The effect of cross-border shopping on commodity tax revenue: Results from a natural experiment

BY Richard Friberg, Emil M. Strøm Halseth, Frode Steen and Simen A. Ulsaker

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Department of Economics

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The effect of cross-border shopping on commodity tax revenue: Results from a natural experiment*

Richard Friberg†, Emil M. Strøm Halseth‡, Frode Steen§and Simen A. Ulsaker¶

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Abstract

We use grocery data from Norway and COVID-19 border closings to gauge the effect of cross-border shopping on commodity tax revenue. Detailed store-category level data identify differential treatment effects that depend on distance to Swedish stores. Economically significant effects extend to up to two hours' drive from the border, and even further for prominent cross-border shopping products as beer, cigarettes and soda. Across all products, cross-border shopping decreases tax revenue from VAT by 3.6% at the national level. National commodity tax revenue from carbonated soft drinks (subject to a sugar tax) is reduced by 8.1% and from cigarettes by 11.9%.

Keywords: Cross-border shopping, Commodity taxes, Excise taxes, Tax Competition
JEL: F15, H20, L81

1 Introduction

Excise taxes play a key role in limiting the consumption of goods where excessive consumption is seen as harmful to the consumer herself or to others. Such "sin taxes" are pervasive on for instance alcohol, gasoline and tobacco. Excise taxes, and other commodity taxes such as sales tax and value added tax (VAT), are also an important source of tax revenue. Both of these roles are potentially affected by cross-border shopping, where consumers purchase

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†Stockholm School of Economics, Norwegian School of Economics and CEPR; richard.friberg@hhs.se
‡Norwegian School of Economics; emil.halseth@nhh.no
§Norwegian School of Economics and CEPR; frode.steen@nhh.no
¶Telenor Research and Norwegian School of Economics; simen.ulsaker@telenor.com

the good at a lower price in a neighboring country. A rich literature documents the empirical relevance of such cross-border shopping across national borders. This is manifested in the number of retailers established in several border areas, in local demand and in how the number of border crossings respond to relative price changes.[1] A related literature examines within-country patterns and documents the crossing of state or municipal borders to avoid local sales and excise taxes on for instance cigarettes (Lovenheim 2008) and gasoline (Manuszak and Moul 2009). A case of much recent policy interest is that of taxes on sugar-sweetened beverages, where city level taxes have been shown to lead to substantial substitution towards out-of-town purchases.[2]

In this paper we estimate the impact of cross-border shopping on commodity tax revenue. We use weekly store-category level data from a Norwegian grocery retail chain and the natural experiment provided by border closures in connection with the COVID-19 pandemic to estimate the quantitative impact of cross-border shopping. Friberg, Steen, and Ulsaker (2022) have previously documented that Norwegian cross-border shopping responds to price differences relative to neighboring Sweden and that cross-border shopping affects local Norwegian demand, also far away from the border.

The current paper makes two main contributions. First, we provide a very clean identification of the quantitative impact of cross-border shopping on local sales. Norway's geography with large swaths of the country many hours' drive from the border creates a clear control group against which to gauge the impact of closing the border on the stores in "treated" areas closer to the long Norwegian-Swedish border. Combined with strict border closings, this creates a natural experiment with the kind of autarky flavor often assumed in theoretical work in international economics, but rarely observed in practice (see e.g., Bernhofen and Brown (2005) who performs an empirical study of Japan's opening up to trade in the 1800s, which is a notable study in the same vein). Second, category level sales from a large number of stores across the country allow us to measure the quantitative effect of cross-border shopping on commodity tax revenue with high precision.

We establish that cross-border shopping has a large effect on sales in areas close to Swedish stores, that effects only gradually diminish with driving duration and that, broadly speaking, effects are stronger and stretch further inland for products with larger price differences and products that are easy to transport and stockpile. While these effects may not be surprising it is worth emphasizing the value of actual border closings, rather than just having to rely on relative price variation, when we want to identify the overall impact of cross-border shopping

[1] See for instance Campbell and Lapham (2004), Asplund, Friberg, and Wilander (2007), Chandra, Head, and Tappata (2014) or Baggs, Fung, and Lapham (2018); Leal, Lopez-Laborda, and Rodrigo (2010) provide a survey.

[2] See e.g. Cawley et al. (2019) or Allcott, Lockwood, and Taubinsky (2019b) for an overview.

on sales and tax revenue. Friberg, Steen, and Ulsaker (2022) highlight the fact that the elasticity of demand to relative price changes (which is what we can usually measure to make inferences about cross-border shopping) does not have a one-to-one relation to the overall level of cross-border shopping. The response to a price *change* may be the largest some distance inland (since that is where the extensive margin decision of whether to make the cross-border trip or not bites), even if the *level* of cross-border shopping is higher closer to the border. With the current natural experiment we estimate the effect of cross-border shopping directly. The number of store visits and customers' basket size are of approximately equal importance in generating the effect of cross-border shopping on local sales [3]

We combine our store-category level estimates of how sales are affected by cross-border shopping with information on the total number of stores in Norway, and their location, to infer the overall loss in tax revenue. In particular we calculate losses in VAT and excise taxes that are due to cross-border shopping, and how these losses relate to travel duration to the closest Swedish stores. We take the last full year before the COVID border closures as our benchmark, and use our estimated effects to calculate a counterfactual outcome with a closed border. In border areas the effects are large: due to cross-border shopping VAT revenue is 27% lower in stores that are within 30 minutes' driving distance from a Swedish store due to cross-border shopping. For several of the products subject to excise taxes, such as carbonated soft drinks ("soda" henceforth), beer, cigarettes and snus,[4] tax revenue more than doubles in these border areas when we move to a counterfactual situation with no cross-border shopping. Aggregating up to the national level, the effects are still substantial with an estimated VAT loss of 3.6% and a loss of excise taxes on, for instance, soda of 8.1% and on cigarettes of 11.9%.

The COVID-19 pandemic has triggered a large amount of research – primarily on estimating the effects of the pandemic and on evaluating various policy responses (see e.g., Coibion, Gorodnichenko, and Weber (2020) and Goolsbee and Syverson (2021)). Most close in spirit to the current research are articles such as Bian et al. (2022), that, like us, use COVID-19 as an exogenous shock to examine some variable of interest and are not primarily aimed at evaluating pandemic responses per se. The Norway-Sweden border is only one of many that have been closed to cross-border shopping due to the pandemic, and to the extent that researchers will gain access to detailed data we expect to see similar analyses to ours for other jurisdictions. So far we are aware of Baggs, Fung, and Lapham (2021) who examine the

[3]See Einav et al. (2021) for a recent analysis of the role of the relative contribution of the number of customers and basket size in explaining retail firm growth.

[4]Snus is a smokeless tobacco product that is placed between the upper lip and gum and commonly used in Norway and Sweden. Statistics Norway (2022b) reports that in 2019 15% of the Norwegian population aged between 16 and 74 were daily users of snus.

effect of COVID-19 border closures on Canadian retailers otherwise subject to cross-border shopping into the neighboring US. They combine actual data on cross-border travel for a period including the pandemic with estimated coefficients using pre-pandemic data, which were reported in Baggs, Fung, and Lapham (2018), to estimate the effect of border closing on store level revenue. They find that on average the closing of the border avoided a drop in revenue of 1.7% for a small Canadian retailer located within 150 kilometers of the closest border crossing with the largest average effects (4.3%) for gasoline stations. An important contribution of the current article relative to Baggs, Fung, and Lapham (2021) is that our detailed data allow us to examine the tax consequences of closing the border to cross-border shopping.

Apart from the empirical literature on cross-border shopping referred to above, the current research also relates to a set of papers that examine theoretical models of commodity "tax competition". In a setting with two countries and costly cross-border shopping, Kanbur and Keen (1993) show that a smaller country will set lower commodity taxes and analyze the case for commodity tax harmonization. Their baseline model has been extended in a number of directions, for instance allowing for one country to decide taxes first (Wang 1999) and allowing for lower commodity taxes in border regions (Agrawal 2012). The related empirical literature on tax competition has by and large not chosen to test specific predictions of the models above and has typically focused on other aspects of tax competition than commodity tax levels across countries.[5] Our key contribution to the literature on tax competition is to document an example where substantial commodity tax revenue is lost due to cross-border shopping and hence, point to the importance of the trade-offs modeled in the theoretical literature.

Asymmetries across countries are potentially important in the literature that has followed Kanbur and Keen (1993), see Keen and Konrad (2013) for a discussion. We estimate that cross-border shopping from Norway to Sweden implies a tax loss of 2.3 billion NOK through lost VAT and excise taxes. Nearly one third of this loss comes through lost excise taxes on five top border-trade product categories: beer, cigarettes, snus, soda and sweets. Importantly, some cross-border shopping would be likely to remain from Norway to Sweden even if all

[5] As an example of such other aspects Devereux, Lockwood, and Redoano (2008) show that tax competition has lowered corporate taxes in open economies. Kanbur and Keen (1993) assume that taxes are strategic complements across jurisdictions, an assumption that also fits well with policy discussions aimed at avoiding a "race to the bottom". A notable aspect of some recent work on within-country tax competition is that it indicates that local taxes are strategic substitutes (downward sloping reaction functions such that lower taxes in one jurisdiction imply higher taxes in another). Such a pattern is for instance found by Chirinko and Wilson (2017) for capital taxes across US states and for local income taxes across Switzerland in Parchet (2019); see Agrawal, Hoyt, and Wilson (2022) for a survey of tax competition and policy choices across local governments.

excise taxes were eliminated. For instance, abolishing the excise tax on cigarettes would reduce prices in Norway by around 40% if the tax change was fully passed through to consumer prices. However, in 2019 tobacco prices in Sweden were more than 50% lower than in Norway. For soda, the excise tax in 2019 constituted about 20% of the average price in Norway, while the Swedish prices were close to 40% lower than the Norwegian prices. Removing these two excise taxes alone would have reduced tax revenue by five billion NOK (from only the grocery store sales) but would still come short of completely removing the incentives to buy these products in Sweden. This example illustrates that large cross-border price differences make independent tax policy difficult since the border trade leakage will be significant. On the other hand, the example also illustrates that it is not necessarily revenue maximizing to reduce taxes, because revenue loss inland may not make up for gains in regions closer to the border.

In the next section we look closer at cross-border shopping and the COVID-19 pandemic. Then, in Section 3 we present our data and provide descriptive statistics, before we analyze the effects of cross-border shopping on retail activity in Section 4, and discuss the economic impact in Section 5. Section 6 provides a number of robustness tests, and Section 7 concludes.

2 Cross-border shopping and the COVID-19 pandemic

Cross-border shopping from Norway into neighboring Sweden features prominently in policy discussions in Norway and has been the subject of many policy reports (see, e.g., Statistics Norway (2022a), Skogli et al. (2020), NHO Mat og Drikke (2020), Abel, Totland, and Gulseth (2021)). Norway is not a member of the EU and maintains tariffs on many food products which, together with a high general price level and high excise taxes, combine to create substantial price differences relative to neighboring Sweden. One way to observe the incentives for cross-border shopping is to examine price level indexes reported by Eurostat at a yearly level for many European countries (Eurostat 2022). The average across all the 27 EU countries (excluding UK) is set to 100 in each year, and we report the indexes for selected categories in 2019 in Table 1. For food the index for Norway is 155.2, thus implying that food prices in Norway are about 50% higher than the average in EU. Sweden's corresponding price index of 114.8 in the same year makes it clear that there are substantial incentives to cross-border shop for food. While the price difference is large it is notable that it is not unique, for instance Switzerland's corresponding price index was 165.8. Price differences are especially marked on products that are protected by agricultural policy (meat, milk, cheese and eggs) and products subject to excise taxes (alcohol, tobacco and a "sugar tax" on soft drinks). A notable feature of the Norwegian grocery market is that all the chains have

national pricing, and prices are thus not endogenously lower closer to the border (Friberg, Steen, and Ulsaker 2022): this means that the relevant price comparison is crucially affected by driving duration to the closest Swedish store. Uniform nationwide pricing may at first seem surprising to many economists but is a common feature of grocery retailing, see for instance Seaton and Waterson (2013) for UK grocery retailing or DellaVigna and Gentzkow (2019) for US grocery retailing.

[Table 1 about here]

Let us now turn to an overview of the aspects of the COVID-19 pandemic of relevance to the current article. In March 2020, the consequences of the COVID-19 pandemic hit Norway as the numbers of infections increased. As in many countries, the development of the pandemic was very rapid, and we have little reason to assume that there were any important anticipatory measures on the part of consumers with regards to cross-border shopping. On March 12, the Norwegian Government implemented a string of severe infection control measures, together constituting the most intrusive measures imposed in Norway in peacetime (Reuters 2020). Schools were closed, cultural and sporting events cancelled, and travel restrictions imposed. The measures effectively closed down much of the economic activity and led to the biggest recorded fall in GDP for mainland Norway, and to a rise in the unemployment rate from 3.8 to 15.3% (NAV 2021). In late March 2020, a major economic policy package was implemented, which included, but was not limited to relief packages to businesses that had lost 30% of their revenue or more. On April 20, 2020, a partial reopening of Norway was announced, but the pandemic continued to affect everyday life and economic activity throughout 2020, as restrictions were eased and tightened in response to changes in the infection rates. Like in many other countries, domestic and international travel, shopping activities, the use of face masks, remote work, social gatherings, and a wide range of other issues were subject to legislation and recommendations.[6]

The pandemic and the control measures affected the grocery sector in several ways. In March 2020, stockpiling led to sharp spikes in sales but also to temporary stock-outs of goods such as toilet paper and flour. Throughout the pandemic, the dramatic increase in remote work, together with closed bars and restaurants, meant that more meals were eaten at home. Especially relevant for our purpose are the restrictions on international travel.

[6]For most of 2020, the restrictions were national in scope. Towards the end of the year, there was some geographical variation in in the severity of the restrictions in response to local outbreaks. The regulation *Covid-19-forskriften* (2020) contained the valid national legislation at any time. All versions of the regulation are available (in Norwegian) at https://lovdata.no/dokument/SF/forskrift/2020-03-27-470.

Under regulations imposed on March 12, 2020, any travelers arriving from outside the Nordic countries were required to undergo ten days of quarantine (Norwegian Directorate of Health 2020a,b). By March 17, quarantine was imposed also for travelers arriving from Sweden and the rest of the Nordic countries. For the rest of 2020 visiting countries and areas with high infection rates triggered quarantine upon re-entering Norway. Consequently, cross-border shopping was infeasible for most of 2020, and practically all food and alcohol had to be bought in Norwegian stores. In the next section, we describe in more detail how different counties in Sweden were effectively opened and closed for cross-border shopping during 2020, as travel restrictions were imposed and lifted.

The estimation of the effects of cross-border shopping on local sales in Norway is made simpler by the fact that the relevant restrictions on cross-border shopping were essentially all driven by policy variation in Norway, rather than by policy in neighboring Sweden. Throughout 2020 Sweden largely relied on voluntary measures to limit contagion and enforced light-handed restrictions compared to other European countries.[7] Grocery stores enforced caps on the number of customers that were allowed in store, but these were rarely binding.

3 Data and descriptive statistics

The main data set used for estimation of the effects of cross-border shopping consists of weekly sales and volumes at the store-category level for 2019 and 2020 from a random sample of grocery stores belonging to the largest Norwegian grocery umbrella chain, Norgesgruppen. Norgesgruppen had a market share of 43.7% in 2019 and has retail stores across all market segments and across the entire country (Nielsen 2020).[8] In addition to the sales data, we have information about the number of distinct store visits per week at the store level. Since we are interested in cross-border shopping across the Swedish border, we over-sampled stores located close to the border when selecting our sample of stores. Specifically, 200 stores were drawn randomly from the whole of Norway, and an additional 200 stores were drawn randomly from three counties bordering Sweden (Viken, Innlandet and Trøndelag). The data set used for estimation has been created by the authors aggregating up from store-barcode level data for the full assortment following product categorizations used by Norgesgruppen. Since we are ultimately interested in overall grocery sales, and not just sales in the sampled stores, we also use information about the location and estimated yearly sales amounts for all Norwegian grocery stores in 2019, obtained from Geodata (2021).

[7] See for instance Ludvigsson (2020).

[8] There are no hard discounters in Norway, and very few hypermarkets. Discount stores, a segment in which Norgesgruppen also has a presence, constitutes the largest market segment with a market share of about 60% in 2019 (Nielsen 2020).

The Norwegian store data contain the location of the Norwegian stores. Data on the location of all grocery stores in Swedish counties that border on Norway were obtained from Delfi Marknadspartner (2021). Using map data OpenStreetMap we calculate driving duration in minutes from each Norwegian store to each Swedish store.[9] Figure 1 plots the location of the Norwegian and Swedish stores. In this figure we also plot the driving duration to the closest Swedish store across Norwegian municipalities.

[Figure 1 about here]

In our analysis we explore how changes in the accessibility of cross-border shopping affect grocery store sales in Norway. The source of this variation is regulations that restrict travel to Sweden. Information about which Swedish counties could be visited without triggering quarantine upon re-entering Norway on given dates during 2020 is obtained from Norwegian Institute of Public Health (2021a). We refer to a Swedish county as open for cross-border shopping whenever it can be visited without triggering a quarantine, and closed for cross-border shopping otherwise. Figure IA.2 in the Online Appendix plots traffic flows at the main border crossings into Sweden and clearly indicates the impact of the restrictions on travel.

Our main measure of the availability of cross-border shopping is the driving duration to the closest Swedish store that is located in a border county that is open for cross-border shopping. From the start of our sample period in January 2019 until March 17, 2020, all Swedish border counties were open for border shopping. In the following, we refer to these driving durations as pre-COVID driving durations. In Table 2, we report the distribution of pre-COVID driving durations, where we use 30-minute bins (up to 180 minutes) to categorize the stores.

[Table 2 about here]

From Tuesday March 17 until July 25, 2020 Norwegians had no access to cross-border shopping in Sweden and the border was effectively closed to any private travel (unless one was willing to undergo ten days of quarantine on the return to Norway). As discussed below, in relation to our examination of the robustness of our empirical estimates, a recent empirical

[9]We accessed OpenStreetMap data for Norway and Sweden through Geofabrik (2021). We used the OSRM routing engine to calculate driving durations and driving distances. See http://project-osrm.org for more information about the routing engine.

literature has highlighted concerns with difference-in-difference estimates when treatment is heterogeneous in terms of timing (see e.g. De Chaisemartin and d'Haultfoeuille (2020)). A treatment that puts a stop to cross-border shopping across the whole country on the same day clearly avoids such concerns. Towards the end of the sample period there is, however, some variation across locations in border closings. Between July 25 and October 9, 2020, cross-border travel to some Swedish counties was allowed without triggering quarantine, based on local infection rates. For the period October 9, 2020, until the end of the sample period the border was then again closed for all cross-border shoppers unless one was willing to undergo the quarantine. Figure 2 details which Swedish counties that were open for cross-border shopping during which weeks. For the summer and early fall period, when some Swedish locations were open for cross-border shopping, we keep track of the driving duration to the closest accessible Swedish store as it varies due to border closures. In Figure IA.3 in the Online Appendix, we use maps to illustrate how driving duration to the closest available Swedish store varies during the late summer and early fall of 2020.

[Figure 2 about here]

In our empirical analyses, we include a number of municipality-level control variables that may both affect grocery store activity and be affected by COVID-19 pandemic. The variables we consider are COVID-19 infection rates (Norwegian Institute of Public Health 2021b), unemployment rates (Norwegian Labour and Welfare Administration 2021), population (Statistics Norway 2021b), and the proportion of residential dwellings in the municipality that are holiday homes (Statistics Norway 2021a). In Table 3, we present mean values for these variables, along with the outcome variables we consider in our empirical analysis. We break down the descriptive statistics by year, and by the pre-COVID travel duration category.

[Table 3 about here]

Some interesting patterns emerge from Table 3. First, we see that average weekly sales at the store level are significantly higher in 2020 than in 2019, regardless of the driving duration to Sweden. This indicates that the pandemic had a positive impact on grocery store sales also in regions where cross-border shopping is unlikely to be an important factor. As discussed above, this can be explained by factors such as closed restaurants, remote work and restrictions on international travel. However, the relative growth is significantly larger for stores located close to Sweden than for stores located further away. We also see that

average number of visits per store and per week is higher in 2020 than in 2019 for the < 30 minutes and $30 - 60$ minutes categories, but that the reverse is true for the other duration categories. Basket size is, on the other hand, increasing from 2019 to 2020 in all duration categories. There is substantial variation in the average number of new COVID-19 cases in the municipality in which a store is located. Infection rates are highest in the $60 - 90$ minutes and $90 - 120$ minutes categories. The mean unemployment rate is growing from 2019 to 2020 across the duration groups, with no clear indications that some duration categories are affected more than others. Finally, mean population in the municipality in which a store is located varies quite a bit between the duration groups, but changes between 2019 and 2020 are relatively small.

Table 3 already gives an indication that the COVID-19 pandemic affected grocery store activity in regions close to Sweden differently than in regions further from the border. Our hypothesis is that this difference is driven by travel restrictions that made cross-border shopping more difficult (indeed mostly impossible) during the pandemic. Figures 3 and 4 provide some initial informal support for our hypothesis. Figure 3 illustrates how, prior to the pandemic, product categories that are well suited for cross-border shopping (beer, cheese, meat, soda, sweets, and tobacco) account for an increasing share of store level sales as we move away from the border. Conversely, product categories that are less suitable for cross-border shopping (freshly baked products, ice cream, milk and ready-made food) account for a decreasing share. However, as can be seen from Figure 4, None of these trends are present in the period from March to July 2020 when all Swedish border regions were closed for cross-border shopping.

[Figure 3 about here]
[Figure 4 about here]

4 The effect on cross-border shopping retail activity

We are interested in estimating the effect of the availability of cross-border shopping on grocery sales in Norway. Our empirical strategy exploits the fact that travel restrictions due to the COVID-19 pandemic introduced within-store variability with regards to the accessibility of border shopping in Sweden. In addition, since buying groceries in Sweden is not an equally viable alternative to buying groceries locally across Norway, the travel restrictions do not affect all Norwegian stores in the same way. This enables us to estimate the effect

of cross-border shopping on retail activity by including both store fixed effects (capturing unobservable time-invariant differences between the stores) and time fixed effects (capturing country wide shocks that affect all the stores equally).

We follow Friberg, Steen, and Ulsaker (2022) in considering the effect of cross-border shopping on retail activity in Norwegian stores that are located within a 180-minute drive from the closest Swedish grocery store. The variable B_{st} takes the value one if there is an accessible Swedish store less than a 180-minute drive from store s in period t, and takes the value zero otherwise. A Swedish store will be considered accessible if it can be visited without triggering a quarantine stay upon re-entering Norway. In periods where no Swedish stores are accessible, B_{st} will be zero for all stores in the data set. We assume that cross-border shopping is not a viable alternative for stores located 180 minutes or more from the closest Swedish grocery store. This group of stores will therefore be assumed to be unaffected by the travel restrictions, effectively functioning as a control group in our analysis, by providing a reference point from which we can estimate the effect of the accessibility of cross-border shopping for stores closer to the border.[10] The key identifying assumption that enables a causal interpretation of our results is that the underlying trend in grocery sales is not dependent on the distance to Sweden. In Section 6, we provide evidence in support of this assumption.

As a first measure of the effect of dross-border shopping on grocery store activity, we estimate equations of the following form.

$$Y_{st} = \gamma_s + \lambda_t + \delta B_{st} + \epsilon_{st} \tag{1}$$

In Equation (1), Y_{st} is the outcome of interest, *e.g.,* store level sales. B_{st} is a binary treatment variable capturing the availability of cross-border shopping as defined above. For stores located within a 180-minute drive from the closest Swedish store, B_{st} switches between zero and one depending on which Swedish border counties are open for cross-border shopping. For stores located more than 180 minutes from the closest Swedish store, B_{st} is zero during the entire sample period. γ_s and λ_t are store and time fixed effects, respectively. In Table 4, we report the results from the estimation of (1) with three different store-level outcome variables: the natural logarithm of total weekly sales, the natural logarithm of the number of weekly customers, and the natural logarithm of the average basket size.

