	32'919	26	16	5	22	7	15
23	Bad Säckingen	GER	17'510	25	11	4	23	18	22
24	Bregenz	AT	29'806	25	12	5	23	16	15
25	Montbéliard	FR	25'806	25	10	3	23	22	34
			...						
Overall									
117			1'980'614	1'787	691	304			

Notes: The table shows the 25 largest cross-border locations for grocery shopping. *Number of Stores* counts the municipality's stores for a given minimum of Google reviews, while *Rank* ranks the locations according to the number of stores. All store locations are scraped from Google Maps.

Appendix A.2. Additional results: spatial heterogeneities

To begin with, Figure A.1 relates to the regional differences discussed in the paper. In detail, I aggregate the estimated dynamic coefficients during the border closure presented in Figure 2 to an average treatment effect for different regions. The colors show the entire administrative regions (called *cantons*), while the values are again only calculated for the households living within 30 minutes of a cross-border location.

Figure A.1: Cantonal static average treatment effects

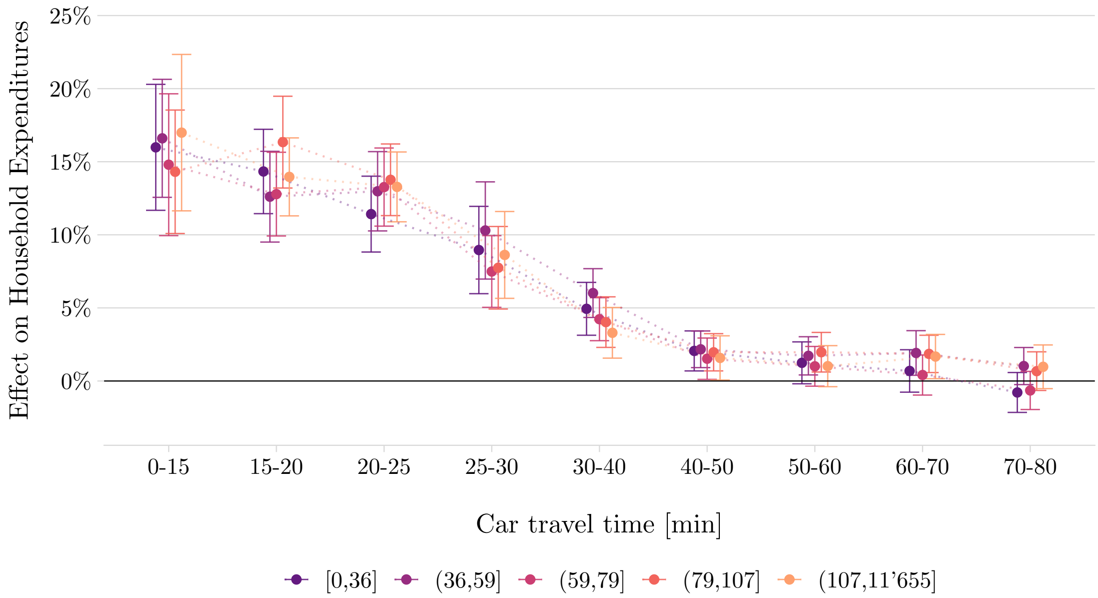


Notes: The figure shows the geographical variation of the border closure's effect on household expenditures within a 30-minute car ride from a cross-border location compared to households living further away than 80 minutes. The regression estimates model (3) and uses 8.8 million observations.