[10] One could of course assume that stores more than 180 minutes from the closest Swedish grocery store are also affected by the availability of cross-border shopping. In Section 6 we re-estimate our main model using only stores located at least 300 minutes from Sweden as the control group.

[Table 4 about here]

We see from Table 4 that the availability of cross-border shopping (defined as having an accessible Swedish store within a 180-minute drive), is estimated to reduce grocery sales by about 6.1%. Since sales are the product of the number of store visits and the average basket size, Column (2) and Column (3) give the contribution to the total effect of store visits and average basket size, respectively. We see reduction in store visits and reduction in basket size contribute about equally to the total effect.

In Equation (1), we treat the availability of cross-border shopping as a binary treatment variable. However, it seems unlikely that all stores within 180 minutes from a Swedish store are equally affected by cross-border shopping. In our next empirical models, we therefore interact the binary variable B_{st} with a categorical variable D_{st}, which measures the driving duration from store s to the closest Swedish store that is accessible in period t. We measure duration in 30-minute bins between 0 and 180, with a final category capturing cases where the closest available store is more than 180 minutes away or where there are no Swedish stores available because all border counties are closed for cross-border shopping. The equation we estimate is now

$$Y_{st} = \gamma_s + \lambda_t + \sum_j \delta_j (B_{st} \times D_{st}) + \epsilon_{st}. \tag{2}$$

Here, the variables of interest are the δ_j's, which estimate the effect of cross-border shopping on sales for the different duration categories. Table 5 reports the results for the same three outcome variables as in Table 4.

[Table 5 about here]

From Column (1) of Table 5 we see that the availability of cross-border shopping is estimated to lead to a 25% $((\exp(-.294)-1)*100)$ reduction of grocery store sales for stores located within 30 minutes of the closest Swedish store. As one would expect, the size of the effect is reduced as we move further away from the border, eventually becoming insignificant for stores located between 90 and 120 minutes from the closest Swedish store. Figure 5 illustrates how the effect of cross-border shopping on sales depends on the distance to the closest Swedish grocery store.

[Figure 5 about here]

Inspecting the relative contributions of store visits and basket size, we see that the contribution of fewer store visits is large close to the border but diminishes as we move away from the border. Conversely, the relative contribution of basket size is larger further away from the border, and the effect is statistically significant at the one percent level even at travel durations between 90 and 120 minutes. A possible explanation for this pattern could be that household living close to the border can often cross the border regularly and cover much of their daily grocery needs in Sweden, also in product categories that are relatively difficult to store and transport. These households can therefore to a large extent replace store visits in Norway with cross-border shopping, whenever the border is open. Households located further away from the border, on the other hand, will find it more difficult to cover their daily needs of all product categories through cross-border shopping, therefore finding it more difficult substitute store visits in Norway with store visits in Sweden. At these distances, the average basket size bought in Norway could still be sensitive to cross-border shopping, since even relatively infrequent cross-border shopping could cover the needs in categories well suited for cross-border shopping, thus reducing the average basket size in the Norwegian stores.

This explanation can be investigated by estimating the effect of cross-border shopping on the sales in categories that are more or less suitable for (long-distance) cross-border shopping. In Table 6, we consider the effect of cross-border shopping in four product categories that are difficult to transport over distance, and therefore not likely to be purchased in Sweden by Norwegian households that are located some distance from the border. We see that the estimated effects are relatively large close to the border, but that, as expected, the effects taper off quickly and are statistically insignificant for travel durations above 60 minutes.

[Table 6 about here]

In Table 7, we consider seven product categories that should be more suitable for cross-border shopping also at relatively large distances.[11] In all seven categories, we see large effects that are also apparent relatively far from the border. For example, cross-border shopping is estimated to reduce the sales of soda by about 7% as far away as 90-120 minutes from the closest Swedish store. We find the largest effects for beer and tobacco products, which is not

[11] We consider cheese, meat, sweets and soda (the same four categories as in Friberg, Steen, and Ulsaker (2022)), in addition to beer, cigarettes and snus.

surprising given that prices are substantially higher for these categories in Norway than in Sweden, and given that both beer and tobacco are easy to store and transport. Closest to the border, cigarette sales are reduced by about 67%, while beer sales are reduced by about 40%, due to the cross-border shopping. We also see that the effects are substantial even more than 120 minutes from the closest Swedish store.

[Table 7 about here]

5 The effect of cross-border shopping on sales and tax revenue

As noted in the Introduction, the detailed data allow for an examination of cross-border shopping of sales at the category level as well as the effect on tax revenue from excise taxes and VAT. Several of the product categories most frequently bought in Sweden by Norwegian customers are subject to excise taxes in Norway. Specifically, in 2019, there were excise taxes for beer, cigarettes, snus, soda and sweets. These excise taxes are non-trivial. For instance, cigarettes faced an excise tax of 2.63 NOK per cigarette in 2019, equivalent to around 0.25 euros using the average EUR/NOK exchange rate for 2019 (the average consumer price was 6.17 NOK or about 0.63 euros per cigarette).[12] Of particular interest may be the "sugar tax". In 2019 this excise tax for chocolates and sweets amounted to 20.82 NOK per kilogram (representing 8.7% of the average consumer price), for beverages the tax was 4.82 NOK per liter (representing 21.4% of the average consumer price).[13]

In this section we seek to quantify the effect of cross-border shopping on store sales and tax revenue. Because the excise taxes were calculated on the basis of units sold, we first estimate the effect of cross-border shopping on the volume sold in the different categories, and then use these estimates to calculate the estimated loss in excise taxes resulting from cross-border shopping. In addition to category specific excise taxes, all products sold in grocery stores are subject to VAT. Because our sales data include information about VAT, we can estimate the effect of cross-border shopping on VAT revenue directly.[14]

[12]The average exchange rate was 9.8527. The exchange rates are available through Norges Bank (2022).

[13]The "sugar tax" has been the subject of considerable discussion in Norway. It was subject to a sharp and unexpected increase in 2018, followed by a partial lowering in 2019. In 2021 the tax was abolished, arguably partly in response to concerns about cross-border shopping as borders reopened. See Table IA.1 in the Online Appendix for average consumer prices (per unit) and excise tax rates.

[14]There are two relevant VAT rates for Norwegian grocery stores, 15% for food items and 25% for non-food items, our data set provides exact values for VAT for each product.

In Table 8, we report the estimated effect of cross-border shopping on VAT and on the volume sold in the categories subject to excise taxes. The models are defined by Equation 2, and the outcome variables are log-transformed.

[Table 8 about here]

As expected, the effect of cross-border shopping on VAT is similar to the effect of cross-border shopping on store sales (as reported in Column 1 of Table 5), and the effect of cross-border shopping on the category sales by volume is similar to the effect on category sales in NOK (as reported in Table 7), although the estimated effect on soda volume is slightly higher than the estimated effect on sales in NOK. This suggests that lower-priced sodas are more affected by cross-border shopping than premium products, consistent with the notion that it is the more price sensitive consumers that stock up sufficient volumes of soda from cross-border trips to affect local sales.[15]

Table 9 contains our estimates of the effect of cross-border shopping on total sales and VAT, while the estimated effect on category level sales and excise tax is reported in Table 10. To obtain the reported estimates, we proceed as follows. For each duration category, we calculate the mean value of total store sales, category sales volumes, and VAT in our estimation sample in 2019. We then use the estimated effects reported in Table 5 (for store level sales) and Table 8 (for category volumes and VAT) to calculate the counterfactual closed-border outcome the last full normal year before COVID closures. To get an estimate of the economic impact of cross-border shopping, we then multiply these estimated effect by the total number of grocery stores in each duration category (*i.e.*, not only the stores in our estimation sample).[16]

For instance, stores in the estimation sample within a 30-minute drive from the closest Swedish border sold on average 8.69 metric tons of sweets in 2019 (see Table IA.2 in the Online Appendix). For these stores, the estimated effect of cross-border shopping on the log of sweet sales (in metric tons) is -0.374 (see Column 2 of Table 8). The counterfactual mean level of sales is therefore given by $8.69/\exp(-.374) = 12.63$, which gives an estimated mean loss due to cross-border shopping equal to $12.63 - 8.69 = 3.94$. Multiplying the actual

[15] This is in some contrast to Wang (2015) who, using US household level data for 2002-2004, finds that low-income households are less likely to stockpile soda.

[16] An underlying assumption of the results reported in Tables 9 and 10 is that, within each duration category, the stores in our estimation sample are representative of the grocery stores. Because the umbrella chain to which our sample stores belong has stores in all market segments, we believe that this is a reasonable assumption. Furthermore, in Figure IA.1 in the Online Appendix, we compare the yearly sales amounts of the estimation stores and the population of stores (within each duration category). We find that the distributions are very similar.

and counterfactual mean sales volume and the estimated mean sales volume loss by the total number of grocery stores in this duration category (62) gives numbers reported in Column 1 of Table 10.

[Table 9 about here]

We see that the economic significance of cross-border shopping is substantial. We commence with the effect on store sales and VAT as reported in Table 9. As expected, the effects are the strongest close to the border and then gradually diminish with travel duration to the closest Swedish stores. Sales are reduced by 25.5% (1071.6/4203) in stores that are within 30 minutes' driving distance from a Swedish store due to cross-border shopping and VAT revenue from stores in these locations is reduced by 27% (162.3/602). For locations between 30 and 60 minutes away, the corresponding VAT loss is 20.2% and for locations between 60 and 90 minutes from Sweden the corresponding VAT loss is 8.5%. These are clearly substantial numbers. In many European countries large shares of the population live within a 90-minute drive of a border and numbers such as these provide a foundation for why minimum levels of VAT have been adopted within the European single market.[17] Moreover, in a large and mountainous country such as Norway, the VAT loss is non-trivial, also at the national level, with an estimated VAT loss of 3.6% due to cross-border shopping.

[Table 10 about here]

For VAT revenue the key motivation for international tax agreements to avoid a "race to the bottom" is clearly tax revenue per se. For goods subject to excise taxes the tax revenue motivation may be combined with a motivation to limit harm due to externalities (*e.g.* gasoline taxes to lower greenhouse gas emissions) or "internalities" (*e.g.* excessive consumption due to self-control problems related to consumption of products like smokeless tobacco and soda) or a combination of the two (for instance alcohol and cigarettes). As noted in the introduction, for all the products that we examine and which are subject to excise taxes (alcoholic beverages, sugar-sweetened products and tobacco), there are well-documented studies showing that they are the subject of substantial cross-border shopping (Leal, Lopez-Laborda, and Rodrigo (2010)). With store-level data on quantity of these products we are able to contribute to the literature by providing evidence of how volumes sold and tax revenue are affected at locations ranging from below 30 minutes up to 180 minutes away from the border.

[17] See European Commision (2022) for the EU VAT regulation.

Table 10 reports the estimated effects on volumes sold and on commodity tax revenue for different duration intervals from the border.[18]

Again effects are strongest close to the border and then gradually diminish. In several cases, the estimated foregone tax revenue is very large for stores within a 30-minute drive from the closest Swedish store, and for cigarettes, soda and snus, tax revenue more than doubles in these border areas in a situation with no cross-border shopping. However, only 2% of the grocery stores in Norway are located this close to Sweden. On the other hand, more than a third of the grocery stores are located within 120 minutes from the closest Swedish store, and we see substantial effects also at this distance. The effects are largest for beer, soda and tobacco products. For areas located between 90 and 120 minutes from the closest Swedish store, the estimated loss of tax revenue in these categories is close to, or above, 10% of the actual tax revenue. Aggregating up to the national level effects are still substantial with a loss of excise taxes on for instance soda of 8.1% and on cigarettes of 11.9%. Total estimated loss of tax revenue (VAT and excise taxes) from cross-border shopping at the national level is about 2.3 billion NOK.

The numbers above clearly point to difficulties for smaller jurisdictions in maintaining higher excise taxes than neighboring jurisdictions. An application of particular interest may be that of soda taxes. As discussed above soda taxes (or more broadly excise taxes on non-alcoholic beverages) have been implemented both at a national (*e.g.* Chile, France, UK) level and at a city and state level (*e.g.* Berkeley, Philadelphia, Washington state) and are the subject of a rapidly growing academic literature (see *e.g.* Allcott, Lockwood, and Taubinsky (2019b) for a survey. Most closely related to the current research are studies that explicitly discuss geographical constraints such as Rojas and Wang (2021), who examine the introduction of these excise taxes in Berkeley and Washington state and Seiler, Tuchman, and Yao (2021), who examine the Philadelphia tax. The strength of the effects also at long distances, clearly indicates the important constraint that cross-border shopping imposes on excise taxes at a city level or for smaller jurisdictions.

Still, whether numbers are seen as large or small at the national level is partly in the eye of the beholder. In terms of limiting consumption of particular products, the effects of cross-border shopping are clearly very large for short and intermediate travel durations. Arguably this was an important reason why the excise tax on non-alcoholic beverages was

[18]In the analysis above we also examined the effect of cross-border shopping on sales of meat and cheese that are not subject to excise taxes but to import tariffs. The motivation for such tariffs is to protect domestic production rather than a combination of externalities and internalities directly linked to consumption. Evaluating the impact of those tariffs could be done in similar ways but would require keeping track of the origin of different products and is arguably of less interest outside Norway than the examination of how cross-border shopping interacts with excise taxes at different distances (travel duration) from the border.

removed in 2021 in Norway. In terms of the overall direct impact of cross-border shopping on tax revenue the consequences for Norway are nevertheless limited, as our estimate of 2.3 billion NOK corresponds to approximately 0.2% of taxes and levies from non-oil related income.[19]

6 Robustness checks

To interpret our results causally, we have to maintain that the underlying trend in grocery store activity does not vary with the travel duration to Sweden. In this section we provide evidence in support of this underlying assumption, and show that the results found in Section 4 are robust to a number of alternative specifications.

Figure 6 plots the average weekly sales for stores in the different pre-COVID duration categories. The thick grey line represents the stores in the control group, that is, stores that were located further than 180 minutes from the closest accessible Swedish store before the travel restrictions were implemented. We plot the average weekly sales in the period when all Swedish counties were open to border trade (from January 1, 2019 until March 17, 2020) and in the period when all Swedish counties were closed to cross-border trade (that is, between March 17 and July 25, 2020). While there is some variation in the levels between the groups, they follow each other quite closely over time, and there is no indication that the trends are different.

[Figure 6 about here]

We can also investigate the underlying common trends assumption by adding separate linear time trends for each of the pre-COVID duration categories depicted in the figure. If this produces significantly different results from the results reported in Table 5, it could reflect diverging underlying trends in sales in different regions rather than the effect of cross-border shopping (Angrist and Pischke 2008, p. 238). Reassuringly, we see that the results reported in Column 1 of Table 11 are very similar to the results in the main specification.

Even though both visual and statistical tests provide support for the common trends assumption, one could still imagine that different regions experienced different shocks that coincided with the closing of the border. Any shocks unrelated to the closing of the border that affected stores differently depending on their distance from the border would bias

[19] According to the 2019 government budget, (Finansdepartmentet (2019, p 52)), revenue from taxes and levies excluding oil related revenue amounted to 1031.3 billion NOK. As is well known Norway is a major oil exporter and taxes and levies from the oil sector contributed a further 312.8 billion NOK.

our results. However, travel restrictions affected stores *within* pre-COVID duration groups differently at different times, because different Swedish counties were open to cross-border shopping at different times during 2020. This variation allows us to include week × pre-COVID duration group fixed effects in the model. The estimated effects of cross-border shopping now no longer rely on stores from different pre-COVID duration groups having identical underlying developments in sales, but rather that stores in the *same* pre-COVID duration groups share a common underlying trend. The results from this specification are reported in Column 2 of Table 11. Compared to the main specification, the estimated effects are somewhat larger in magnitude up to until the $60-90$ duration category, but the general impression is very similar. We also see that the standard errors are slightly larger, which is not surprising given that we are now using only within pre-COVID duration group variation in the accessibility of cross-border shopping to identify the effects.

In our analysis so far, we have considered the effect of cross-border shopping on stores located less than 180 minutes from the closest Swedish store. All stores located 180 minutes or more away have been assumed to be unaffected by the availability of cross-border shopping in Sweden, effectively functioning as a control group. If sales in some of the stores in the control group are in fact negatively affected by the availability of cross-border shopping, the results reported in Table 5 would be misleading, with the estimated coefficients biased towards zero. As a robustness check on our results, we therefore estimate our model using only observations where the pre-COVID driving duration to the closest Swedish store is below 180 minutes or above 300 minutes. The control group now consists of stores that are at least 300 minutes away from the closest Swedish store, a distance that should reduce the relevance of cross-border shopping to a minimum. The results are reported in Column 3 of Table 11. The results are very similar to the ones in the main specification. The estimated coefficients are generally slightly larger in magnitude, which is what we would expect if some stores located between 180 and 300 minutes from the closest Swedish store are in fact affected by cross-border shopping. We also see that the effect of cross-border shopping is now statistically significant at the 1% level, also in the $90-120$ minutes-category.[20]

The results in our main specification are based on an assumption that the effect on grocery store sales in Norway of having an accessible Swedish store a certain distance away is the same before and during the pandemic. That is, we assume that having a Swedish store a 45-minute drive away is the same in September 2019 as in September 2020. However, there could be reasons to believe that this is not the case. For instance, infection rates were typically higher in Sweden than in Norway even in periods where some Swedish counties were open for cross-border shopping, something that could deter Norwegians from cross-

[20]In the main specification, the p value for this category is 0.067.

border shopping even in periods where Swedish border counties where open. To see whether this implicit assumption affects our results, we re-estimate our model excluding data from the period between the week starting on Monday, July 27, 2020, and the week starting on Monday, October 5, 2020, a period during which some but not all Swedish border counties were open. We are then left with a pre-period before March, 17, 2020 where cross-border shopping was possible and the COVID-19 infection rates where nonexistent or very low in both counties, and a post-period between March 17 and July 27, 2020, where cross-border shopping was not possible. The results are reported in Column 4 of Table 11. The point estimates are more or less unchanged from the main specification.

The results in Column 4 are also useful for another reason: several recent methodological papers have shown that the two-way fixed effects regressions we use in this paper can give biased results if treatment effects are heterogeneous across time or groups and there is variation in treatment timing (see *e.g.*, De Chaisemartin and d'Haultfoeuille (2020), Borusyak, Jaravel, and Spiess (2021), Callaway and Sant'Anna (2021), and Sun and Abraham (2021)).[21] The results reported in Column 4 of Table 11 are based on a restricted time period where there is no variation in treatment timing. This means that we avoid the forbidden comparison of units going into treatment with already treated units (Borusyak, Jaravel, and Spiess 2021). The fact that the results in this specification are similar to the results in the main specification indicates that they are not biased by heterogenous treatment effects.[22]

In our view, the main analysis and robustness checks performed so far provide clear evidence that Norwegian stores close to the border experienced increases in store activity during the COVID-19 pandemic. Our hypothesis is that this increase in store activity was the result of cross-border shopping effectively becoming impossible. An alternative explanation could be that the grocery trade in some or all border regions was affected differently by the COVID-19 pandemic than grocery trade in the rest of Norway. To provide some additional support for our explanation, we estimate a specification where we include several control variables that may both affect grocery demand, and be affected by the pandemic. First, we include a measure of COVID-19 infection rates at the municipality level, specifically, new infections per 1000 inhabitants during the last two weeks.[23] The COVID-19 pandemic also affected the labor market and led to sharp increases in unemployment rates. We therefore include monthly unemployment rates at the municipality level as a control variable. The

[21] Using the `twowayfeweights` STATA-package of De Chaisemartin and d'Haultfoeuille (2020), none of the weights attached to our main regression were negative, satisfying the no sign reversal property.

[22] Several alternative estimators that are robust to heterogeneous treatment effects have been proposed, but most of these estimators do not apply to our natural experiment since treatment is switching. One exception is the estimator of Borusyak, Jaravel, and Spiess (2021), which yields almost identical point estimates to our main specification.

[23] That is, the sum of infected individuals in week t and $t-1$ divided by the population of the municipality.

population dynamics in many Norwegian municipalities also changed during the pandemic. We therefore include population at the municipality-quarterly level as a control variable. Finally, local markets with a large number of holiday homes may have been affected differently by the pandemic than other local markets. First, in the period between March 19, 2020 and April 20, 2020 there was a ban in Norway on staying in holiday homes located outside one's home municipality. Secondly, after this first period, staying at holiday homes was permitted, while travelling abroad was severely restricted, which could lead to unusually high retail activity in municipalities with a high proportion of holiday homes. To account for these factors we include an interaction between the proportion of holiday homes in the municipality and an indicator variable, C, that is one in the period after March 13 (when national restrictions were put in place) and zero in the period before March 13. The results are reported in Column 5 of Table 11. Many of these variables affect grocery store sales, but the estimated effects of the interaction terms of interest are little changed compared to the main specification. We do note, however, that the estimated effect of cross-border shopping in the 90-120 duration category is higher and highly statistically significant.

[Table 11 about here]

For yet additional robustness exercises see the Online Appendix where we present pre-treatment plots and specification checks for the other dependent variables considered in Section 4: store visits and basket size from Table 5, sales in the categories from Table 7 and Table 6, as well as VAT and category volumes from Table 8. The results reinforce the impression from this section that our results are very robust to alternative specifications and explanations.

A comparison with a survey-based estimate of cross-border shopping

Another way of establishing that results are credible is to compare to other sources of information about Norwegian cross-border shopping. Above we estimated a counterfactual sales loss in 2019 of approximately 7.3 billion NOK, including excise taxes and VAT. One external comparison for this number comes from the survey of cross-border shopping conducted by Statistics Norway (2022a), where a random sample of 2000 Norwegians are surveyed about cross-border shopping in each quarter every year. Our counterfactual estimates based on the border closures provide an opportunity to validate the results from the 2019 pre-closure survey of cross-border shopping and vice versa. Based on survey responses Statistics Norway (2022a) estimates that the cross-border grocery trade amounted to around 10.6 billion

NOK in 2019.[24] The difference between the two estimates is thus relatively minor, which is reassuring. Let us nevertheless briefly discuss reasons for the potential discrepancies.

We estimate that grocery stores lost about 7.3 billion to cross-border shopping in 2019. However, groceries are also sold through kiosks, gasoline stations and variety discount stores. In 2019 more than 13 billion NOK worth of grocery sales originated from these sales channels.[25] Assuming the same sales loss due to cross-border shopping for these channels as what we found for our grocery stores (3.4%), this suggests that grocery sales of about 488 million NOK are disregarded when we rely only on grocery stores to estimate the loss from cross-border shopping.

More conceptually interesting however is that while we estimate the value of the sales lost in Norway through cross-border shopping, Statistics Norway estimates the value of the goods bought in Sweden. Given the large price differences between the two countries, it is not surprising that we see a discrepancy between these two estimates. The price indices reported in Table 1 suggest that, overall, food prices were about 35% (155/114.8) more expensive in Norway than in Sweden in 2019.[26] Furthermore, price differences tend to be greater than 35% for the categories most frequently bought in Sweden by Norwegian customers. For instance, non-alcoholic beverages were 64% more expensive in Norway in 2019 and Tobacco was 109% more expensive. In response to lower prices, we expect that Norwegian customers buy substantially more when shopping in Sweden than they would if facing Norwegian prices. If we account for sales through gasoline stations, kiosks and variety discount stores, as well as the larger price differences for key cross-border shopping categories, the difference between our estimate of a loss of 7.3 billion NOK in Norway and a cross-border shopping value of 10.6 billion NOK, as estimated by Statistics Norway, is explained by an own-price elasticity

[24] According to Statistics Norway (2020), Norwegians spent 16,041 billion NOK in Sweden in 2019 but this included spending on gasoline, restaurant meals and products from all retail segments. In the 2019 survey, respondents were also asked which product categories they bought in Sweden. The largest category was food and non-food items typically sold in grocery stores (33.7%), followed by alcohol (18.2%) and tobacco (15.9%), soda (10.6%) and sweets (6.7%), with a range of other products such as clothes and electronics making up the remaining 15%. If we disregard alcohol (in Norway and Sweden wine and liquor are exclusively retailed in state-controlled retail monopolies and only beer can be sold in grocery stores) and "other products", we estimate that 66% of the cross-border shopping in Sweden is groceries, giving the number 10,587 billion NOK.

[25] The Norwegian gasoline stations sold grocery products for 7033 million NOK and Norwegian kiosks for another 4196 million NOK (Dagligvarehandelen 2021). The discount chain Normal offers the same personal care products as the grocery chains and had a turnover of 944 million NOK in 2019 (Kapital 2021). Finally, Europris, the largest Norwegian variety discount chain, had a total turnover of 6234 million NOK in 2019 (Europris 2020). Europris has a product overlap with the Norwegian grocery chains of more than 35% (Evensen, Steen, and Ulsaker 2021). If we use this as a rough estimate for the share of Europris' turnover stemming from groceries, suggests that they had "grocery" turnover of 2182 million NOK in 2019. In total these four channels thus represented grocery sales of an estimated 14.4 billion NOK in 2019.

[26] This is well in line with Pettersen (2020), who estimates that the price differences between Norway and Sweden and Denmark were about 32% in 2018.

of cross-border shopping goods in the range between -4 to -2.

The elasticities outlined in the discussion above are well within the bounds of estimates from the international literature, even if typical estimates are less elastic (see *e.g*, Fogarty (2010) for beer and Cornelsen et al. (2015) for meat, dairy and sweets). For soda Allcott, Lockwood, and Taubinsky (2019b, p.216) report own-price elasticities across a large number of studies ranging from -0.13 to -3.9 with Allcott, Lockwood, and Taubinsky (2019a) using an estimated own-price elasticity of soda of -1.4.

In conclusion this validation exercise finds that our results match up well with the questionnaire of cross-border shopping conducted by Norway's national statistical agency. Perhaps even more importantly our results also provide a validation the other way around – a well conducted survey with 2000 respondents sampled nationally paints a picture that is remarkably well in line with observed patterns in this natural experiment. As such the results should be encouraging for statistical agencies in both Norway and other countries that use surveys to track cross-border shopping.

7 Conclusion

Travel restrictions due to the COVID-19 pandemic made cross-border shopping in neighboring Sweden infeasible for Norwegians for most of 2020. In this paper we exploit this natural experiment to estimate the effects of cross-border shopping on the grocery retail sector in Norway. The natural experiment is unique in the sense that it mimics the autarky regime often taken as a benchmark in theoretical work on cross-border shopping but rarely observed in practice. The natural experiment allows us to estimate the *total* effect of cross-border shopping directly, something that is difficult when – as is usually the case in the empirical literature on cross-border shopping – one has to rely only on changes in the relative prices.

Our estimates suggest that cross-border shopping reduces sales in the grocery stores closest to the border by more than a quarter compared to a counterfactual situation with closed borders. For typical cross-border shopping categories such as tobacco, more than half of the sales are lost. By not only estimating the effects of cross-border shopping in the regions closest to the border but also tracking how they gradually diminish as we move away from the border, we are able to quantify the effects at the national level. We estimate that the cross-border-shopping reduces total grocery sales in Norway by more than 3%, with a corresponding reduction in VAT income.

Our study also clearly illustrates the challenges of independent tax policies when shopping in a neighboring jurisdiction is possible. Excise taxes on products such as tobacco, alcohol and soda can be motivated by both fiscal and public health reasons. Our results demonstrate

that a substantial part of the potential tax revenue can disappear through cross-border shopping. For tobacco and soda, we estimate that about 10% of the counterfactual tax income under closed borders is lost due to border shopping. In addition, our results indicate that Norwegians living in the border areas cover a large part of their consumption of products such as tobacco and alcohol through cross-border shopping, dampening the effectiveness of the excise taxes in reducing consumption.

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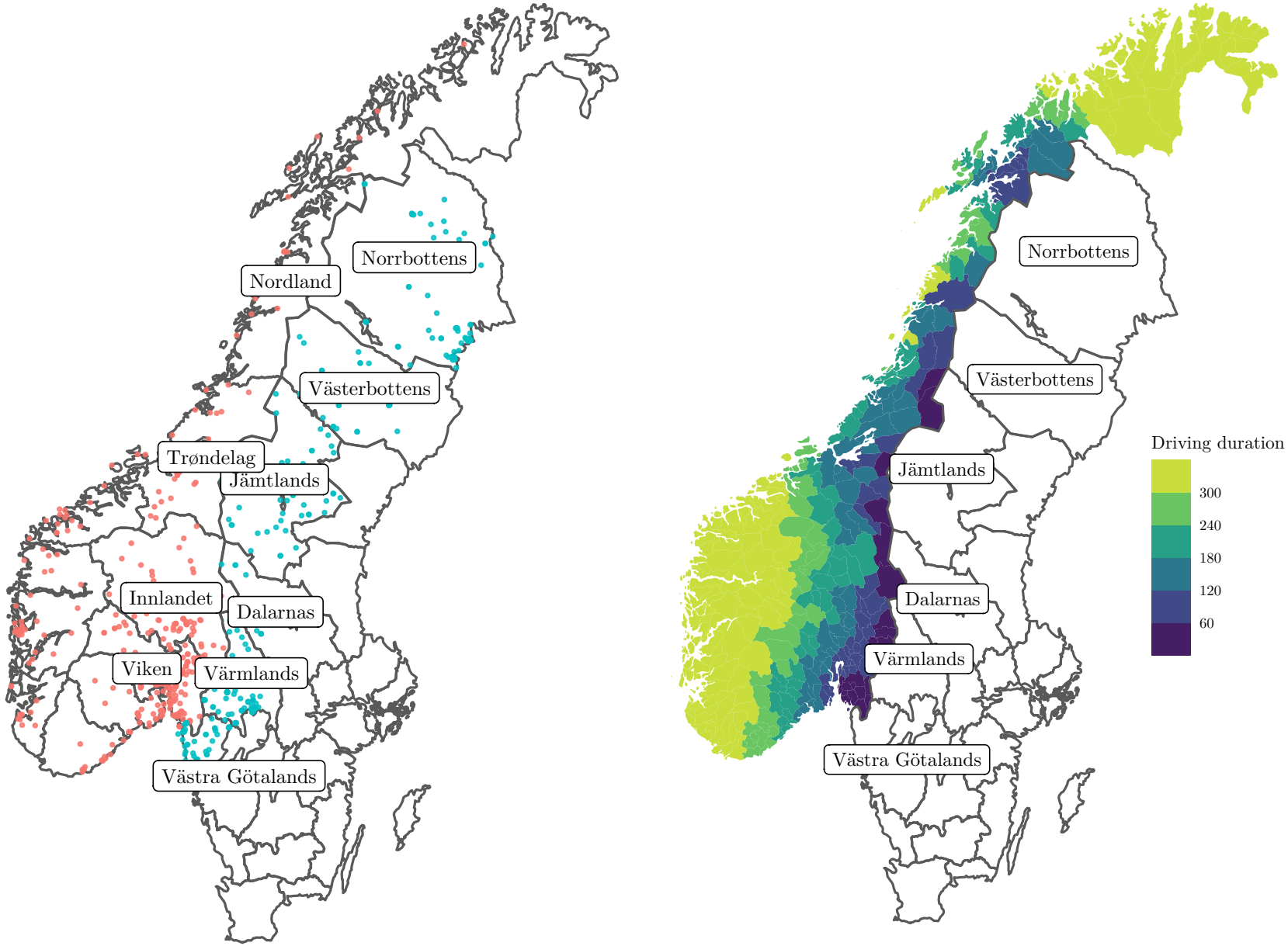
Figure 1: Grocery stores and driving duration

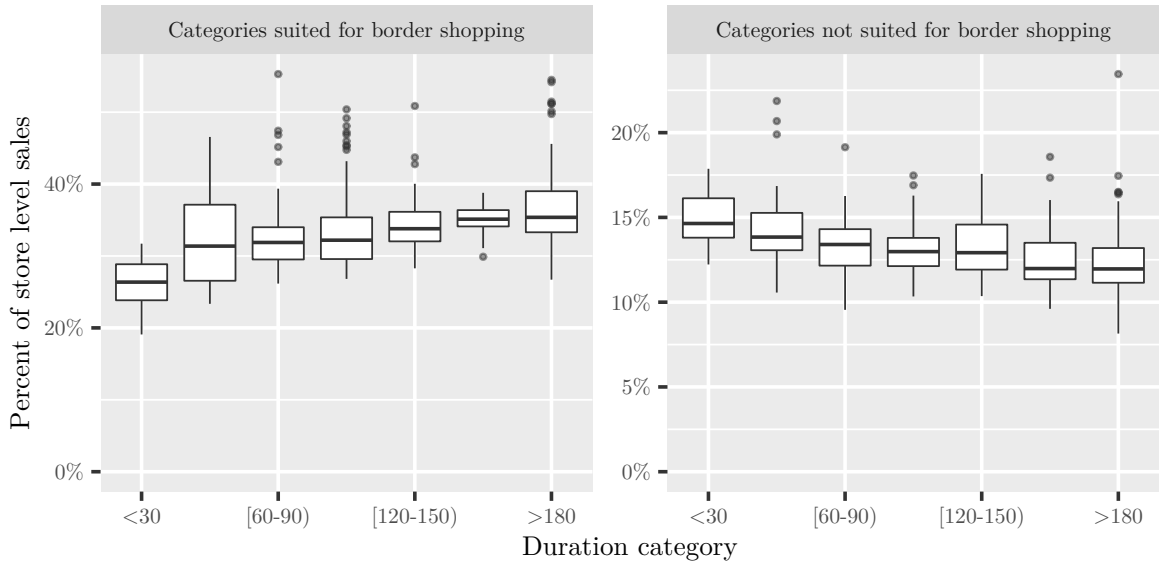


Note: Left panel: The red points are the 400 Norwegian grocery stores in the sample. The turquoise points are the 403 Swedish grocery stores that are located in the 10 labor market regions that border Norway. Right panel: Driving duration in minutes from centroid of Norwegian municipalities to closest Swedish grocery store.

Figure 2: Accessibility of Swedish border counties

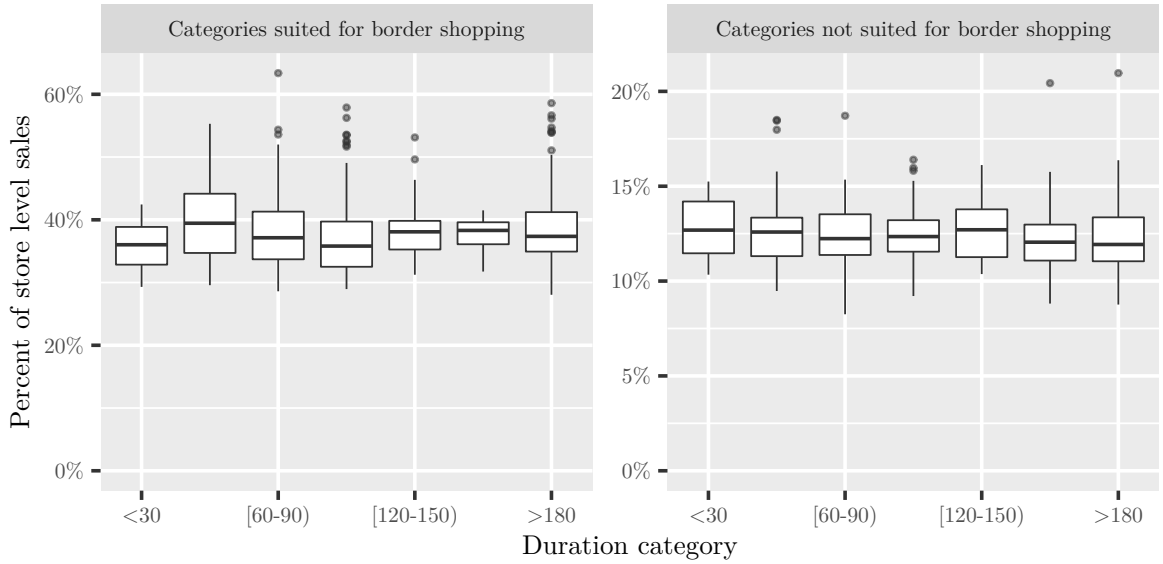
Note: This figure indicates which weeks the Swedish border counties were closed to cross-border shopping in 2020. We define a county as closed in a given week if in the majority of the days of the week visiting the county triggered a quarantine upon returning to Norway. The first week shown is the week starting on Monday March 16, 2020. Travels to Sweden were restricted from Tuesday March 17, 2020.

Figure 3: Category sales shares pre COVID-19 pandemic



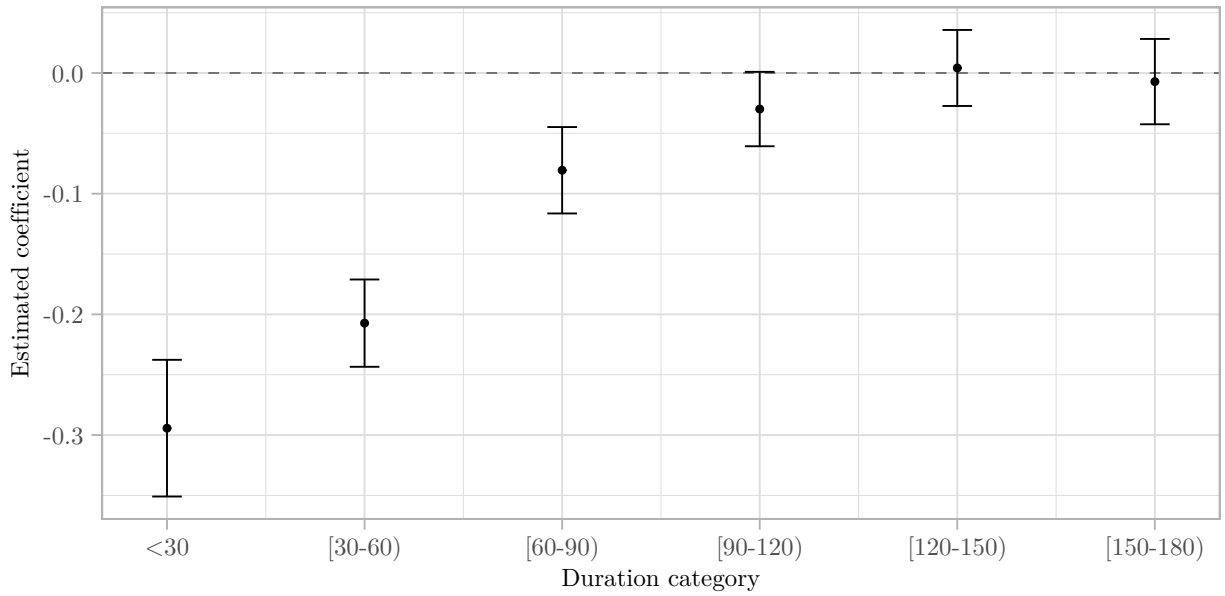
Note: The panel on the left-hand side shows a boxplot of the share of total store level sales that are accounted for by the categories Sweets, Soda, Cheese, Meat, Beer and Tobacco. The panel on the left-hand side shows a boxplot of the share of total store level sales that are accounted for by the categories Ice cream, Milk, Fresh bake and Ready-made. For each store the share is calculated across all weeks between the week starting on Monday December 31, 2018 and the week starting on Monday, 2, March, 2020. The lower and upper hinges correspond to the first and third quartiles. The upper whisker extends from the hinge to the largest value no further than $1.5 \times IQR$ from the hinge. The lower whisker extends from the hinge to the smallest value at most $1.5 \times IQR$ of the hinge.

Figure 4: Category sales shares during COVID-19 pandemic



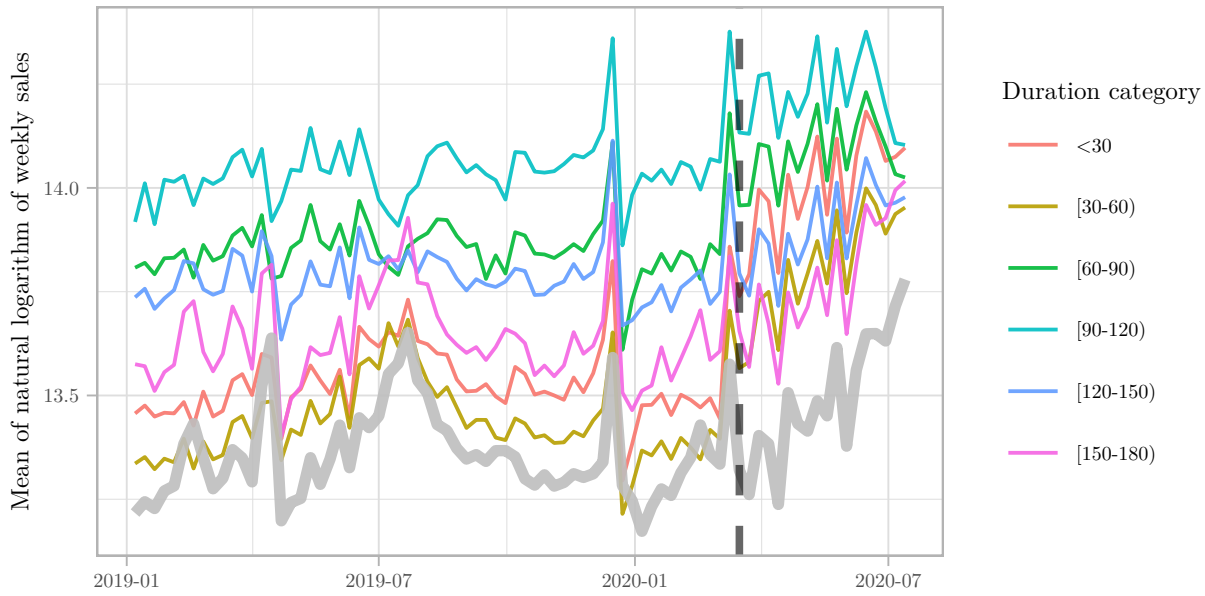
Note: The panel on the left-hand side shows a boxplot of the share of total store level sales that are accounted for by the categories Sweets, Soda, Cheese, Meat, Beer and Tobacco. The panel on the left-hand side shows a boxplot of the share of total store level sales that is accounted for by the categories Ice cream, Milk, Fresh bake and Ready-made. For each store the share is calculated across all weeks between the week starting on Monday March 16, 2020 and the week starting on Monday, July 13, 2020. During these weeks, all Swedish border counties were closed for cross-border shopping. The lower and upper hinges correspond to the first and third quartiles. The upper whisker extends from the hinge to the largest value no further than $1.5 \times IQR$ from the hinge. The lower whisker extends from the hinge to the smallest value at most $1.5 \times IQR$ of the hinge.

Figure 5: Effect of cross-border shopping on grocery store sales



Note: The points show estimated coefficients reported in Column 1 of Table 5. The vertical bars represent 95 % confidence intervals and are calculated using standard errors clustered at the store level.

Figure 6: Pre-trends in store sales



Note: The figure shows the Natural logarithm of the average weekly sales at the store level (in NOK), for stores in different duration groups. The first week included in the figure is the week starting on Monday, January 7, 2019. The last week included in the figure is the week starting on Monday, July 13, 2020. The dashed vertical line indicates the week travels to Sweden became restricted. The thick grey line represents stores that were located at least 180 minutes from the closest Swedish store.

Table 1: Price level index for selected product categories (EU27=100) for Norway and Sweden in 2019

	Norway	Sweden
Food	155.2	114.8
Alcohol	260.4	155.9
Meat	149.1	115.1
Milk, Cheese and Eggs	168.7	109.2
Non-alcoholic Beverages	177.8	108.3
Tobacco	234.9	112.3

Table 2: Frequency distribution of minutes to closest Swedish store before travel restrictions were implemented

	Frequency	Percent
Duration $<$ 30	14	3.50
30 $\leq$ Duration $<$ 60	33	8.25
60 $\leq$ Duration $<$ 90	55	13.75
90 $\leq$ Duration $<$ 120	103	25.75
120 $\leq$ Duration $<$ 150	41	10.25
150 $\leq$ Duration $<$ 180	27	6.75
Duration $\geq$ 180	127	31.75
Total	400	100.00

Note: This table shows the number of stores within each duration category in the week starting on Monday 2020-03-09, that is, the week before travels to Sweden became restricted.

Table 3: Descriptive statistics

	<30		[30, 60)		[60, 90)		[90, 120)		[120, 150)		[150, 180)		>180	
	2019	2020	2019	2020	2019	2020	2019	2020	2019	2020	2019	2020	2019	2020
Outcome variables														
Store sales (millions NOK)	0.97	1.37	0.92	1.20	1.40	1.66	1.60	1.88	1.17	1.31	1.09	1.22	0.84	0.94
Store visits	4591	5015	4179	4430	5891	5809	6703	6559	5104	4876	4350	4144	3734	3565
Basket size (NOK)	206.7	266.9	206.6	256.5	226.1	273.8	230.9	278.0	227.1	270.4	247.4	296.2	229.7	273.5
VAT (thousands NOK)	136	196	131	173	198	239	226	268	167	189	157	178	121	137
Ice cream sales (thousands NOK)	15.9	22.0	14.6	19.4	20.0	25.3	21.3	27.1	14.1	17.1	12.7	15.8	11.0	13.5
Milk sales (thousands NOK)	31.0	38.3	28.3	31.9	43.1	46.2	45.3	48.7	35.0	35.5	35.1	35.5	26.5	27.3
Fresh bake sales (thousands NOK)	47.1	52.4	43.2	46.8	59.4	61.7	63.4	66.5	48.4	49.0	40.6	40.4	31.2	31.7
Ready made sales (thousands NOK)	45.5	53.2	38.3	43.8	56.1	60.5	64.5	70.4	44.2	46.8	35.4	37.9	26.6	28.5
Cheese sales (thousands NOK)	42.3	57.8	39.2	49.3	61.9	71.7	75.2	87.2	50.9	54.7	48.6	52.3	34.9	37.9
Meat sales (thousands NOK)	43.6	79.6	46.6	69.4	81.2	102.9	99.7	122.4	66.0	79.3	56.6	67.5	42.0	49.0
Sweets sales (thousands NOK)	39.2	56.8	37.5	48.9	57.8	68.3	66.1	77.0	52.0	57.3	49.9	55.4	38.3	42.8
Sweets sales (kilograms)	167.2	233.9	153.8	190.3	236.2	265.5	273.8	304.6	215.2	224.0	216.2	225.0	163.9	171.4
Soda sales (thousands NOK)	32.3	60.7	35.4	52.3	54.8	66.3	61.1	71.4	52.0	58.0	49.4	55.0	37.8	40.3
Soda sales (liters)	1435	3167	1520	2488	2408	3081	2672	3217	2397	2758	2318	2642	1686	1832
Beer sales (thousands NOK)	46.0	80.6	51.8	78.1	75.5	98.2	85.2	108.9	65.7	80.0	65.9	78.7	53.3	62.2
Beer sales (liters)	782	1343	845	1244	1226	1557	1325	1656	1046	1244	1065	1244	868	969
Cigarette sales (thousands NOK)	17.5	50.8	26.8	56.9	40.9	66.4	42.0	60.3	41.4	56.0	41.9	55.1	32.5	40.4
Cigarette sales (items)	2897	8053	4338	8838	6569	10,241	6760	9315	6713	8713	6917	8739	5308	6340
Snus sales (thousands NOK)	7.5	23.2	12.1	27.6	23.1	37.3	30.0	43.3	23.6	33.1	24.1	32.6	23.0	28.6
Snus sales (kilograms)	1.8	5.4	2.7	6.2	5.1	8.3	6.5	9.4	5.2	7.3	5.5	7.4	5.0	6.2
Control variables														
New Covid-19 cases	0.0	25.4	0.0	23.3	0.0	86.3	0.0	79.8	0.0	9.4	0.0	2.8	0.0	15.1
Holiday home proportion	0.11	0.11	0.14	0.13	0.10	0.10	0.07	0.07	0.17	0.17	0.28	0.28	0.27	0.27
Unemployment rate	0.03	0.05	0.03	0.05	0.02	0.05	0.02	0.05	0.02	0.04	0.02	0.04	0.02	0.04
Population (in thousands)	45.5	45.9	42.5	42.8	134.3	136.1	147.4	149.0	25.8	25.9	11.9	12.2	44.2	43.9
Sweets tax (NOK per kilogram)	20.8	21.2	20.8	21.2	20.8	21.2	20.8	21.2	20.8	21.2	20.8	21.2	20.8	21.2
Soda tax (NOK per liter)	4.8	4.9	4.8	4.9	4.8	4.9	4.8	4.9	4.8	4.9	4.8	4.9	4.8	4.9
Beer tax (NOK per liter)	22.4	22.8	22.4	22.8	22.4	22.8	22.4	22.8	22.4	22.8	22.4	22.8	22.4	22.8
Cigarette tax (NOK per item)	2.6	2.7	2.6	2.7	2.6	2.7	2.6	2.7	2.6	2.7	2.6	2.7	2.6	2.7
Snus tax (NOK per kilogram)	1070	1090	1070	1090	1070	1090	1070	1090	1070	1090	1070	1090	1070	1090

Note: This table shows the mean value of the outcome and control variables. All variables are measured at the week-store level. The mean values are calculated by year and duration groups, where the duration group is defined by the driving duration to the closest Swedish store when all Swedish counties were open for cross-border shopping.