Appendix A.3. Additional results: socioeconomic heterogeneities

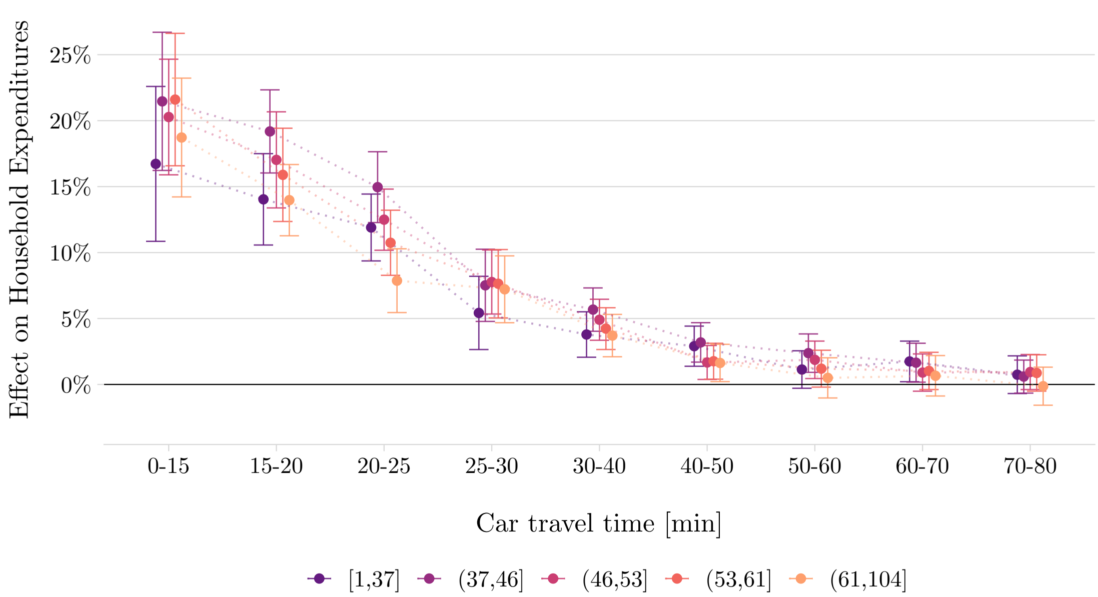
Figure A.2 and Figure A.4 illustrate the decay of the treatment effect with distance for the different heterogeneities. Here, I exploit the 4.9 million shop visits of households for which socioeconomic characteristics are available.

Figure A.2: Decay of the treatment effect: by income



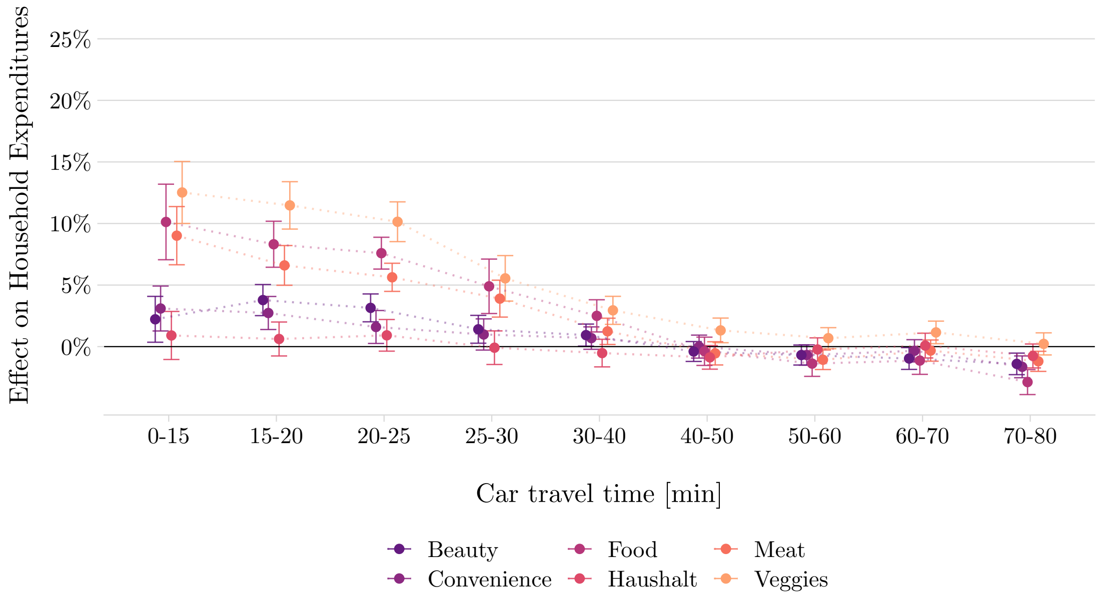
Notes: The figure shows the border closure's effect on household expenditures for different distance bins and income quintiles compared to households living further away than 80 minutes. Income is measured in 1'000 CHF. Standard errors are clustered at the zip code level. The regression estimates model (3) and uses 4.9 million observations.

Figure A.3: Decay of the treatment effect: by age



Notes: The figure shows the border closure's effect on household expenditures for different distance bins and age quintiles compared to households living further away than 80 minutes. Standard errors are clustered at the zip code level. The regression estimates model (3) and uses 4.9 million observations.

Figure A.4: Decay of the treatment effect: by product groups

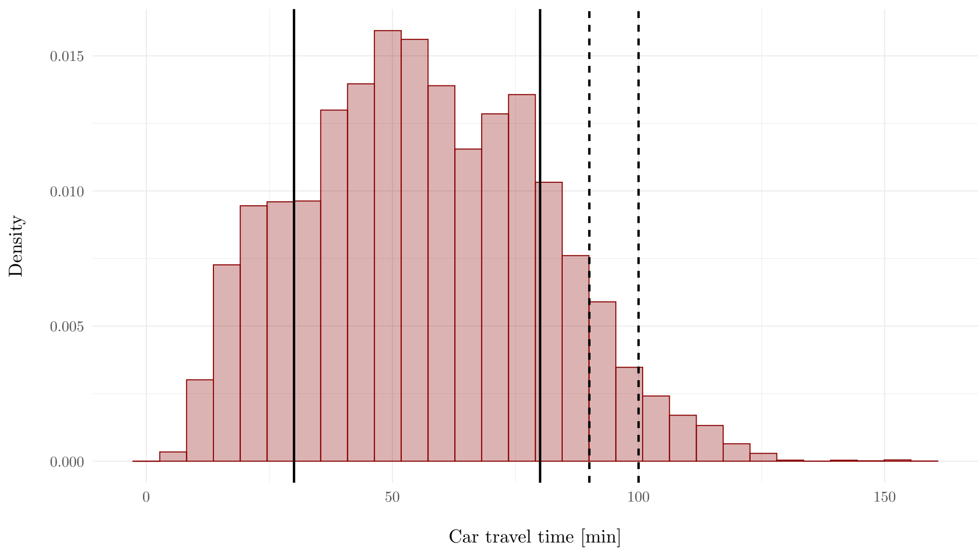


Notes: The figure shows the border closure's effect on household expenditures for different distance bins and product groups compared to households living further away than 80 minutes. Standard errors are clustered at the zip code level. The regression estimates model (3) and uses 67.6 million observations, where the transactions are aggregated to product categories.