Table 4: Effect of cross-border shopping on grocery store activity - simple specification

	(1) Sales	(2) Store visits	(3) Basket size
B	-0.061^{***}	-0.032^{**}	-0.030^{***}
	(0.012)	(0.011)	(0.004)
Observations	42000	42000	42000
Stores	400	400	400

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Note: This table reports results from estimation of (1). In Column (1) the dependent variable is the natural logarithm of weekly sales. In Column (2) the dependent variable is the natural logarithm of the number of weekly store visits. In Column (3) the dependent variable is the natural logarithm of the average weekly basket size, defined as weekly sales divided by weekly store visits. The standard errors reported in parentheses are clustered at the store level.

Table 5: Effect of cross-border shopping on grocery store activity - main specification

	(1) Sales	(2) Store visits	(3) Basket size
Duration $< 30 \times B$	-0.294^{***}	-0.174^{***}	-0.121^{***}
	(0.029)	(0.028)	(0.010)
$30 \leq$ Duration $< 60 \times B$	-0.207^{***}	-0.135^{***}	-0.073^{***}
	(0.018)	(0.017)	(0.009)
$60 \leq$ Duration $< 90 \times B$	-0.081^{***}	-0.050^{**}	-0.030^{***}
	(0.018)	(0.017)	(0.007)
$90 \leq$ Duration $< 120 \times B$	-0.030	-0.009	-0.021^{***}
	(0.016)	(0.015)	(0.006)
$120 \leq$ Duration $< 150 \times B$	0.004	0.016	-0.011^{*}
	(0.016)	(0.015)	(0.005)
$150 \leq$ Duration $< 180 \times B$	-0.007	0.005	-0.013^{*}
	(0.018)	(0.017)	(0.006)
Observations	42000	42000	42000
Stores	400	400	400

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Note: This table reports results from estimation of Equation (2). In Column (1) the dependent variable is the natural logarithm of weekly sales. In Column (2) the dependent variable is the natural logarithm of the number of weekly store visits. In Column (3) the dependent variable is the natural logarithm of the average weekly basket size, defined as weekly sales divided by weekly store visits. The standard errors reported in parentheses are clustered at the store level.

Table 6: Effect of cross-border shopping on sales in categories not suitable for cross-border shopping

	Ice cream	Milk	Fresh bake	Ready made
Duration $< 30 \times B$	-0.121^{**}	-0.220^{***}	-0.152^{***}	-0.143^{***}
	(0.040)	(0.032)	(0.036)	(0.039)
$30 \leq$ Duration $< 60 \times B$	-0.093^{***}	-0.112^{***}	-0.102^{***}	-0.116^{***}
	(0.018)	(0.021)	(0.024)	(0.023)
$60 \leq$ Duration $< 90 \times B$	-0.035	-0.029	-0.042	-0.007
	(0.019)	(0.019)	(0.022)	(0.020)
$90 \leq$ Duration $< 120 \times B$	0.019	-0.002	-0.020	0.020
	(0.016)	(0.017)	(0.018)	(0.017)
$120 \leq$ Duration $< 150 \times B$	0.036	0.029	0.006	0.033
	(0.020)	(0.018)	(0.019)	(0.018)
$150 \leq$ Duration $< 180 \times B$	-0.022	0.015	0.005	0.001
	(0.021)	(0.018)	(0.018)	(0.020)
Observations	41995	41993	41994	41993
Stores	400	400	400	400

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Note: This table reports results from estimation of Equation 2. Each column shows the result of an estimation where the dependent variable is the weekly sales at store level (in NOK) of the given product category. The standard errors reported in parentheses are clustered at the store level.

Table 7: Effect of cross-border shopping on sales in categories well suited for cross-border shopping

	(1) Cheese	(2) Meat	(3) Sweets	(4) Soda	(5) Beer	(6) Cigarettes	(7) Snus
Duration $< 30 \times B$	−0.280***	−0.519***	−0.349***	−0.660***	−0.510***	−1.101***	−1.098***
	(0.034)	(0.034)	(0.036)	(0.050)	(0.047)	(0.096)	(0.057)
$30 \leq$ Duration $< 60 \times B$	−0.178***	−0.328***	−0.214***	−0.375***	−0.309***	−0.680***	−0.770***
	(0.025)	(0.028)	(0.024)	(0.031)	(0.027)	(0.037)	(0.048)
$60 \leq$ Duration $< 90 \times B$	−0.074***	−0.104***	−0.085***	−0.151***	−0.143***	−0.309***	−0.305***
	(0.021)	(0.021)	(0.022)	(0.022)	(0.022)	(0.027)	(0.029)
$90 \leq$ Duration $< 120 \times B$	−0.039*	−0.037*	−0.029	−0.076***	−0.090***	−0.141***	−0.140***
	(0.019)	(0.018)	(0.020)	(0.018)	(0.019)	(0.019)	(0.021)
$120 \leq$ Duration $< 150 \times B$	0.005	−0.017	0.005	−0.048**	−0.052**	−0.071***	−0.086***
	(0.020)	(0.020)	(0.018)	(0.019)	(0.018)	(0.021)	(0.022)
$150 \leq$ Duration $< 180 \times B$	−0.014	−0.033	0.003	−0.042	−0.029	−0.045*	−0.047
	(0.020)	(0.020)	(0.022)	(0.022)	(0.023)	(0.021)	(0.025)
Observations	41994	41993	41998	41997	41996	41997	41927
Stores	400	400	400	400	400	400	400

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Note: This table reports results from estimation of Equation 2. Each column shows the result of an estimation where the dependent variable is the weekly sales at store level (in NOK) of the given product category. The standard errors reported in parentheses are clustered at the store level.

Table 8: Effect of cross-border shopping on VAT and category volumes

	(1) VAT	(2) Sweets	(3) Soda	(4) Beer	(5) Cigarettes	(6) Snus
Duration $< 30 \times B$	−0.314***	−0.374***	−0.790***	−0.520***	−1.102***	−1.106***
	(0.029)	(0.040)	(0.062)	(0.049)	(0.096)	(0.060)
$30 \leq$ Duration $< 60 \times B$	−0.226***	−0.219***	−0.434***	−0.322***	−0.680***	−0.783***
	(0.018)	(0.026)	(0.039)	(0.029)	(0.038)	(0.049)
$60 \leq$ Duration $< 90 \times B$	−0.089***	−0.091***	−0.174***	−0.153***	−0.309***	−0.315***
	(0.018)	(0.022)	(0.022)	(0.023)	(0.028)	(0.029)
$90 \leq$ Duration $< 120 \times B$	−0.034*	−0.035	−0.086***	−0.103***	−0.139***	−0.147***
	(0.016)	(0.020)	(0.018)	(0.021)	(0.019)	(0.021)
$120 \leq$ Duration $< 150 \times B$	0.001	0.008	−0.063**	−0.061**	−0.067**	−0.092***
	(0.016)	(0.019)	(0.020)	(0.021)	(0.021)	(0.023)
$150 \leq$ Duration $< 180 \times B$	−0.008	0.007	−0.053**	−0.046	−0.045*	−0.055*
	(0.018)	(0.024)	(0.020)	(0.025)	(0.021)	(0.024)
Observations	41995	42398	42397	42396	42397	42326
Stores	400	400	400	400	400	400

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Note: This table reports results from estimation of Equation 2. Columns (2)-(6) show the result of an estimation where the dependent variable is the weekly sales (in volume) at store level of the given product category. The standard errors reported in parentheses are clustered at the store level.

Table 9: Estimated effect of border trade on stores sales and VAT

	<30	[30, 60)	[60, 90)	[90, 120)	[120, 150)	[150, 180)	>180	Total
Store distribution								
Number of stores	62	188	371	762	279	176	1985	3823
Proportion of stores	0.02	0.05	0.10	0.20	0.07	0.05	0.52	1.00
Sales (million NOKs)								
Counterfactual	4203	11,091	29,265	65,292	16,904	10,031	86,381	223,166
Actual	3132	9015	26,999	63,369	16,974	9959	86,381	215,828
Loss	1071.6	2076.2	2266.2	1922.7	−70.4	71.5	0.0	7337.8
VAT (million NOKs)								
Counterfactual	602	1602	4185	9283	2426	1452	12,531	32,081
Actual	440	1278	3828	8971	2428	1440	12,531	30,916
Loss	162.3	324.0	356.6	311.5	−2.3	12.1	0.0	1164.3

Note: The duration groups are defined by driving duration to closest Swedish store when all Swedish counties were open for cross-border shopping.

Table 10: Estimated effect of border trade on sales and tax income

	<30	[30, 60)	[60, 90)	[90, 120)	[120, 150)	[150, 180)	>180	Total
Sweets								
Sales (metric tons)								
Counterfactual	784	1871	4991	11,227	3098	1965	16,913	40,849
Actual	539	1504	4557	10,846	3122	1978	16,913	39,459
Loss	245	368	433	381	−24	−13	0	1389
Tax (millions NOKs)								
Counterfactual	16.3	39.0	103.9	233.7	64.5	40.9	352.1	850.5
Actual	11.2	31.3	94.9	225.8	65.0	41.2	352.1	821.5
Loss	5.1	7.7	9.0	7.9	−0.5	−0.3	0.0	28.9
Soda								
Sales (thousand liters)								
Counterfactual	10,191	22,932	55,279	115,312	37,025	22,368	174,023	437,130
Actual	4626	14,862	46,449	105,844	34,777	21,212	174,023	401,792
Loss	5565	8071	8831	9467	2249	1156	0	35,338
Tax (million NOKs)								
Counterfactual	49.1	110.5	266.4	555.8	178.5	107.8	838.8	2107.0
Actual	22.3	71.6	223.9	510.2	167.6	102.2	838.8	1936.6
Loss	26.8	38.9	42.6	45.6	10.8	5.6	0.0	170.3
Beer								
Sales (thousand liters)								
Counterfactual	4243	11,400	27,572	58,164	16,121	10,205	89,595	217,300
Actual	2522	8265	23,651	52,489	15,168	9748	89,595	201,438
Sales loss (thousand liters)	1721	3136	3921	5675	953	457	0	15,862
Tax (million NOKs)								
Counterfactual	95.0	255.4	617.6	1302.9	361.1	228.6	2006.9	4867.5
Actual	56.5	185.1	529.8	1175.8	339.8	218.4	2006.9	4512.2
Loss	38.6	70.2	87.8	127.1	21.3	10.2	0.0	355.3
Cigarettes								
Sales (thousand items)								
Counterfactual	28,118	83,737	172,618	307,899	104,125	66,246	547,895	1,310,640
Actual	9341	42,405	126,734	267,821	97,387	63,308	547,895	1,154,891
Loss	18,777	41,333	45,884	40,079	6738	2938	0	155,749
Tax (million NOKs)								
Counterfactual	74.0	220.2	454.0	809.8	273.8	174.2	1441.0	3447.0
Actual	24.6	111.5	333.3	704.4	256.1	166.5	1441.0	3037.4
Loss	49.4	108.7	120.7	105.4	17.7	7.7	0.0	409.6
Snus								
Sales (metric tons)								
Counterfactual	15.86	57.81	135.89	298.92	83.14	53.27	518.77	1163.66
Actual	5.25	26.42	99.19	258.08	75.85	50.44	518.77	1033.99
Loss	10.62	31.39	36.70	40.84	7.30	2.84	0.00	129.67
Tax (million NOKs)								
Counterfactual	17.0	61.9	145.4	319.8	89.0	57.0	555.1	1245.1
Actual	5.6	28.3	106.1	276.1	81.2	54.0	555.1	1106.4
Loss	11.4	33.6	39.3	43.7	7.8	3.0	0.0	138.7

Note: The duration groups are defined by driving duration to closest Swedish store when all Swedish counties were open for cross-border shopping.

Table 11: Effect of border shopping on store sales – robustness checks

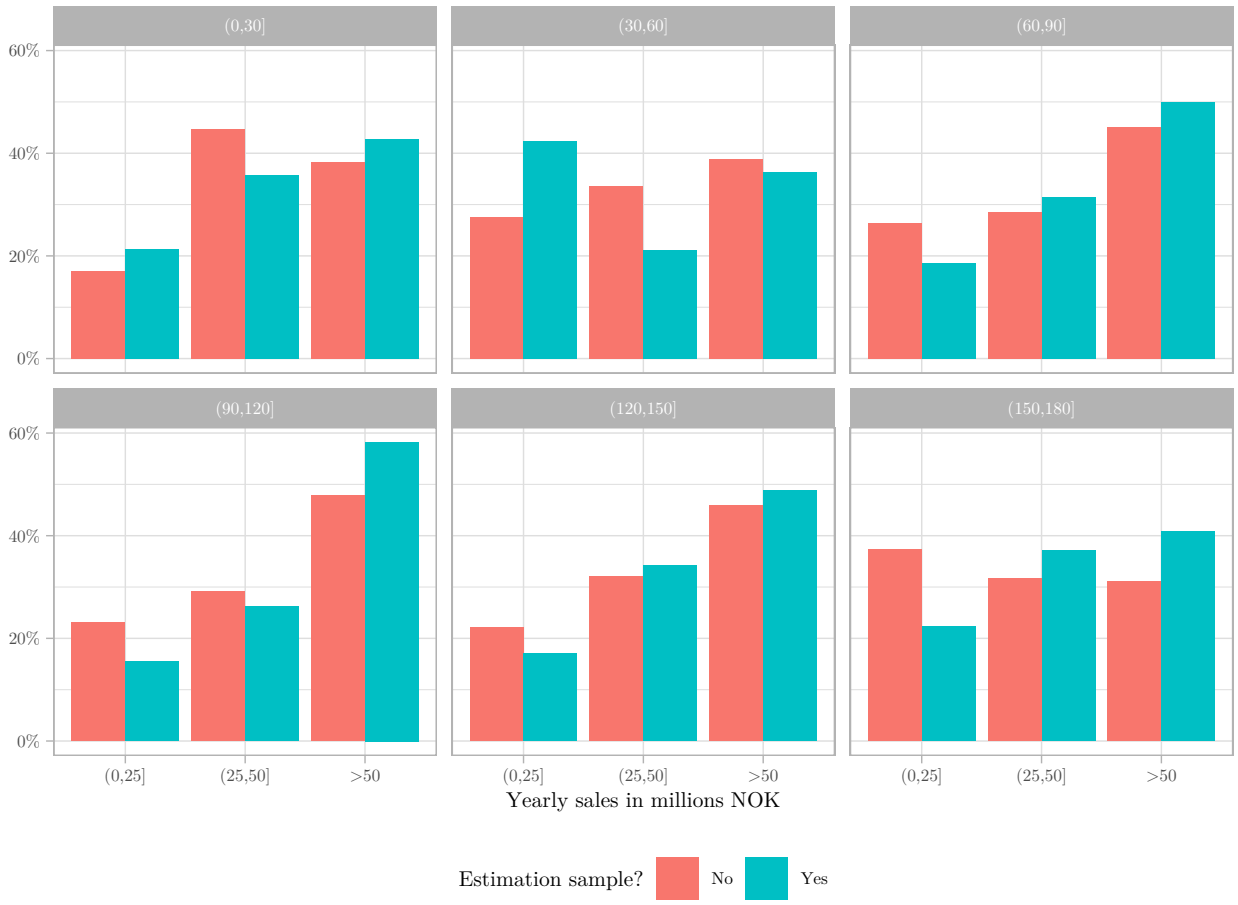
	(1) Sales	(2) Sales	(3) Sales	(4) Sales	(5) Sales
Duration $< 30 \times B$	−0.309***	−0.328***	−0.309***	−0.301***	−0.311***
	(0.045)	(0.069)	(0.029)	(0.029)	(0.030)
$30 \leq$ Duration $< 60 \times B$	−0.225***	−0.280***	−0.221***	−0.206***	−0.229***
	(0.032)	(0.056)	(0.019)	(0.020)	(0.019)
$60 \leq$ Duration $< 90 \times B$	−0.101***	−0.199***	−0.090***	−0.077***	−0.109***
	(0.017)	(0.053)	(0.018)	(0.022)	(0.019)
$90 \leq$ Duration $< 120 \times B$	−0.033*	−0.002	−0.042**	−0.034	−0.059***
	(0.015)	(0.025)	(0.016)	(0.018)	(0.016)
$120 \leq$ Duration $< 150 \times B$	−0.011	0.022	−0.006	0.010	−0.005
	(0.017)	(0.021)	(0.016)	(0.020)	(0.016)
$150 \leq$ Duration $< 180 \times B$	−0.018	0.002	−0.017	−0.006	−0.003
	(0.021)	(0.019)	(0.018)	(0.021)	(0.018)
New Covid-19 cases					0.014***
					(0.004)
$C \times$ Holiday home proportion					0.135***
					(0.036)
Unemployment rate					−1.854***
					(0.367)
Population					0.499
					(0.260)
Observations	42000	42000	35490	37600	41016
Stores	400	400	338	400	400
Control group	$>$ 180 minutes	$>$ 180 minutes	$>$ 300 minutes	$>$ 180 minutes	$>$ 180 minutes
Linear time trends	Yes	No	No	No	No
Duration group × week FEs	No	Yes	No	No	No
Time window	Full	Full	Full	Restricted	Full

* p < 0.05, ** p < 0.01, *** p < 0.001.

Note: This table reports results from estimation of Equation 2 with the Natural logarithm of sales as the dependent variable. In Column 1, observations from stores that before the COVID 19 restrictions were located between 180 and 300 minutes from the closest Swedish store are dropped. In Column 2, separate linear time trends for duration groups based on the pre-COVID duration to the closest Swedish store are included. The frequency distribution of the groups is reported in Table 2. In Column 3, week × pre-COVID duration group fixed effects are included. In Column 4, observations from the weeks between and including the week starting on Monday, July 27, 2020 and the week starting on Monday, October 5, 2020 are dropped. In these weeks some, but not all, Swedish border counties were open for cross-border shopping. The variable New COVID-19 cases included in Column 5 is the sum of the registered COVID-19 cases in week t and $t-1$ divided by the population of the municipality. C is an indicator variable taking the value one in the weeks after March 17, 2020 (and zero in the weeks before). Holiday home proportion is the proportion of residential dwellings that are holiday homes. The unemployment rate is measured at the municipality-month level. Population is measured at the municipality-quarter level. The standard errors reported in parentheses are clustered at the store level.

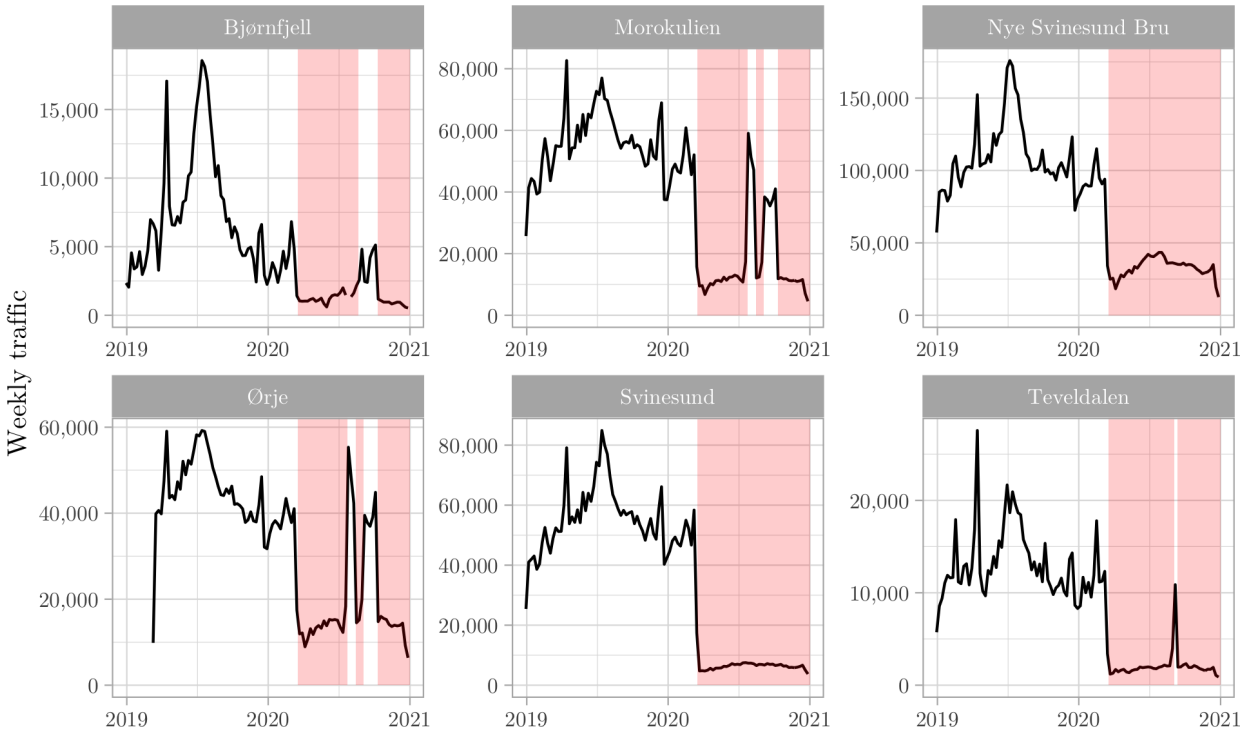
Online Appendix to "The effect of cross-border shopping on commodity tax revenue: Results from a natural experiment".

Figure IA.1: Store sales by duration category



Note: This figure shows the distribution of yearly store-level sales in million NOK in 2019 in the different duration bins up to 180 minutes from Sweden, for stores included in the estimation sample as well as for stores that are excluded. For all stores, the source of the yearly sales figure is from Geodata (2021).

Figure IA.2: Traffic at border crossing stations



Note: The figure shows weekly traffic of small vehicles (<5.6 meters) at the six border crossing stations with most traffic (excluding the traffic station "Nye Ørje Vest" which was closed for parts of 2020). Red shading indicates that visiting the bordering Swedish county triggered quarantine upon re-entering Norway.

Figure IA.3: Driving duration to closest accessible Swedish store

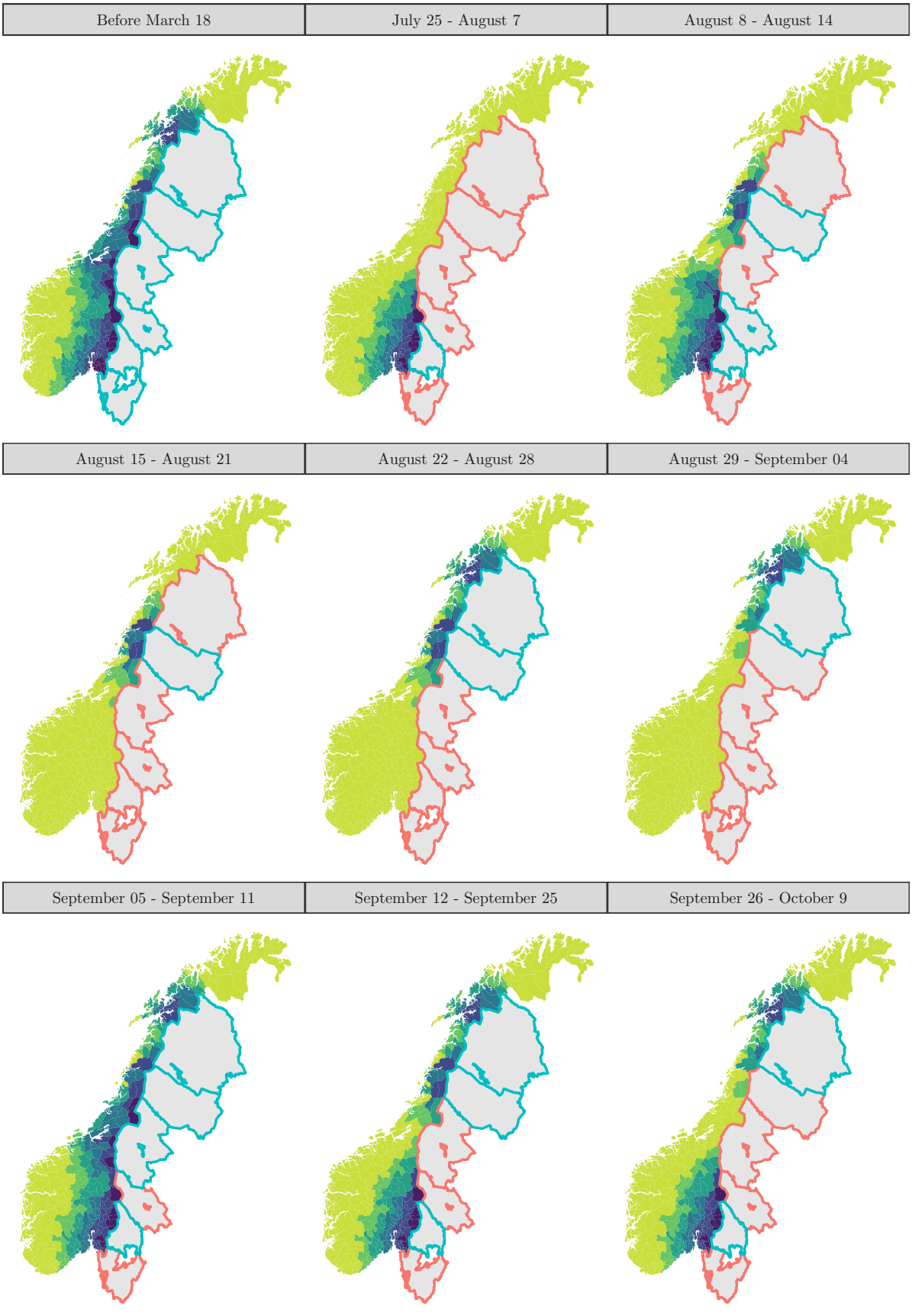
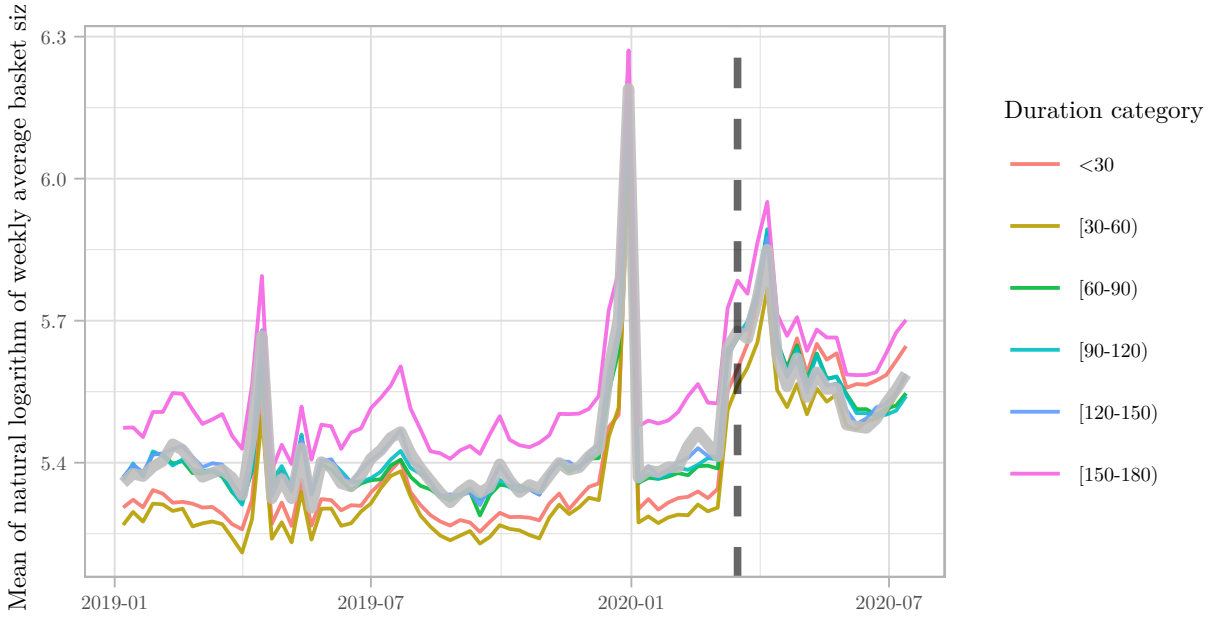
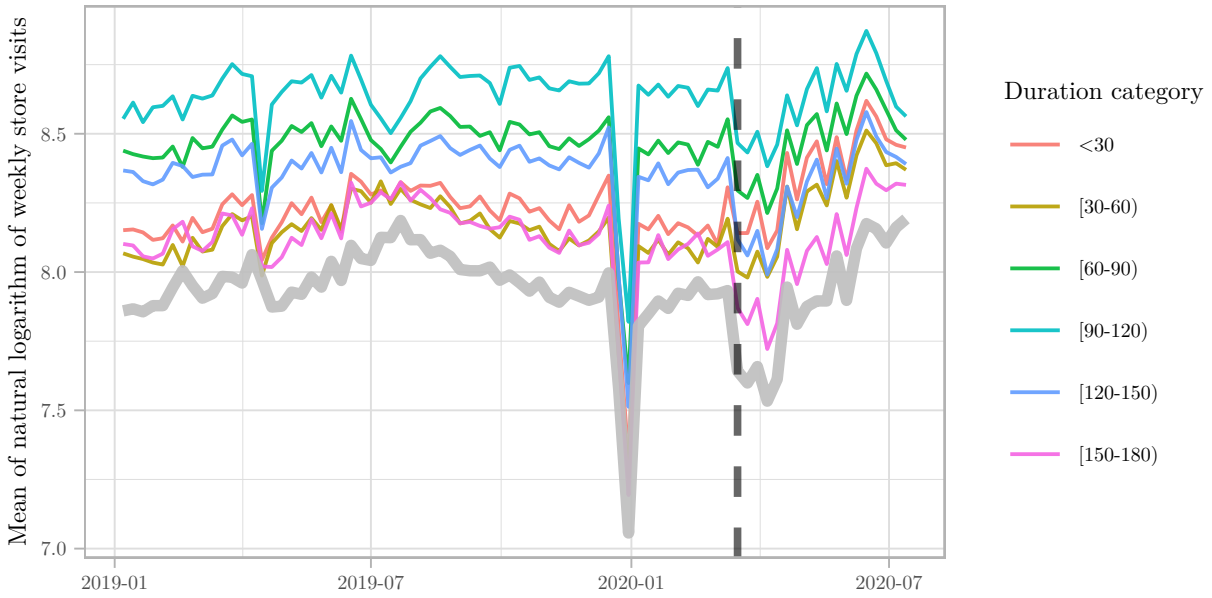


Figure IA.4: Pre-trends in basket size



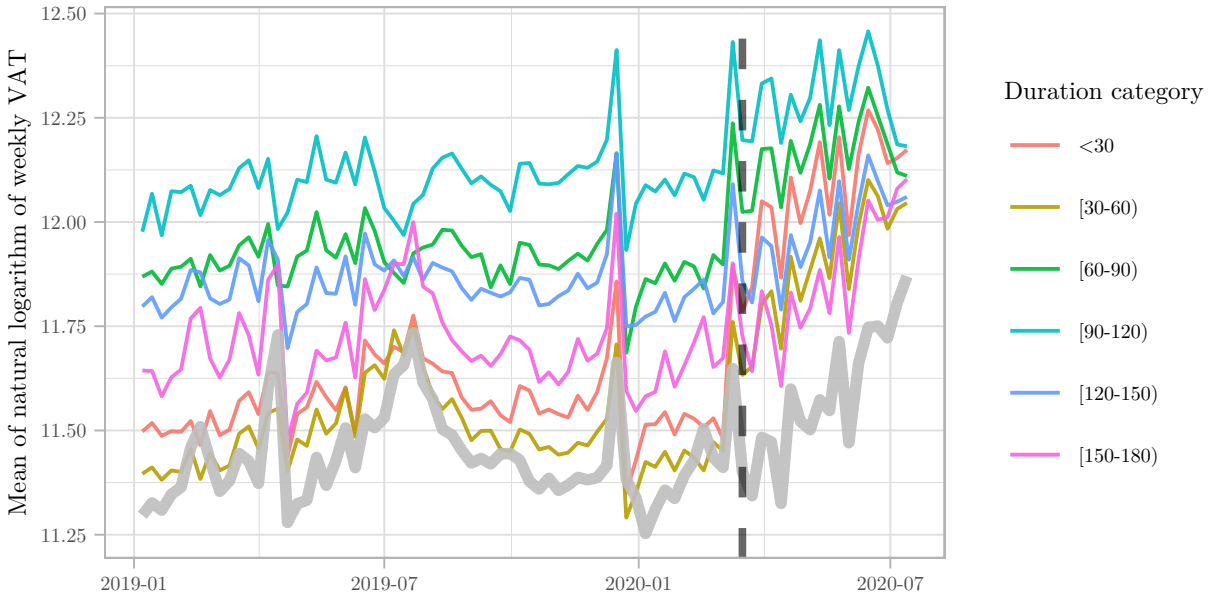
Note: The figure shows the Natural logarithm of the average basket size (in NOK) at the store level, for stores in different duration groups.The first week included in the figure is the week starting on Monday, January 7, 2019. The last week included in the figure is the week starting on Monday, July 13, 2020. The dashed vertical line indicates the week travels to Sweden became restricted. The thick grey line represents stores that were located at least 180 minutes from the closest Swedish store.

Figure IA.5: Pre-trends in store visits



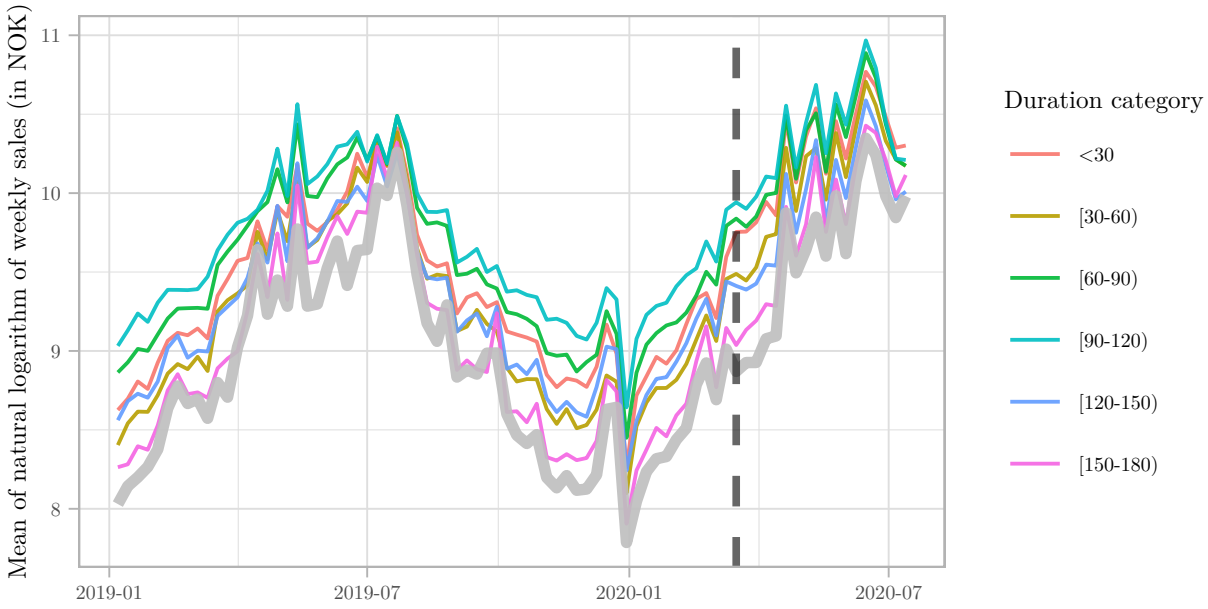
Note: The figure shows the Natural logarithm of the average number of weekly store visits at the store level, for stores in different duration groups. The first week included in the figure is the week starting on Monday, January 7, 2019. The last week included in the figure is the week starting on Monday, July 13, 2020. The dashed vertical line indicates the week travels to Sweden became restricted. The thick grey line represents stores that were located at least 180 minutes from the closest Swedish store.

Figure IA.6: Pre-trends in VAT



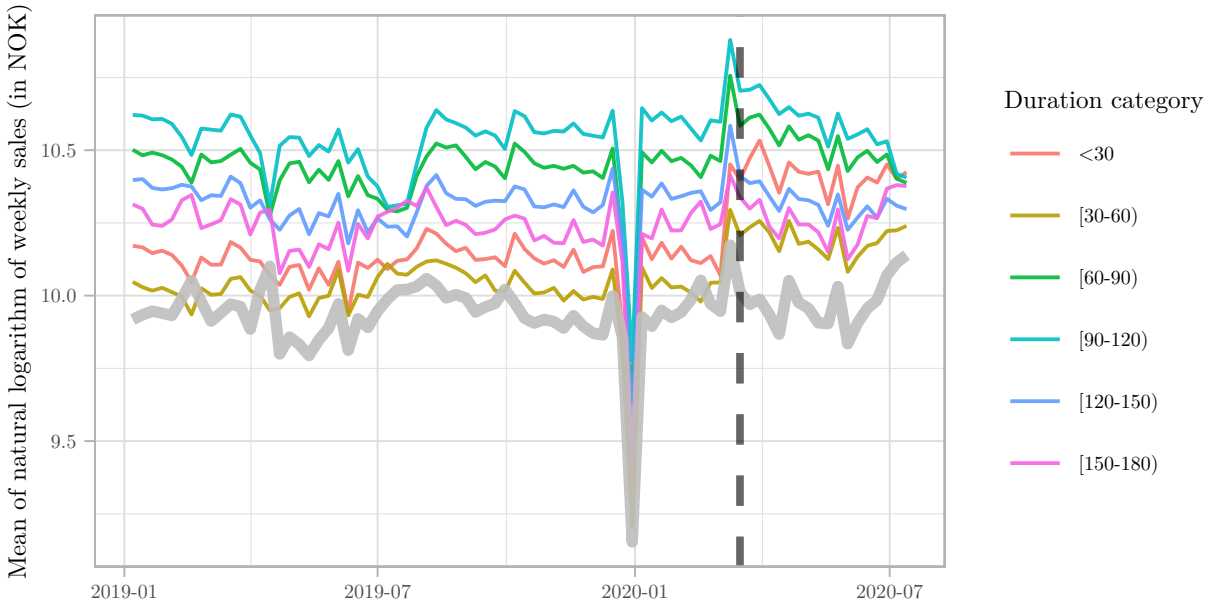
Note: The figure shows the Natural logarithm of the average VAT amount (in NOK) at the store level, for stores in different duration groups. The first week included in the figure is the week starting on Monday, January 7, 2019. The last week included in the figure is the week starting on Monday, July 13, 2020. The dashed vertical line indicates the week travels to Sweden became restricted. The thick grey line represents stores that were located at least 180 minutes from the closest Swedish store.

Figure IA.7: Pre-trends in ice cream sales (in NOK)



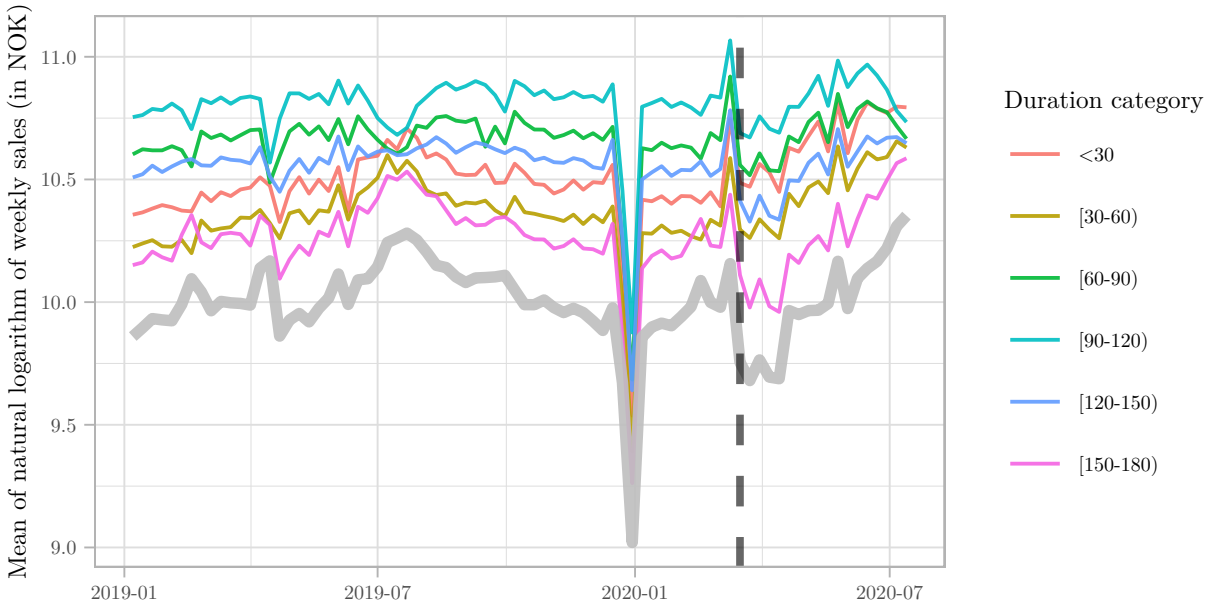
Note: The figure shows the Natural logarithm of the average weekly sales of ice cream (in NOK) at the store level, for stores in different duration groups. The first week included in the figure is the week starting on Monday, January 7, 2019. The last week included in the figure is the week starting on Monday, July 13, 2020. The dashed vertical line indicates the week travels to Sweden became restricted. The thick grey line represents stores that were located at least 180 minutes from the closest Swedish store.

Figure IA.8: Pre-trends in milk sales (in NOK)



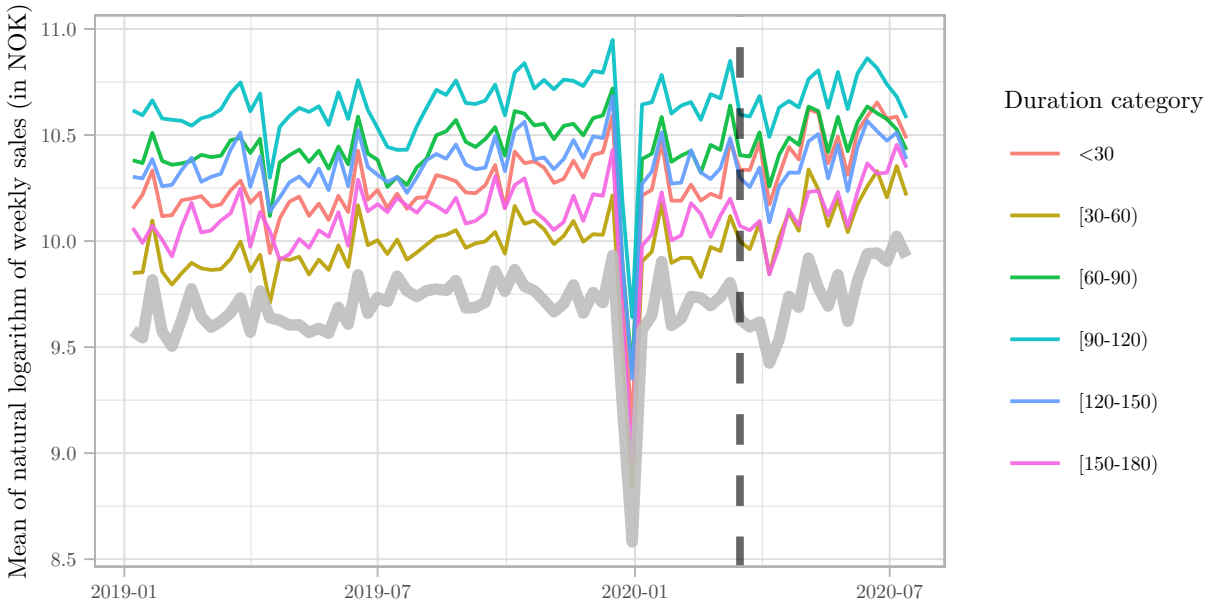
Note: The figure shows the Natural logarithm of the average weekly sales of milk (in NOK) at the store level, for stores in different duration groups.The first week included in the figure is the week starting on Monday, January 7, 2019. The last week included in the figure is the week starting on Monday, July 13, 2020. The dashed vertical line indicates the week travels to Sweden became restricted. The thick grey line represents stores that were located at least 180 minutes from the closest Swedish store.

Figure IA.9: Pre-trends in fresh bake sales (in NOK)



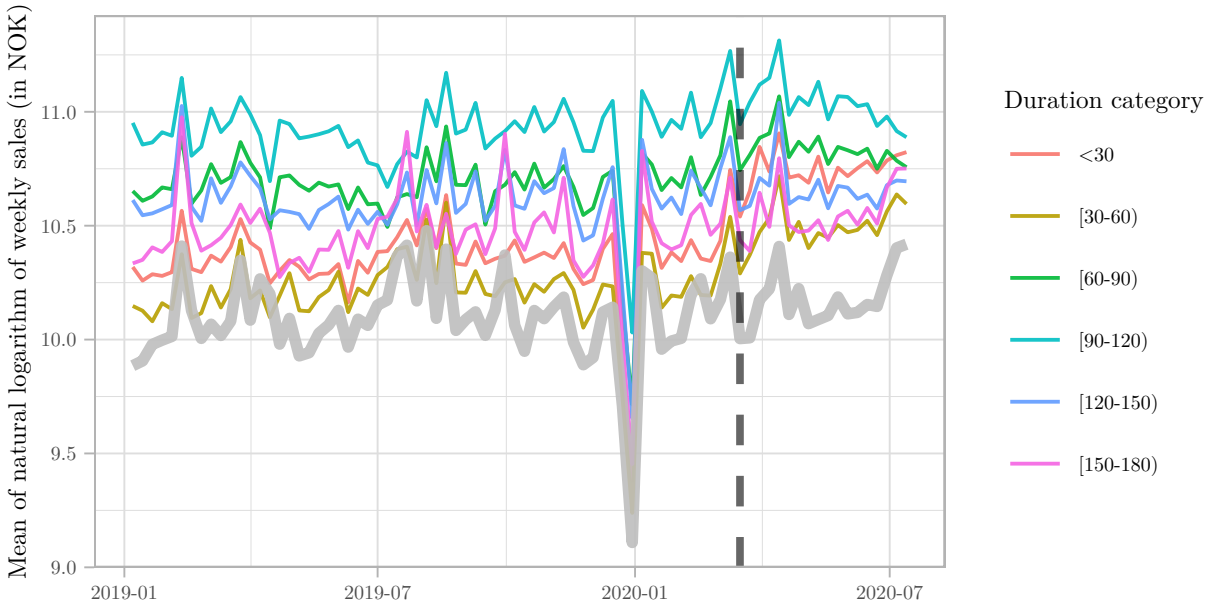
Note: The figure shows the Natural logarithm of the average weekly sales of freshly baked goods (in NOK) at the store level, for stores in different duration groups. The first week included in the figure is the week starting on Monday, January 7, 2019. The last week included in the figure is the week starting on Monday, July 13, 2020. The dashed vertical line indicates the week travels to Sweden became restricted. The thick grey line represents stores that were located at least 180 minutes from the closest Swedish store.