Appendix A.4. Robustness

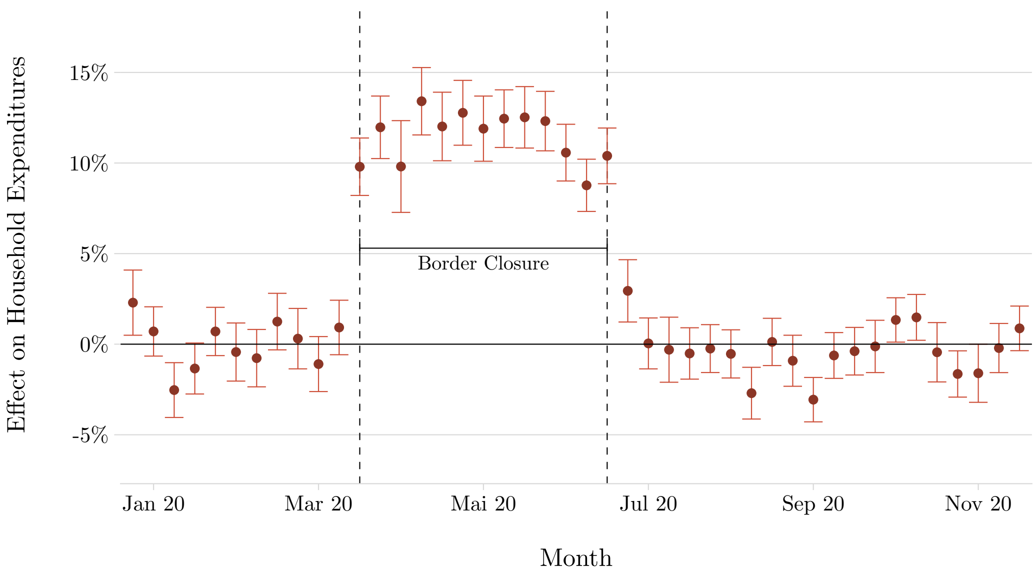
This section adds robustness checks. Figure A.5 displays the distribution of car travel times to the closest cross-border location for all households in the final data. Built on that, Figure A.6 provides a robustness check for the dynamic treatment effects using the subsample of matched households. Further, Figure A.7 reproduces the same results but uses a control group that lives at least 90 or 100 minutes from the closest cross-border location (resulting in a control group of 6% and 2.5% of the sample, respectively). Ultimately, Figure A.8 uses different definitions of cross-border locations: (i) locations with at least three stores with more than 100 Google reviews and (ii) locations with at least three stores with more than 500 Google ratings. My results are robust to these various checks.

Figure A.5: Distribution of travel times



Notes: The figure shows the distribution of car travel times from a household's home to the closest cross-border shopping location. The subsamples of control units used in the different robustness checks of the dynamic results are marked.

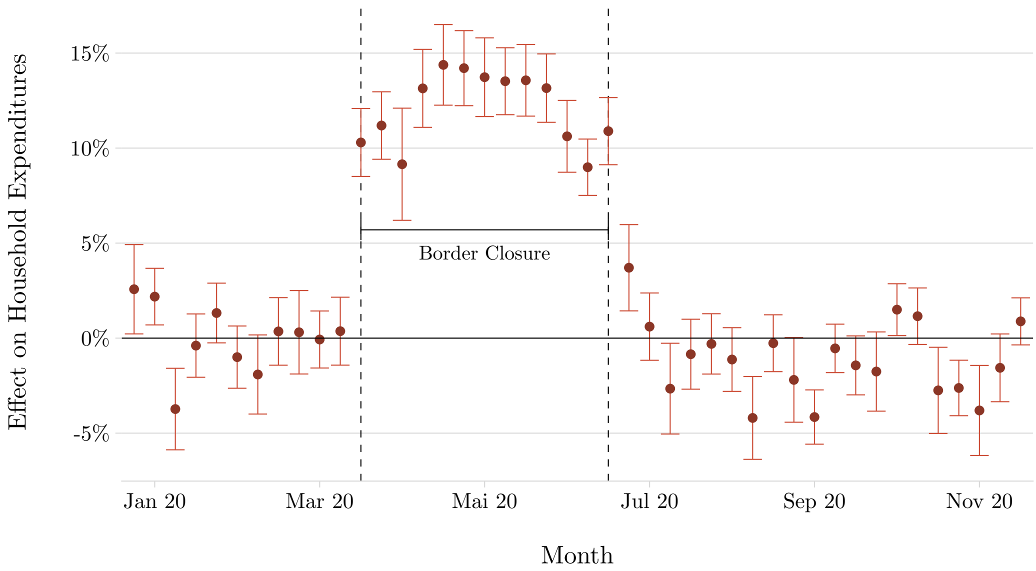
Figure A.6: Robustness of the dynamic treatment effects: only matched households



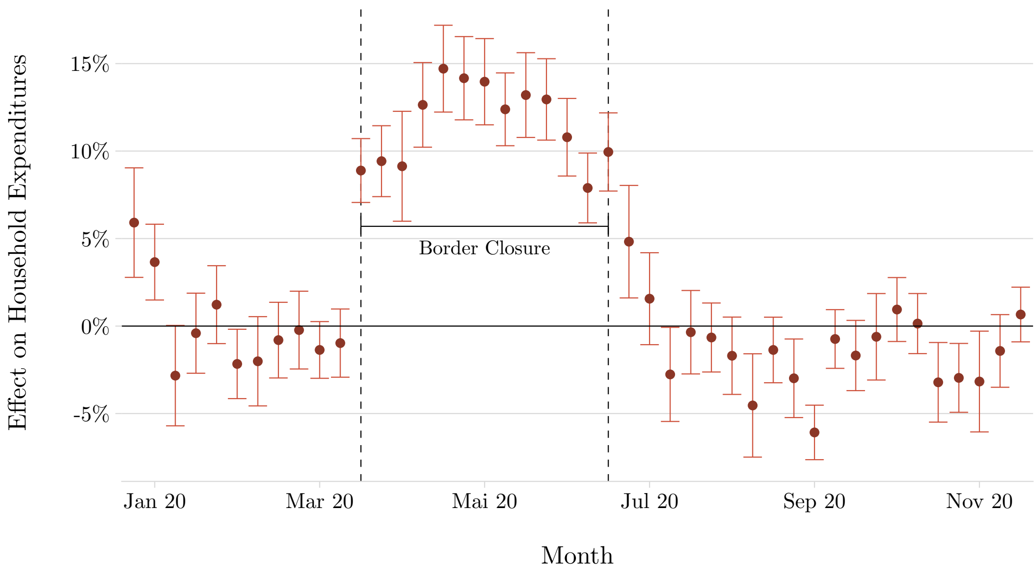
Notes: The figure shows the border closure's effect on household expenditures within a 30-minute car ride from a cross-border location compared to households living further away than 80 minutes. Standard errors are clustered at the zip code level. The regression estimates model (1) and uses 4.7 million observations.

Figure A.7: Robustness of the dynamic treatment effects: different control distance

(a) Control group: more than 90 minutes distance



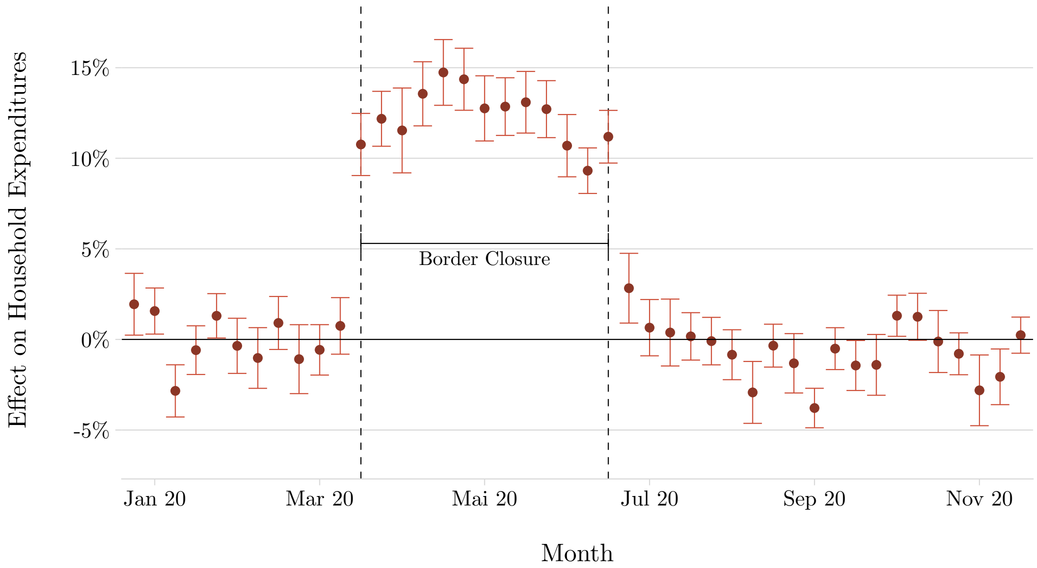
(b) Control group: more than 100 minutes distance