Figure IA.10: Pre-trends in ready made sales (in NOK)



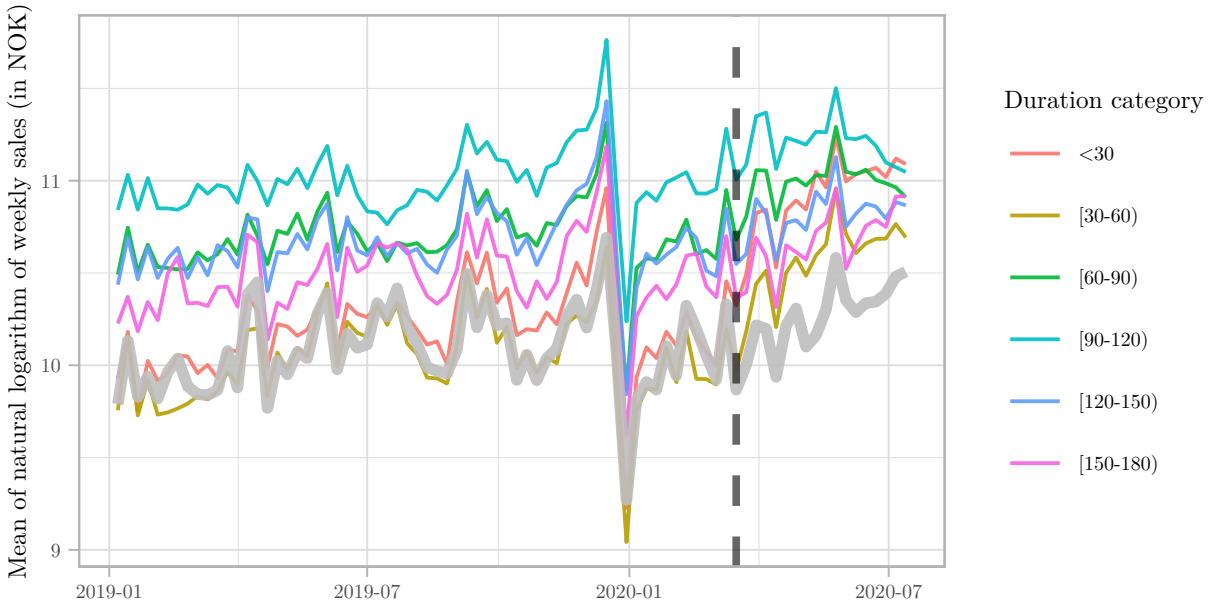
Note: The figure shows the Natural logarithm of the average weekly sales of fresh ready-made (in NOK) at the store level, for stores in different duration groups.The first week included in the figure is the week starting on Monday, January 7, 2019. The last week included in the figure is the week starting on Monday, July 13, 2020. The dashed vertical line indicates the week travels to Sweden became restricted. The thick grey line represents stores that were located at least 180 minutes from the closest Swedish store.

Figure IA.11: Pre-trends in cheese sales (in NOK)



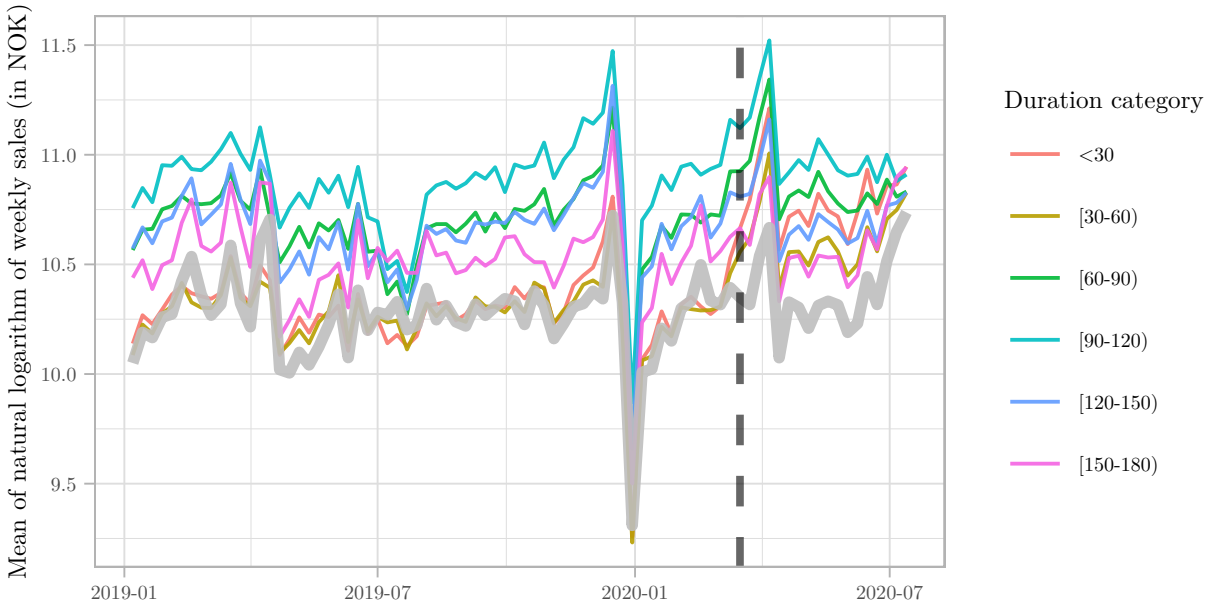
Note: The figure shows the Natural logarithm of the average weekly sales of cheese (in NOK) at the store level, for stores in different duration groups. The first week included in the figure is the week starting on Monday, January 7, 2019. The last week included in the figure is the week starting on Monday, July 13, 2020. The dashed vertical line indicates the week travels to Sweden became restricted. The thick grey line represents stores that were located at least 180 minutes from the closest Swedish store.

Figure IA.12: Pre-trends in meat sales (in NOK)



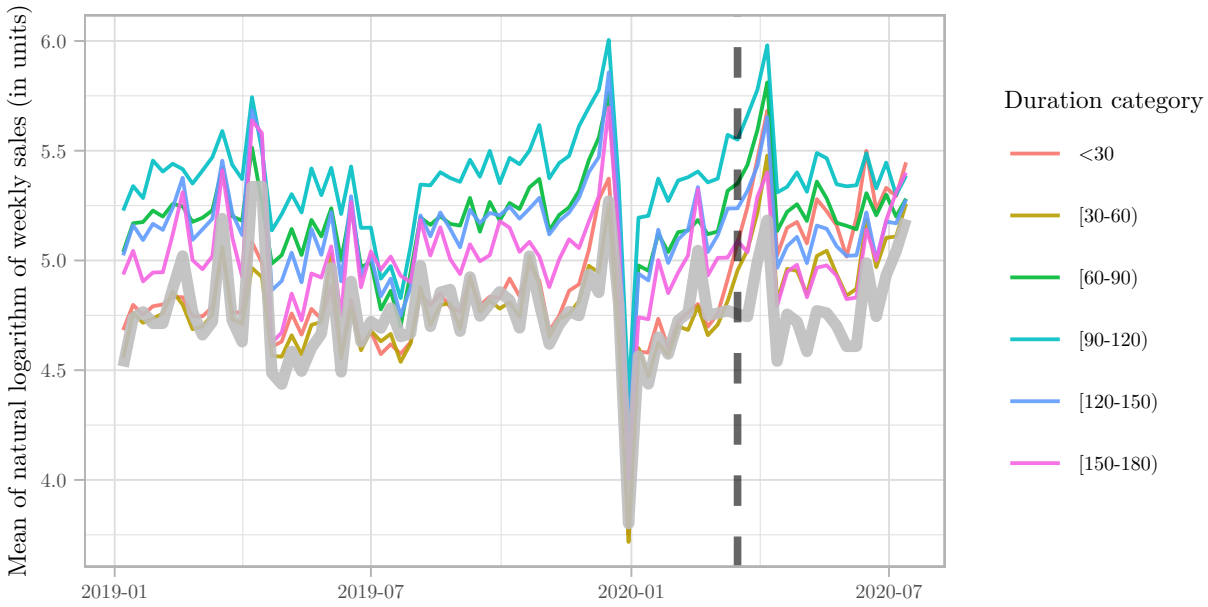
Note: The figure shows the Natural logarithm of the average weekly sales of meat (in NOK) at the store level, for stores in different duration groups. The first week included in the figure is the week starting on Monday, January 7, 2019. The last week included in the figure is the week starting on Monday, July 13, 2020. The dashed vertical line indicates the week travels to Sweden became restricted. The thick grey line represents stores that were located at least 180 minutes from the closest Swedish store.

Figure IA.13: Pre-trends in sweets sales (in NOK)



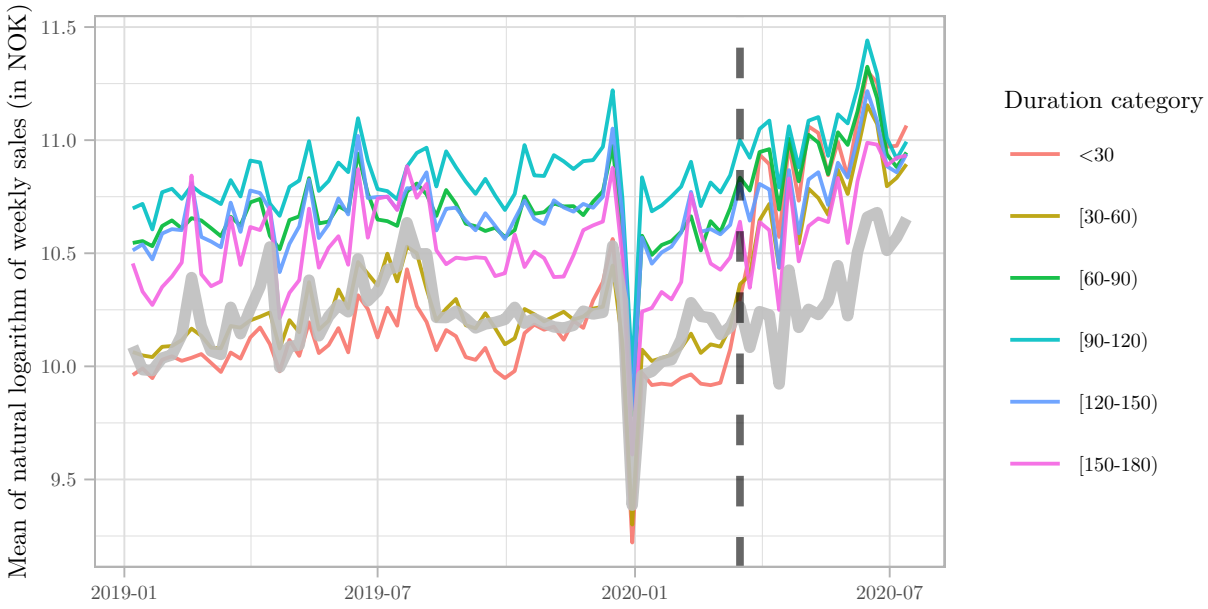
Note: The figure shows the Natural logarithm of the average weekly sales of sweets (in NOK) at the store level, for stores in different duration groups. The first week included in the figure is the week starting on Monday, January 7, 2019. The last week included in the figure is the week starting on Monday, July 13, 2020. The dashed vertical line indicates the week travels to Sweden became restricted. The thick grey line represents stores that were located at least 180 minutes from the closest Swedish store.

Figure IA.14: Pre-trends in sweets sales (in kilograms)



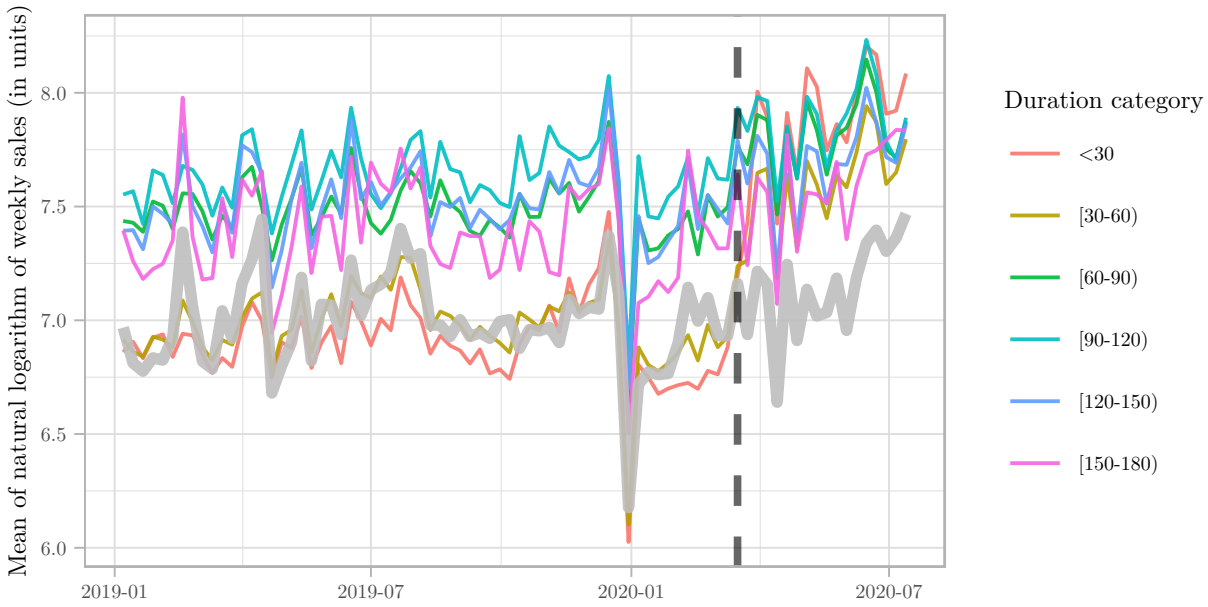
Note: The figure shows the Natural logarithm of the average weekly sales of sweets (in kilograms) at the store level, for stores in different duration groups. The first week included in the figure is the week starting on Monday, January 7, 2019. The last week included in the figure is the week starting on Monday, July 13, 2020. The dashed vertical line indicates the week travels to Sweden became restricted. The thick grey line represents stores that were located at least 180 minutes from the closest Swedish store.

Figure IA.15: Pre-trends in soda sales (in NOK)



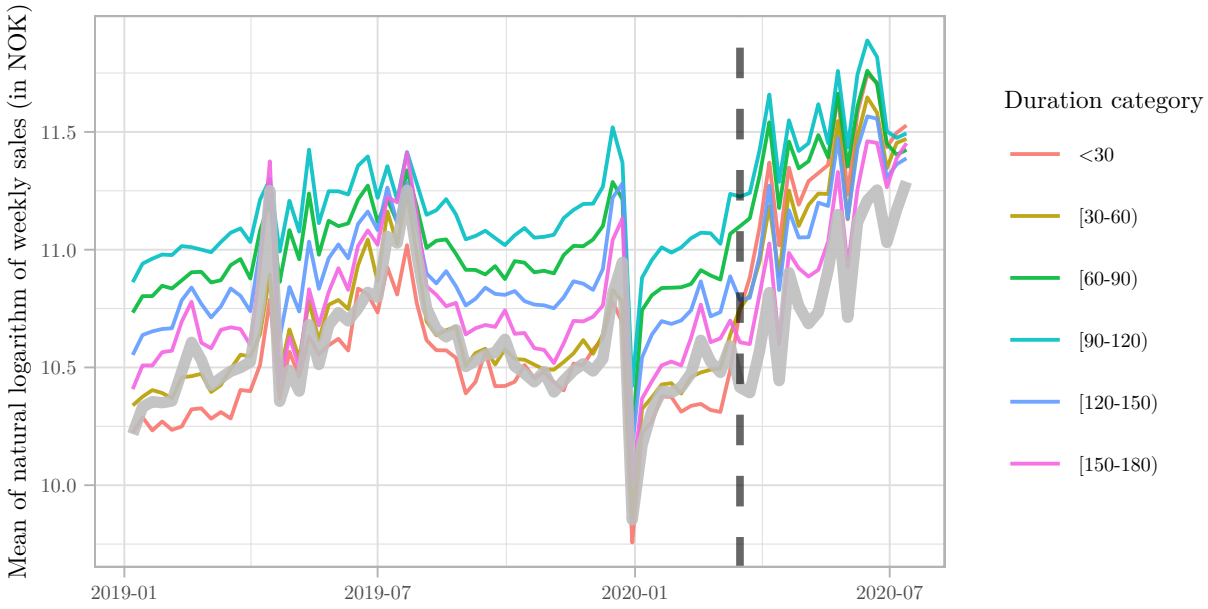
Note: The figure shows the Natural logarithm of the average weekly sales of soda (in NOK) at the store level, for stores in different duration groups. The first week included in the figure is the week starting on Monday, January 7, 2019. The last week included in the figure is the week starting on Monday, July 13, 2020. The dashed vertical line indicates the week travels to Sweden became restricted. The thick grey line represents stores that were located at least 180 minutes from the closest Swedish store.

Figure IA.16: Pre-trends in soda sales (in liters)



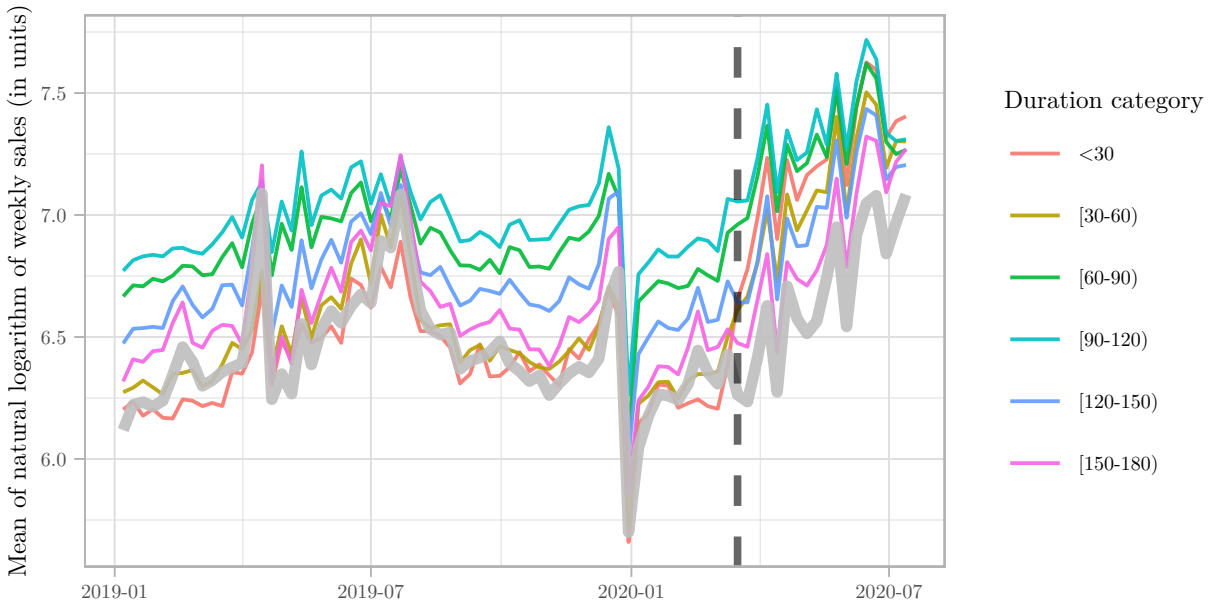
Note: The figure shows the Natural logarithm of the average weekly sales of soda (in liters) at the store level, for stores in different duration groups. The first week included in the figure is the week starting on Monday, January 7, 2019. The last week included in the figure is the week starting on Monday, July 13, 2020. The dashed vertical line indicates the week travels to Sweden became restricted. The thick grey line represents stores that were located at least 180 minutes from the closest Swedish store.

Figure IA.17: Pre-trends in beer sales (in NOK)



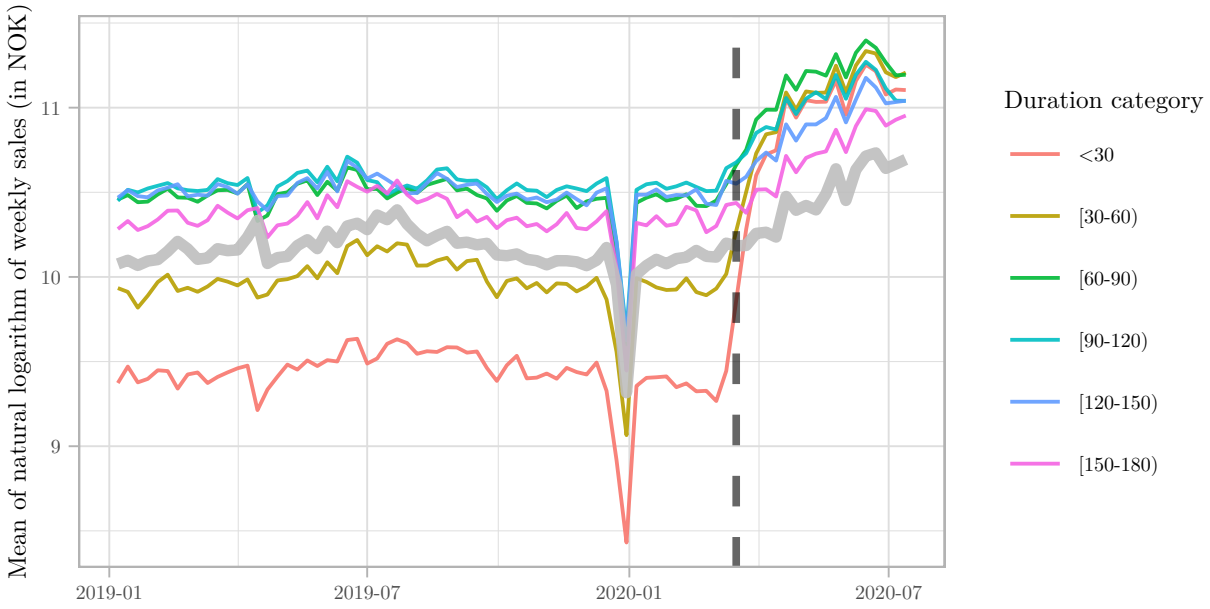
Note: The figure shows the Natural logarithm of the average weekly sales of beer (in NOK) at the store level, for stores in different duration groups. The first week included in the figure is the week starting on Monday, January 7, 2019. The last week included in the figure is the week starting on Monday, July 13, 2020. The dashed vertical line indicates the week travels to Sweden became restricted. The thick grey line represents stores that were located at least 180 minutes from the closest Swedish store.

Figure IA.18: Pre-trends in beer sales (in liters)



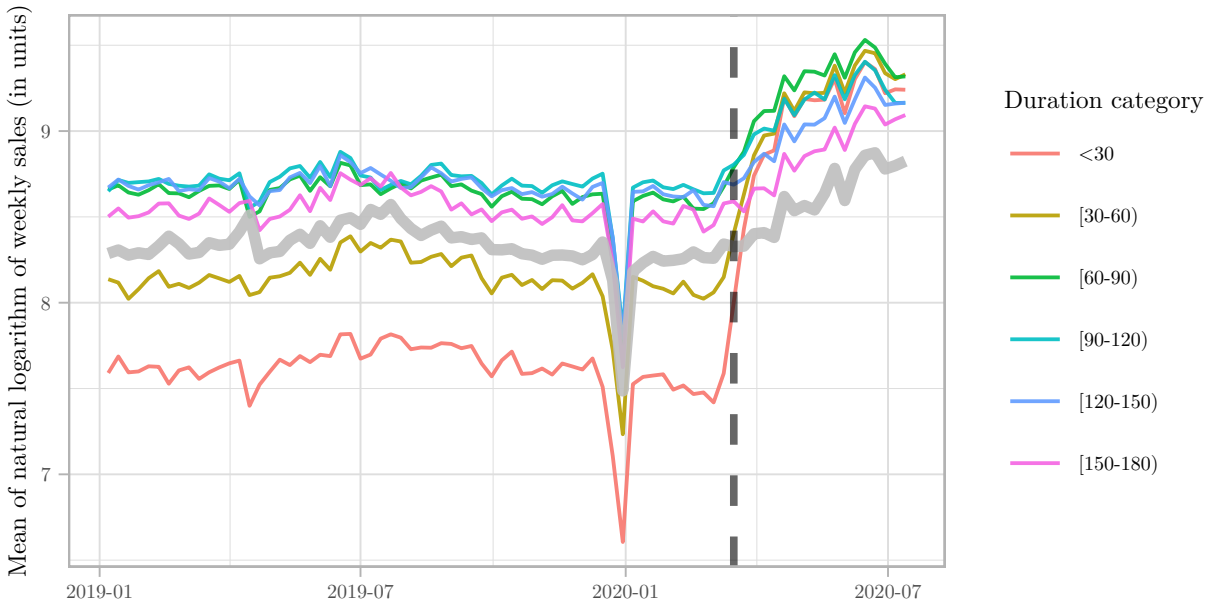
Note: The figure shows the Natural logarithm of the average weekly sales of beer (in liters) at the store level, for stores in different duration groups. The first week included in the figure is the week starting on Monday, January 7, 2019. The last week included in the figure is the week starting on Monday, July 13, 2020. The dashed vertical line indicates the week travels to Sweden became restricted. The thick grey line represents stores that were located at least 180 minutes from the closest Swedish store.

Figure IA.19: Pre-trends in cigarette sales (in NOK)



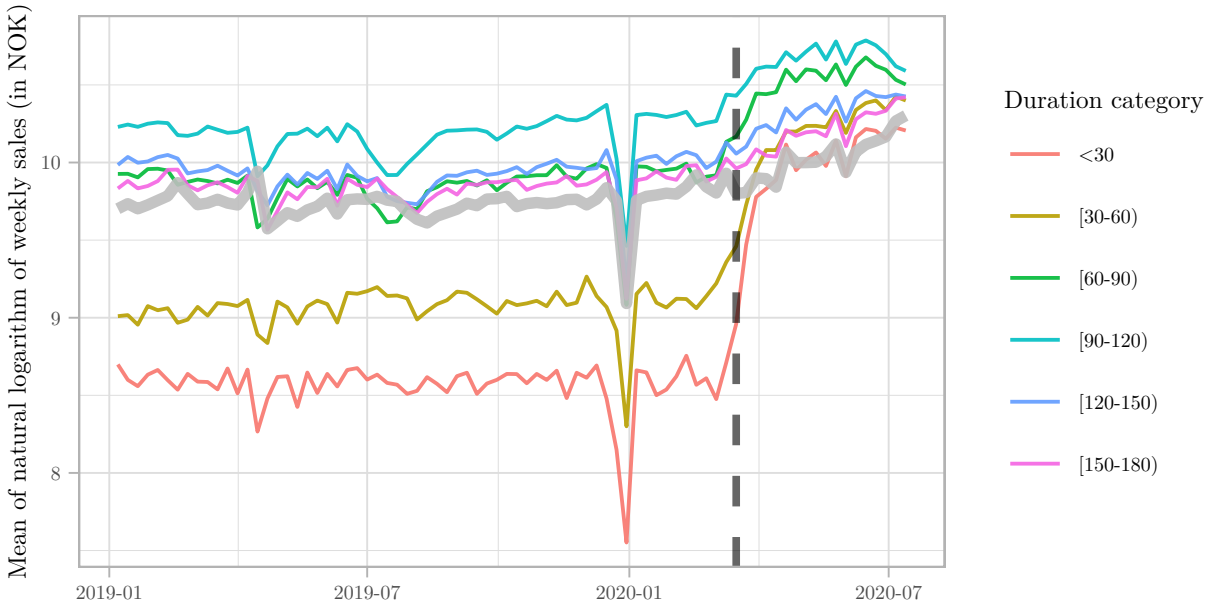
Note: The figure shows the Natural logarithm of the average weekly sales of cigarettes (in NOK) at the store level, for stores in different duration groups. The first week included in the figure is the week starting on Monday, January 7, 2019. The last week included in the figure is the week starting on Monday, July 13, 2020. The dashed vertical line indicates the week travels to Sweden became restricted. The thick grey line represents stores that were located at least 180 minutes from the closest Swedish store.

Figure IA.20: Pre-trends in cigarette sales (in items)



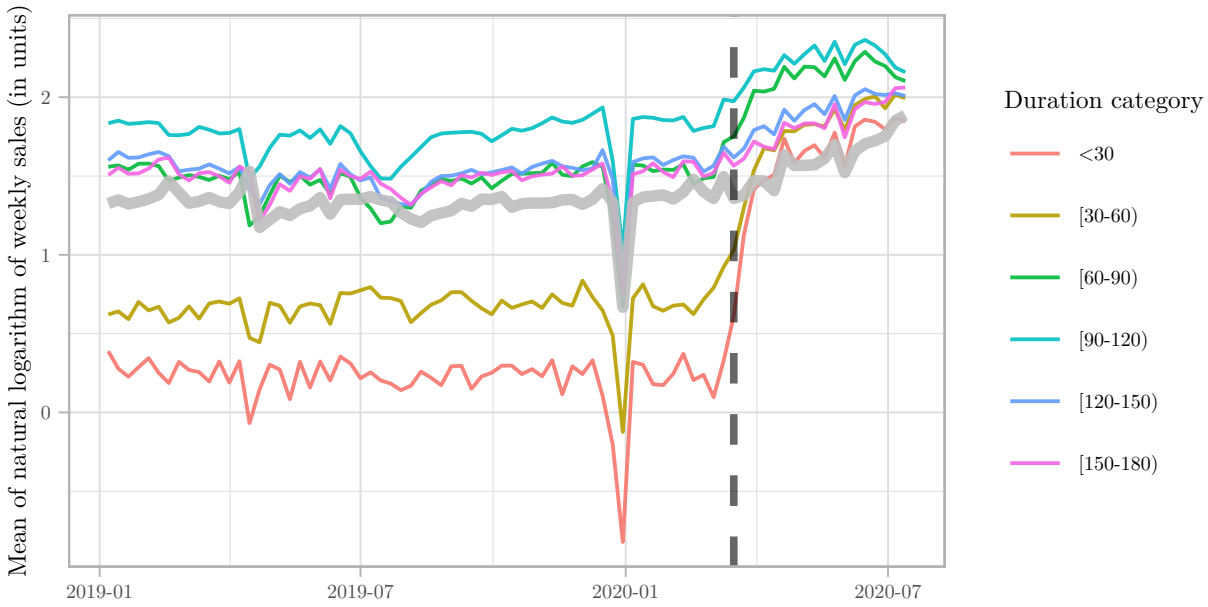
Note: The figure shows the Natural logarithm of the average weekly sales of cigarettes (in items) at the store level, for stores in different duration groups. The first week included in the figure is the week starting on Monday, January 7, 2019. The last week included in the figure is the week starting on Monday, July 13, 2020. The dashed vertical line indicates the week travels to Sweden became restricted. The thick grey line represents stores that were located at least 180 minutes from the closest Swedish store.

Figure IA.21: Pre-trends in snus sales (in NOK)



Note: The figure shows the Natural logarithm of the average weekly sales of snus (in NOK) at the store level, for stores in different duration groups. The first week included in the figure is the week starting on Monday, January 7, 2019. The last week included in the figure is the week starting on Monday, July 13, 2020. The dashed vertical line indicates the week travels to Sweden became restricted. The thick grey line represents stores that were located at least 180 minutes from the closest Swedish store.

Figure IA.22: Pre-trends in snus sales (in kilograms)



Note: The figure shows the Natural logarithm of the average weekly sales of snus (in kilograms) at the store level, for stores in different duration groups. The first week included in the figure is the week starting on Monday, January 7, 2019. The last week included in the figure is the week starting on Monday, July 13, 2020. The dashed vertical line indicates the week travels to Sweden became restricted. The thick grey line represents stores that were located at least 180 minutes from the closest Swedish store.

Table IA.1: Average unit prices and excise taxes

	2019	2020
Sweets		
Average price (NOK per kilo)	239.26	252.56
Tax (NOK per kilo)	20.82	21.22
Soda		
Average price (NOK per liter)	22.50	21.60
Tax (NOK per liter)	4.82	4.91
Beer		
Average price (NOK per liter)	62.46	64.21
Tax (NOK per liter)	22.40	22.83
Cigarettes		
Average price (NOK per item)	6.17	6.42
Tax (NOK per kilo)	2.63	2.68
Snus		
Average price (NOK per kilo)	4542.7	4547.6
Tax (NOK per kilo)	1070.0	1090.0

Note: The table shows the average unit prices and excise taxes. The average prices are calculated as the total sales expenditure (including VAT and excise taxes) divided by total units.

Table IA.2: Average yearly sales volume

	<30		[30, 60)		[60, 90)		[90, 120)		[120, 150)		[150, 180)		>180	
	2019	2020	2019	2020	2019	2020	2019	2020	2019	2020	2019	2020	2019	2020
Sweets (metric tons)	8.69	12.63	8.00	10.28	12.28	14.34	14.23	16.45	11.19	12.10	11.24	12.15	8.52	9.25
Soda (thousand liters)	74.61	171.03	79.05	134.37	125.20	166.37	138.90	173.74	124.65	148.93	120.52	142.66	87.67	98.90
Beer (thousand liters)	40.68	72.51	43.96	67.17	63.75	84.10	68.88	89.43	54.37	67.19	55.39	67.20	45.14	52.33
Cigarettes (thousand items)	150.7	434.8	225.6	477.3	341.6	553.0	351.5	502.9	349.1	470.5	359.7	471.9	276.0	342.3
Snus (metric tons)	0.09	0.29	0.14	0.33	0.27	0.45	0.34	0.51	0.27	0.39	0.29	0.40	0.26	0.34

Note: The table shows average yearly sales volumes at the store-category level. The duration groups are defined by driving duration to closest Swedish store when all Swedish counties were open for cross-border shopping.

Table IA.3: Effect of cross-border shopping on store visits – robustness checks

	(1) Store visits	(2) Store visits	(3) Store visits	(4) Store visits	(5) Store visits
Duration $< 30 \times B$	−0.189***	−0.217***	−0.191***	−0.182***	−0.189***
	(0.047)	(0.058)	(0.028)	(0.029)	(0.029)
$30 \leq$ Duration $< 60 \times B$	−0.158***	−0.202***	−0.151***	−0.136***	−0.154***
	(0.030)	(0.050)	(0.017)	(0.018)	(0.018)
$60 \leq$ Duration $< 90 \times B$	−0.068***	−0.163***	−0.062***	−0.041*	−0.075***
	(0.016)	(0.047)	(0.017)	(0.021)	(0.017)
$90 \leq$ Duration $< 120 \times B$	−0.003	0.008	−0.023	−0.011	−0.034*
	(0.014)	(0.023)	(0.015)	(0.017)	(0.015)
$120 \leq$ Duration $< 150 \times B$	0.006	0.024	0.003	0.022	0.007
	(0.015)	(0.020)	(0.015)	(0.018)	(0.015)
$150 \leq$ Duration $< 180 \times B$	−0.012	0.003	−0.007	0.010	0.007
	(0.018)	(0.018)	(0.018)	(0.020)	(0.017)
New Covid-19 cases					0.001
					(0.004)
$C \times$ Holiday home proportion					0.099**
					(0.032)
Unemployment rate					−1.591***
					(0.294)
Population					0.474*
					(0.213)
Observations	42000	42000	35490	37600	41016
Stores	400	400	338	400	400
Control group	$>$ 180 minutes	$>$ 180 minutes	$>$ 300 minutes	$>$ 180 minutes	$>$ 180 minutes
Linear time trends	Yes	No	No	No	No
Duration group × week FEs	No	Yes	No	No	No
Time window	Full	Full	Full	Restricted	Full

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Note: This table reports results from estimation of Equation 2 with the Natural logarithm of store visits as the dependent variable. In Column 1, observations from stores that pre-COVID were located between 180 and 300 minutes from the closest Swedish store are dropped. In Column 2, separate linear time trends for duration groups based on the pre-COVID duration to the closest Swedish store are included. The frequency distribution of the groups is reported in Table 2. In Column 3, week × pre-COVID duration group fixed effects are included. In Column 4, observations from the weeks between and including the week starting on Monday, July 27, 2020 and the week starting on Monday, October 5, 2020 are dropped. In these weeks some, but not all, Swedish border counties were open for cross-border shopping. The variable New COVID-19 cases included in Column 5 is the sum of the registered COVID-19 cases in week t and $t-1$ divided by the population of the municipality. C is an indicator variable taking the value one in the weeks after March 17, 2020 (and zero in the weeks before). Holiday home proportion is the proportion of residential dwellings that are holiday homes. The unemployment rate is measured at the municipality-month level. Population is measured at the municipality-quarter level. The standard errors reported in parentheses are clustered at the store level.

Table IA.4: Effect of cross-border shopping on basket size – robustness checks

	(1) Basket size	(2) Basket size	(3) Basket size	(4) Basket size	(5) Basket size
Duration $< 30 \times B$	−0.120***	−0.111***	−0.118***	−0.119***	−0.122***
	(0.013)	(0.026)	(0.011)	(0.011)	(0.011)
$30 \leq$ Duration $< 60 \times B$	−0.068***	−0.077***	−0.070***	−0.070***	−0.074***
	(0.009)	(0.019)	(0.009)	(0.009)	(0.009)
$60 \leq$ Duration $< 90 \times B$	−0.033***	−0.036*	−0.028***	−0.036***	−0.034***
	(0.005)	(0.018)	(0.008)	(0.008)	(0.007)
$90 \leq$ Duration $< 120 \times B$	−0.030***	−0.010	−0.018**	−0.024***	−0.025***
	(0.005)	(0.007)	(0.007)	(0.006)	(0.005)
$120 \leq$ Duration $< 150 \times B$	−0.017***	−0.002	−0.009	−0.012*	−0.012*
	(0.005)	(0.007)	(0.006)	(0.006)	(0.005)
$150 \leq$ Duration $< 180 \times B$	−0.006	−0.001	−0.010	−0.015*	−0.011
	(0.008)	(0.008)	(0.007)	(0.008)	(0.007)
New Covid-19 cases					0.013***
					(0.002)
$C \times$ Holiday home proportion					0.037**
					(0.013)
Unemployment rate					−0.264
					(0.153)
Population					0.025
					(0.095)
Observations	42000	42000	35490	37600	41016
Stores	400	400	338	400	400
Control group	$>$ 180 minutes	$>$ 180 minutes	$>$ 300 minutes	$>$ 180 minutes	$>$ 180 minutes
Linear time trends	Yes	No	No	No	No
Duration group × week FEs	No	Yes	No	No	No
Time window	Full	Full	Full	Restricted	Full

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Note: This table reports results from estimation of Equation 2 with the Natural logarithm of basket size as the dependent variable. In Column 1, observations from stores that pre-COVID were located between 180 and 300 minutes from the closest Swedish store are dropped. In Column 2, separate linear time trends for duration groups based on the pre-COVID duration to the closest Swedish store are included. The frequency distribution of the groups is reported in Table 2. In Column 3, week × pre-COVID duration group fixed effects are included. In Column 4, observations from the weeks between and including the week starting on Monday, July 27, 2020 and the week starting on Monday, October 5, 2020 are dropped. In these weeks some, but not all, Swedish border counties were open for cross-border shopping. The variable New COVID-19 cases included in Column 5 is the sum of the registered COVID-19 cases in week t and $t-1$ divided by the population of the municipality. C is an indicator variable taking the value one in the weeks after March 17, 2020 (and zero in the weeks before). Holiday home proportion is the proportion of residential dwellings that are holiday homes. The unemployment rate is measured at the municipality-month level. Population is measured at the municipality-quarter level. The standard errors reported in parentheses are clustered at the store level.

Table IA.5: Effect of cross-border shopping on VAT – robustness checks

	(1)	(2)	(3)	(4)	(5)
Duration $< 30 \times B$	−0.327***	−0.345***	−0.329***	−0.321***	−0.331***
	(0.045)	(0.071)	(0.029)	(0.029)	(0.030)
$30 \leq$ Duration $< 60 \times B$	−0.241***	−0.292***	−0.241***	−0.225***	−0.247***
	(0.032)	(0.057)	(0.019)	(0.020)	(0.019)
$60 \leq$ Duration $< 90 \times B$	−0.107***	−0.203***	−0.099***	−0.087***	−0.117***
	(0.017)	(0.053)	(0.018)	(0.022)	(0.019)
$90 \leq$ Duration $< 120 \times B$	−0.035*	−0.003	−0.047**	−0.039*	−0.063***
	(0.015)	(0.025)	(0.016)	(0.018)	(0.016)
$120 \leq$ Duration $< 150 \times B$	−0.014	0.022	−0.010	0.006	−0.007
	(0.017)	(0.022)	(0.016)	(0.019)	(0.016)
$150 \leq$ Duration $< 180 \times B$	−0.019	0.002	−0.019	−0.007	−0.003
	(0.021)	(0.019)	(0.018)	(0.021)	(0.019)
New Covid-19 cases					0.014**
					(0.004)
$C \times$ Holiday home proportion					0.140***
					(0.035)
Unemployment rate					−1.837***
					(0.370)
Population					0.501*
					(0.253)
Observations	41995	41995	35489	37595	41008
Stores	400	400	338	400	400
Control group	$>$ 180 minutes	$>$ 180 minutes	$>$ 300 minutes	$>$ 180 minutes	$>$ 180 minutes
Linear time trends	Yes	No	No	No	No
Duration group × week FEs	No	Yes	No	No	No
Time window	Full	Full	Full	Restricted	Full

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Note: This table reports results from estimation of Equation 2 with the Natural logarithm of VAT as the dependent variable. In Column 1, observations from stores that pre-COVID were located between 180 and 300 minutes from the closest Swedish store are dropped. In Column 2, separate linear time trends for duration groups based on the pre-COVID duration to the closest Swedish store are included. The frequency distribution of the groups is reported in Table 2. In Column 3, week × pre-COVID duration group fixed effects are included. In Column 4, observations from the weeks between and including the week starting on Monday, July 27, 2020 and the week starting on Monday, October 5, 2020 are dropped. In these weeks some, but not all, Swedish border counties were open for cross-border shopping. The variable New COVID-19 cases included in Column 5 is the sum of the registered COVID-19 cases in week t and $t-1$ divided by the population of the municipality. C is an indicator variable taking the value one in the weeks after March 17, 2020 (and zero in the weeks before). Holiday home proportion is the proportion of residential dwellings that are holiday homes. The unemployment rate is measured at the municipality-month level. Population is measured at the municipality-quarter level. The standard errors reported in parentheses are clustered at the store level.

Table IA.6: Effect of cross-border shopping on ice cream sales (in NOK) – robustness checks

	(1)	(2)	(3)	(4)	(5)
Duration $< 30 \times B$	−0.101	−0.229*	−0.126**	−0.127**	−0.134**
	(0.079)	(0.116)	(0.040)	(0.040)	(0.041)
$30 \leq$ Duration $< 60 \times B$	−0.124**	−0.216**	−0.097***	−0.089***	−0.118***
	(0.040)	(0.072)	(0.019)	(0.019)	(0.019)
$60 \leq$ Duration $< 90 \times B$	−0.073**	−0.251***	−0.031	−0.010	−0.072***
	(0.022)	(0.063)	(0.019)	(0.022)	(0.018)
$90 \leq$ Duration $< 120 \times B$	0.016	0.017	0.019	0.023	−0.017
	(0.020)	(0.032)	(0.016)	(0.017)	(0.016)
$120 \leq$ Duration $< 150 \times B$	0.022	0.057	0.037	0.044	0.029
	(0.023)	(0.030)	(0.020)	(0.024)	(0.019)
$150 \leq$ Duration $< 180 \times B$	−0.044	0.003	−0.021	−0.018	−0.009
	(0.028)	(0.032)	(0.021)	(0.023)	(0.022)
New Covid-19 cases					0.040***
					(0.008)
$C \times$ Holiday home proportion					0.196***
					(0.041)
Unemployment rate					−3.008***
					(0.403)
Population					0.912***
					(0.266)
Observations	41995	41995	35486	37595	41000
Stores	400	400	338	400	400
Control group	$>$ 180 minutes	$>$ 180 minutes	$>$ 300 minutes	$>$ 180 minutes	$>$ 180 minutes
Linear time trends	Yes	No	No	No	No
Duration group × week FEs	No	Yes	No	No	No
Time window	Full	Full	Full	Restricted	Full

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Note: This table reports results from estimation of Equation 2 with the Natural logarithm of ice cream sales as the dependent variable. In Column 1, observations from stores that pre-COVID were located between 180 and 300 minutes from the closest Swedish store are dropped. In Column 2, separate linear time trends for duration groups based on the pre-COVID duration to the closest Swedish store are included. The frequency distribution of the groups is reported in Table 2. In Column 3, week × pre-COVID duration group fixed effects are included. In Column 4, observations from the weeks between and including the week starting on Monday, July 27, 2020 and the week starting on Monday, October 5, 2020 are dropped. In these weeks some, but not all, Swedish border counties were open for cross-border shopping. The variable New COVID-19 cases included in Column 5 is the sum of the registered COVID-19 cases in the week t and $t-1$ divided by the population of the municipality. C is an indicator variable taking the value one in weeks after March 17, 2020 (and zero in the weeks before). Holiday home proportion is the proportion of residential dwellings that are holiday homes. The unemployment rate is measured at the municipality-month level. Population is measured at the municipality-quarter level. The standard errors reported in parentheses are clustered at the store level.

Table IA.7: Effect of cross-border shopping on milk sales in (NOK) – robustness checks

	(1)	(2)	(3)	(4)	(5)
Duration $< 30 \times B$	−0.239***	−0.193**	−0.230***	−0.227***	−0.238***
	(0.034)	(0.060)	(0.032)	(0.033)	(0.032)
$30 \leq$ Duration $< 60 \times B$	−0.126***	−0.167**	−0.121***	−0.108***	−0.134***
	(0.026)	(0.053)	(0.021)	(0.024)	(0.021)
$60 \leq$ Duration $< 90 \times B$	−0.054***	−0.101	−0.035	−0.022	−0.052**
	(0.015)	(0.051)	(0.019)	(0.024)	(0.019)
$90 \leq$ Duration $< 120 \times B$	−0.012	0.020	−0.010	−0.004	−0.028
	(0.014)	(0.025)	(0.017)	(0.020)	(0.017)
$120 \leq$ Duration $< 150 \times B$	0.002	0.030	0.022	0.035	0.018
	(0.016)	(0.020)	(0.018)	(0.022)	(0.017)
$150 \leq$ Duration $< 180 \times B$	−0.015	0.021	0.008	0.016	0.016
	(0.018)	(0.017)	(0.019)	(0.022)	(0.018)
New Covid-19 cases					0.011*
					(0.004)
$C \times$ Holiday home proportion					0.142***
					(0.035)
Unemployment rate					−1.523***
					(0.387)
Population					0.901***
					(0.249)
Observations	41993	41993	35485	37593	40994
Stores	400	400	338	400	400
Control group	$>$ 180 minutes	$>$ 180 minutes	$>$ 300 minutes	$>$ 180 minutes	$>$ 180 minutes
Linear time trends	Yes	No	No	No	No
Duration group × week FEs	No	Yes	No	No	No
Time window	Full	Full	Full	Restricted	Full

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Note: This table reports results from estimation of Equation 2 with the Natural logarithm of milk sales as the dependent variable. In Column 1, observations from stores that pre-COVID were located between 180 and 300 minutes from the closest Swedish store are dropped. In Column 2, separate linear time trends for duration groups based on the pre-COVID duration to the closest Swedish store are included. The frequency distribution of the groups is reported in Table 2. In Column 3, week × pre-COVID duration group fixed effects are included. In Column 4, observations from the weeks between and including the week starting on Monday, July 27, 2020 and the week starting on Monday, October 5, 2020 are dropped. In these weeks some, but not all, Swedish border counties were open for cross-border shopping. The variable New COVID-19 cases included in Column 5 is the sum of the registered COVID-19 cases in week t and $t-1$ divided by the population of the municipality. C is an indicator variable taking the value one in the weeks after March 17, 2020 (and zero in the weeks before). Holiday home proportion is the proportion of residential dwellings that are holiday homes. The unemployment rate is measured at the municipality-month level. Population is measured at the municipality-quarter level. The standard errors reported in parentheses are clustered at the store level.