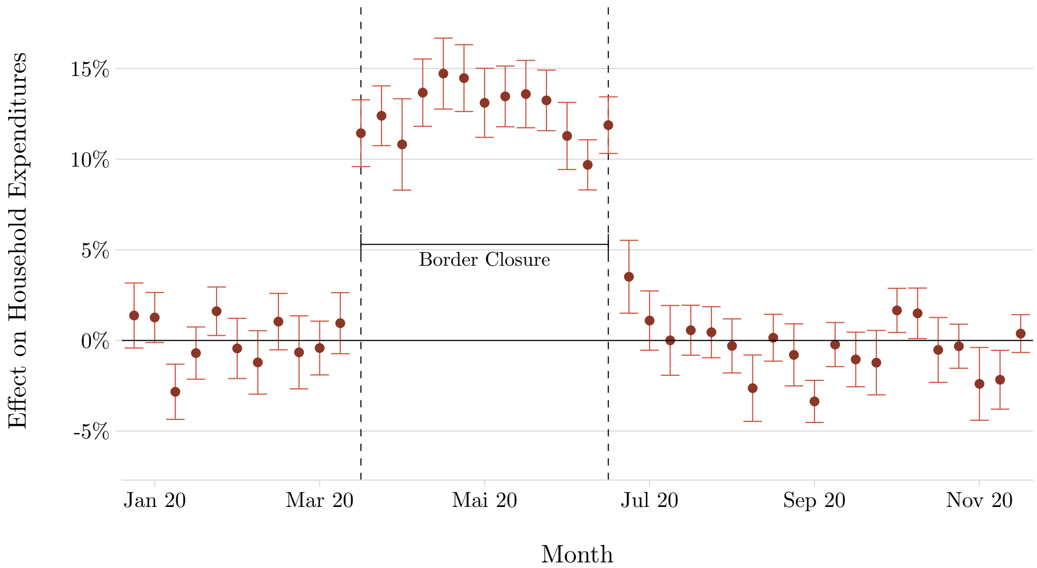
Notes: Figure A.7a shows the border closure's effect on household expenditures within a 30-minute car ride from a cross-border location compared to households living further away than 90 minutes. The regression estimates model (1) and uses 13.3 million observations. Figure A.7b also estimates model (1) for a distance of 100 minutes using 11.2 million observations. Standard errors are clustered at the zip code level.

Figure A.8: Robustness of the dynamic treatment effects: different definitions of cross-border locations

(a) At least three stores with more than 100 Google reviews



(b) At least three stores with more than 500 Google reviews



Notes: Figure A.8a shows the border closure's effect on household expenditures within a 30-minute car ride from a cross-border location compared to households living further away than 80 minutes. I consider all cross-border locations with at least three stores with more than 100 Google reviews. In comparison, Figure A.8b shows the same results but considers locations with at least three stores with more than 500 Google reviews. Both regressions estimate model (1) and use 16.6 million observations. Standard errors are clustered at the zip code level.

Center for Regional Economic Development (CRED)

University of Bern, Schanzeneckstrasse 1, P.O. Box, CH-3001 Bern

Telephone: +41 31 684 37 11

E-Mail: info@cred.unibe.ch

Website: http://www.cred.unibe.ch

The Center for Regional Economic Development (CRED) is an interdisciplinary hub for the scientific analysis of questions of regional economic development. The Center encompasses an association of scientists dedicated to examining regional development from an economic, geographic and business perspective.

Contact of the author:

Frédéric Kluser

University of Bern

Schanzeneckstrasse 1, P.O. Box, CH-3001 Bern, Switzerland

Telephone: +41 31 684 47 92

Email: frederic.kluser@unibe.ch