Table IA.8: Effect of cross-border shopping on fresh bake sales (in NOK) – robustness checks

	(1)	(2)	(3)	(4)	(5)
Duration $< 30 \times B$	−0.172**	−0.203*	−0.169***	−0.163***	−0.172***
	(0.054)	(0.079)	(0.037)	(0.037)	(0.038)
$30 \leq$ Duration $< 60 \times B$	−0.125***	−0.241***	−0.118***	−0.105***	−0.128***
	(0.031)	(0.070)	(0.025)	(0.025)	(0.025)
$60 \leq$ Duration $< 90 \times B$	−0.076***	−0.232***	−0.051*	−0.028	−0.075***
	(0.017)	(0.066)	(0.022)	(0.027)	(0.021)
$90 \leq$ Duration $< 120 \times B$	−0.039*	−0.026	−0.032	−0.022	−0.053**
	(0.015)	(0.031)	(0.019)	(0.021)	(0.018)
$120 \leq$ Duration $< 150 \times B$	−0.021	0.011	−0.005	0.012	−0.006
	(0.017)	(0.028)	(0.020)	(0.023)	(0.019)
$150 \leq$ Duration $< 180 \times B$	−0.009	0.038	−0.006	0.003	0.009
	(0.021)	(0.024)	(0.020)	(0.022)	(0.018)
New Covid-19 cases					0.014**
					(0.005)
$C \times$ Holiday home proportion					0.163***
					(0.037)
Unemployment rate					−2.131***
					(0.398)
Population					0.813**
					(0.290)
Observations	41994	41994	35486	37594	40996
Stores	400	400	338	400	400
Control group	$>$ 180 minutes	$>$ 180 minutes	$>$ 300 minutes	$>$ 180 minutes	$>$ 180 minutes
Linear time trends	Yes	No	No	No	No
Duration group × week FEs	No	Yes	No	No	No
Time window	Full	Full	Full	Restricted	Full

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Note: This table reports results from estimation of Equation 2 with the Natural logarithm of fresh bake sales as the dependent variable. In Column 1, observations from stores that pre-COVID were located between 180 and 300 minutes from the closest Swedish store are dropped. In Column 2, separate linear time trends for duration groups based on the pre-COVID duration to the closest Swedish store are included. The frequency distribution of the groups is reported in Table 2. In Column 3, week × pre-COVID duration group fixed effects are included. In Column 4, observations from the weeks between and including the week starting on Monday, July 27, 2020 and the week starting on Monday, October 5, 2020 are dropped. In these weeks some, but not all, Swedish border counties were open for cross-border shopping. The variable New COVID-19 cases included in Column 5 is the sum of the registered COVID-19 cases in the week t and $t-1$ divided by the population of the municipality. C is an indicator variable taking the value one in weeks after March 17, 2020 (and zero in the weeks before). Holiday home proportion is the proportion of residential dwellings that are holiday homes. The unemployment rate is measured at the municipality-month level. Population is measured at the municipality-quarter level. The standard errors reported in parentheses are clustered at the store level.

Table IA.9: Effect of cross-border shopping on ready made sales (in NOK) – robustness checks

	(1)	(2)	(3)	(4)	(5)
Duration $< 30 \times B$	−0.147**	−0.236***	−0.163***	−0.147***	−0.163***
	(0.048)	(0.069)	(0.039)	(0.039)	(0.039)
$30 \leq$ Duration $< 60 \times B$	−0.123***	−0.207***	−0.136***	−0.117***	−0.141***
	(0.029)	(0.058)	(0.022)	(0.025)	(0.023)
$60 \leq$ Duration $< 90 \times B$	−0.038*	−0.156***	−0.021	0.006	−0.038
	(0.016)	(0.046)	(0.019)	(0.025)	(0.019)
$90 \leq$ Duration $< 120 \times B$	0.004	−0.017	0.002	0.019	−0.013
	(0.015)	(0.028)	(0.017)	(0.021)	(0.017)
$120 \leq$ Duration $< 150 \times B$	0.012	0.028	0.017	0.038	0.022
	(0.016)	(0.025)	(0.018)	(0.023)	(0.018)
$150 \leq$ Duration $< 180 \times B$	−0.006	0.031	−0.014	−0.004	0.005
	(0.016)	(0.020)	(0.020)	(0.024)	(0.020)
New Covid-19 cases					0.010*
					(0.004)
$C \times$ Holiday home proportion					0.166***
					(0.040)
Unemployment rate					−1.892***
					(0.390)
Population					0.595*
					(0.271)
Observations	41993	41993	35485	37593	40995
Stores	400	400	338	400	400
Control group	$>$ 180 minutes	$>$ 180 minutes	$>$ 300 minutes	$>$ 180 minutes	$>$ 180 minutes
Linear time trends	Yes	No	No	No	No
Duration group × week FEs	No	Yes	No	No	No
Time window	Full	Full	Full	Restricted	Full

* p < 0.05, ** p < 0.01, *** p < 0.001.

Note: This table reports results from estimation of Equation 2 with the Natural logarithm of ready-made sales as the dependent variable. In Column 1, observations from stores that pre-COVID were located between 180 and 300 minutes from the closest Swedish store are dropped. In Column 2, separate linear time trends for duration groups based on the pre-COVID duration to the closest Swedish store are included. The frequency distribution of the groups is reported in Table 2. In Column 3, week × pre-COVID duration group fixed effects are included. In Column 4, observations from the weeks between and including the week starting on Monday, July 27, 2020 and the week starting on Monday, October 5, 2020 are dropped. In these weeks some, but not all, Swedish border counties were open for cross-border shopping. The variable New COVID-19 cases included in Column 5 is the sum of the registered COVID-19 cases in week t and $t-1$ divided by the population of the municipality. C is an indicator variable taking the value one in the weeks after March 17, 2020 (and zero in the weeks before). Holiday home proportion is the proportion of residential dwellings that are holiday homes. The unemployment rate is measured at the municipality-month level. Population is measured at the municipality-quarter level. The standard errors reported in parentheses are clustered at the store level.

Table IA.10: Effect of cross-border shopping on cheese sales (in NOK) – robustness checks

	(1)	(2)	(3)	(4)	(5)
Duration $< 30 \times B$	−0.288***	−0.309***	−0.291***	−0.278***	−0.298***
	(0.042)	(0.073)	(0.034)	(0.033)	(0.035)
$30 \leq$ Duration $< 60 \times B$	−0.194***	−0.287***	−0.189***	−0.169***	−0.202***
	(0.036)	(0.063)	(0.026)	(0.027)	(0.025)
$60 \leq$ Duration $< 90 \times B$	−0.099***	−0.194***	−0.080***	−0.068*	−0.099***
	(0.018)	(0.058)	(0.022)	(0.026)	(0.021)
$90 \leq$ Duration $< 120 \times B$	−0.050**	−0.002	−0.048*	−0.041	−0.065***
	(0.016)	(0.029)	(0.019)	(0.021)	(0.018)
$120 \leq$ Duration $< 150 \times B$	−0.025	−0.017	−0.003	0.021	−0.003
	(0.018)	(0.027)	(0.020)	(0.024)	(0.019)
$150 \leq$ Duration $< 180 \times B$	−0.026	−0.057*	−0.022	−0.007	−0.009
	(0.025)	(0.023)	(0.021)	(0.023)	(0.021)
New Covid-19 cases					0.014**
					(0.005)
$C \times$ Holiday home proportion					0.171***
					(0.039)
Unemployment rate					−1.778***
					(0.406)
Population					0.841**
					(0.305)
Observations	41994	41994	35486	37594	40997
Stores	400	400	338	400	400
Control group	$>$ 180 minutes	$>$ 180 minutes	$>$ 300 minutes	$>$ 180 minutes	$>$ 180 minutes
Linear time trends	Yes	No	No	No	No
Duration group × week FEs	No	Yes	No	No	No
Time window	Full	Full	Full	Restricted	Full

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Note: This table reports results from estimation of Equation 2 with the Natural logarithm of cheese sales as the dependent variable. In Column 1, observations from stores that pre-COVID were located between 180 and 300 minutes from the closest Swedish store are dropped. In Column 2, separate linear time trends for duration groups based on the pre-COVID duration to the closest Swedish store are included. The frequency distribution of the groups is reported in Table 2. In Column 3, week × pre-COVID duration group fixed effects are included. In Column 4, observations from the weeks between and including the week starting on Monday, July 27, 2020 and the week starting on Monday, October 5, 2020 are dropped. In these weeks some, but not all, Swedish border counties were open for cross-border shopping. The variable New COVID-19 cases included in Column 5 is the sum of the registered COVID-19 cases in week t and $t-1$ divided by the population of the municipality. C is an indicator variable taking the value one in the weeks after March 17, 2020 (and zero in the weeks before). Holiday home proportion is the proportion of residential dwellings that are holiday homes. The unemployment rate is measured at the municipality-month level. Population is measured at the municipality-quarter level. The standard errors reported in parentheses are clustered at the store level.

Table IA.11: Effect of cross-border shopping on meat sales (in NOK) – robustness checks

	(1)	(2)	(3)	(4)	(5)
Duration $< 30 \times B$	−0.442***	−0.392***	−0.534***	−0.524***	−0.538***
	(0.057)	(0.076)	(0.035)	(0.038)	(0.034)
$30 \leq$ Duration $< 60 \times B$	−0.302***	−0.301***	−0.343***	−0.326***	−0.351***
	(0.044)	(0.069)	(0.028)	(0.030)	(0.028)
$60 \leq$ Duration $< 90 \times B$	−0.116***	−0.229***	−0.113***	−0.107***	−0.143***
	(0.021)	(0.051)	(0.021)	(0.025)	(0.020)
$90 \leq$ Duration $< 120 \times B$	−0.054**	−0.003	−0.048**	−0.037	−0.078***
	(0.018)	(0.027)	(0.019)	(0.021)	(0.017)
$120 \leq$ Duration $< 150 \times B$	−0.009	0.037	−0.027	−0.014	−0.025
	(0.023)	(0.028)	(0.020)	(0.023)	(0.019)
$150 \leq$ Duration $< 180 \times B$	−0.033	−0.038	−0.043*	−0.024	−0.026
	(0.027)	(0.027)	(0.021)	(0.024)	(0.021)
New Covid-19 cases					0.020**
					(0.007)
$C \times$ Holiday home proportion					0.175***
					(0.040)
Unemployment rate					−1.996***
					(0.473)
Population					−0.240
					(0.331)
Observations	41993	41993	35485	37593	40993
Stores	400	400	338	400	400
Control group	$>$ 180 minutes	$>$ 180 minutes	$>$ 300 minutes	$>$ 180 minutes	$>$ 180 minutes
Linear time trends	Yes	No	No	No	No
Duration group × week FEs	No	Yes	No	No	No
Time window	Full	Full	Full	Restricted	Full

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Note: This table reports results from estimation of Equation 2 with the Natural logarithm of meat sales as the dependent variable. In Column 1, observations from stores that pre-COVID were located between 180 and 300 minutes from the closest Swedish store are dropped. In Column 2, separate linear time trends for duration groups based on the pre-COVID duration to the closest Swedish store are included. The frequency distribution of the groups is reported in Table 2. In Column 3, week × pre-COVID duration group fixed effects are included. In Column 4, observations from the weeks between and including the week starting on Monday, July 27, 2020 and the week starting on Monday, October 5, 2020 are dropped. In these weeks some, but not all, Swedish border counties were open for cross-border shopping. The variable New COVID-19 cases included in Column 5 is the sum of the registered COVID-19 cases in week t and $t-1$ divided by the population of the municipality. C is an indicator variable taking the value one in the weeks after March 17, 2020 (and zero in the weeks before). Holiday home proportion is the proportion of residential dwellings that are holiday homes. The unemployment rate is measured at the municipality-month level. Population is measured at the municipality-quarter level. The standard errors reported in parentheses are clustered at the store level.

Table IA.12: Effect of cross-border shopping on sweets sales (in NOK) – robustness checks

	(1)	(2)	(3)	(4)	(5)
Duration $< 30 \times B$	−0.371***	−0.373***	−0.375***	−0.360***	−0.368***
	(0.050)	(0.082)	(0.036)	(0.037)	(0.037)
$30 \leq$ Duration $< 60 \times B$	−0.240***	−0.312***	−0.239***	−0.215***	−0.238***
	(0.037)	(0.074)	(0.025)	(0.026)	(0.035)
$60 \leq$ Duration $< 90 \times B$	−0.116***	−0.279***	−0.103***	−0.074**	−0.122***
	(0.020)	(0.070)	(0.023)	(0.027)	(0.021)
$90 \leq$ Duration $< 120 \times B$	−0.035	−0.024	−0.051*	−0.035	−0.054**
	(0.019)	(0.031)	(0.021)	(0.023)	(0.020)
$120 \leq$ Duration $< 150 \times B$	−0.010	0.017	−0.015	0.011	−0.025
	(0.020)	(0.028)	(0.019)	(0.022)	(0.018)
$150 \leq$ Duration $< 180 \times B$	−0.014	−0.015	−0.016	0.013	−0.006
	(0.026)	(0.025)	(0.024)	(0.026)	(0.027)
New Covid-19 cases					0.017**
					(0.007)
$C \times$ Holiday home proportion					0.167***
					(0.042)
Unemployment rate					−2.125***
					(0.406)
Population					0.643*
					(0.309)
Observations	41998	41998	35488	37598	41009
Stores	400	400	338	400	400
Control group	$>$ 180 minutes	$>$ 180 minutes	$>$ 300 minutes	$>$ 180 minutes	$>$ 180 minutes
Linear time trends	Yes	No	No	No	No
Duration group × week FEs	No	Yes	No	No	No
Time window	Full	Full	Full	Restricted	Full
Tax control	No	No	No	No	Yes

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Note: This table reports results from estimation of Equation 2 with the Natural logarithm of sweet sales (in NOK) as the dependent variable. In Column 1, observations from stores that pre-COVID were located between 180 and 300 minutes from the closest Swedish store are dropped. In Column 2, separate linear time trends for duration groups based on the pre-COVID duration to the closest Swedish store are included. The frequency distribution of the groups is reported in Table 2. In Column 3, week × pre-COVID duration group fixed effects are included. In Column 4, observations from the weeks between and including the week starting on Monday, July 27, 2020 and the week starting on Monday, October 5, 2020 are dropped. In these weeks some, but not all, Swedish border counties were open for cross-border shopping. The variable New COVID-19 cases included in Column 5 is the sum of the registered COVID-19 cases in week t and $t-1$ divided by the population of the municipality. C is an indicator variable taking the value one in the weeks after March 17, 2020 (and zero in the weeks before). Holiday home proportion is the proportion of residential dwellings that are holiday homes. The unemployment rate is measured at the municipality-month level. Population is measured at the municipality-quarter level. The standard errors reported in parentheses are clustered at the store level.

Table IA.13: Effect of cross-border shopping on sweets sales (in kilograms) – robustness checks

	(1)	(2)	(3)	(4)	(5)
Duration $< 30 \times B$	−0.372***	−0.373***	−0.375***	−0.360***	−0.366***
	(0.050)	(0.082)	(0.036)	(0.037)	(0.037)
$30 \leq$ Duration $< 60 \times B$	−0.236***	−0.310***	−0.237***	−0.213***	−0.239***
	(0.036)	(0.073)	(0.025)	(0.026)	(0.035)
$60 \leq$ Duration $< 90 \times B$	−0.114***	−0.278***	−0.102***	−0.073**	−0.121***
	(0.020)	(0.069)	(0.023)	(0.027)	(0.021)
$90 \leq$ Duration $< 120 \times B$	−0.038*	−0.023	−0.052*	−0.037	−0.054**
	(0.018)	(0.031)	(0.021)	(0.023)	(0.020)
$120 \leq$ Duration $< 150 \times B$	−0.008	0.016	−0.014	0.012	−0.025
	(0.020)	(0.028)	(0.020)	(0.022)	(0.018)
$150 \leq$ Duration $< 180 \times B$	−0.012	−0.016	−0.015	0.014	−0.007
	(0.026)	(0.025)	(0.024)	(0.026)	(0.027)
New Covid-19 cases					0.017**
					(0.007)
$C \times$ Holiday home proportion					0.167***
					(0.042)
Unemployment rate					−2.113***
					(0.403)
Population					0.610
					(0.311)
Observations	41998	41998	35488	37598	41009
Stores	400	400	338	400	400
Control group	$>$ 180 minutes	$>$ 180 minutes	$>$ 300 minutes	$>$ 180 minutes	$>$ 180 minutes
Linear time trends	Yes	No	No	No	No
Duration group × week FEs	No	Yes	No	No	No
Time window	Full	Full	Full	Restricted	Full
Tax control	No	No	No	No	Yes

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Note: This table reports results from estimation of Equation 2 with the Natural logarithm of sweet sales (in kilograms) as the dependent variable. In Column 1, observations from stores that pre-COVID were located between 180 and 300 minutes from the closest Swedish store are dropped. In Column 2, separate linear time trends for duration groups based on the pre-COVID duration to the closest Swedish store are included. The frequency distribution of the groups is reported in Table 2. In Column 3, week × pre-COVID duration group fixed effects are included. In Column 4, observations from the weeks between and including the week starting on Monday, July 27, 2020 and the week starting on Monday, October 5, 2020 are dropped. In these weeks some, but not all, Swedish border counties were open for cross-border shopping. The variable New COVID-19 cases included in Column 5 is the sum of the registered COVID-19 cases in week t and $t-1$ divided by the population of the municipality. C is an indicator variable taking the value one in the weeks after March 17, 2020 (and zero in the weeks before). Holiday home proportion is the proportion of residential dwellings that are holiday homes. The unemployment rate is measured at the municipality-month level. Population is measured at the municipality-quarter level. The standard errors reported in parentheses are clustered at the store level.

Table IA.14: Effect of cross-border shopping on soda sales (in NOK) – robustness checks

	(1)	(2)	(3)	(4)	(5)
Duration $< 30 \times B$	−0.655***	−0.585***	−0.672***	−0.667***	−0.700***
	(0.048)	(0.089)	(0.051)	(0.050)	(0.050)
$30 \leq$ Duration $< 60 \times B$	−0.394***	−0.363***	−0.388***	−0.373***	−0.392***
	(0.038)	(0.082)	(0.032)	(0.033)	(0.039)
$60 \leq$ Duration $< 90 \times B$	−0.167***	−0.221**	−0.160***	−0.149***	−0.156***
	(0.021)	(0.071)	(0.023)	(0.027)	(0.021)
$90 \leq$ Duration $< 120 \times B$	−0.079***	−0.009	−0.087***	−0.080***	−0.073***
	(0.017)	(0.036)	(0.019)	(0.020)	(0.017)
$120 \leq$ Duration $< 150 \times B$	−0.057**	−0.003	−0.058**	−0.045*	−0.055**
	(0.018)	(0.032)	(0.019)	(0.022)	(0.017)
$150 \leq$ Duration $< 180 \times B$	−0.044	−0.033	−0.051*	−0.045	−0.030
	(0.023)	(0.035)	(0.022)	(0.023)	(0.024)
New Covid-19 cases					0.012*
					(0.006)
$C \times$ Holiday home proportion					0.147***
					(0.043)
Unemployment rate					−1.720***
					(0.422)
Population					0.187
					(0.303)
Observations	41997	41997	35488	37597	41005
Stores	400	400	338	400	400
Control group	$>$ 180 minutes	$>$ 180 minutes	$>$ 300 minutes	$>$ 180 minutes	$>$ 180 minutes
Linear time trends	Yes	No	No	No	No
Duration group × week FEs	No	Yes	No	No	No
Time window	Full	Full	Full	Restricted	Full
Tax control	No	No	No	No	Yes

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Note: This table reports results from estimation of Equation 2 with the Natural logarithm of soda sales (in NOK) as the dependent variable. In Column 1, observations from stores that pre-COVID were located between 180 and 300 minutes from the closest Swedish store are dropped. In Column 2, separate linear time trends for duration groups based on the pre-COVID duration to the closest Swedish store are included. The frequency distribution of the groups is reported in Table 2. In Column 3, week × pre-COVID duration group fixed effects are included. In Column 4, observations from the weeks between and including the week starting on Monday, July 27, 2020 and the week starting on Monday, October 5, 2020 are dropped. In these weeks some, but not all, Swedish border counties were open for cross-border shopping. The variable New COVID-19 cases included in Column 5 is the sum of the registered COVID-19 cases in week t and $t-1$ divided by the population of the municipality. C is an indicator variable taking the value one in the weeks after March 17, 2020 (and zero in the weeks before). Holiday home proportion is the proportion of residential dwellings that are holiday homes. The unemployment rate is measured at the municipality-month level. Population is measured at the municipality-quarter level. The standard errors reported in parentheses are clustered at the store level.

Table IA.15: Effect of cross-border shopping on soda sales (in liters) – robustness checks

	(1)	(2)	(3)	(4)	(5)
Duration $< 30 \times B$	−0.658***	−0.585***	−0.673***	−0.668***	−0.701***
	(0.048)	(0.090)	(0.051)	(0.050)	(0.051)
$30 \leq$ Duration $< 60 \times B$	−0.395***	−0.365***	−0.388***	−0.373***	−0.393***
	(0.038)	(0.082)	(0.032)	(0.033)	(0.038)
$60 \leq$ Duration $< 90 \times B$	−0.165***	−0.223**	−0.158***	−0.148***	−0.155***
	(0.021)	(0.071)	(0.023)	(0.027)	(0.022)
$90 \leq$ Duration $< 120 \times B$	−0.077***	−0.011	−0.086***	−0.079***	−0.072***
	(0.017)	(0.036)	(0.019)	(0.020)	(0.017)
$120 \leq$ Duration $< 150 \times B$	−0.055**	−0.005	−0.057**	−0.044*	−0.054**
	(0.018)	(0.032)	(0.019)	(0.022)	(0.016)
$150 \leq$ Duration $< 180 \times B$	−0.044	−0.035	−0.051*	−0.045	−0.030
	(0.023)	(0.035)	(0.022)	(0.023)	(0.024)
New Covid-19 cases					0.012*
					(0.006)
$C \times$ Holiday home proportion					0.145***
					(0.043)
Unemployment rate					−1.722***
					(0.415)
Population					0.188
					(0.306)
Observations	41997	41997	35488	37597	41007
Stores	400	400	338	400	400
Control group	> 180 minutes	> 180 minutes	> 300 minutes	> 180 minutes	> 180 minutes
Linear time trends	Yes	No	No	No	No
Duration group × week FEs	No	Yes	No	No	No
Time window	Full	Full	Full	Restricted	Full
Tax control	No	No	No	No	Yes

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Note: This table reports results from estimation of Equation 2 with the Natural logarithm of soda sales (in liters) as the dependent variable. In Column 1, observations from stores that pre-COVID were located between 180 and 300 minutes from the closest Swedish store are dropped. In Column 2, separate linear time trends for duration groups based on the pre-COVID duration to the closest Swedish store are included. The frequency distribution of the groups is reported in Table 2. In Column 3, week × pre-COVID duration group fixed effects are included. In Column 4, observations from the weeks between and including the week starting on Monday, July 27, 2020 and the week starting on Monday, October 5, 2020 are dropped. In these weeks some, but not all, Swedish border counties were open for cross-border shopping. The variable New COVID-19 cases included in Column 5 is the sum of the registered COVID-19 cases in week t and $t-1$ divided by the population of the municipality. C is an indicator variable taking the value one in the weeks after March 17, 2020 (and zero in the weeks before). Holiday home proportion is the proportion of residential dwellings that are holiday homes. The unemployment rate is measured at the municipality-month level. Population is measured at the municipality-quarter level. The standard errors reported in parentheses are clustered at the store level.

Table IA.16: Effect of cross-border shopping on beer sales (in NOK) – robustness checks

	(1)	(2)	(3)	(4)	(5)
Duration $< 30 \times B$	−0.501***	−0.540***	−0.522***	−0.524***	−0.516***
	(0.060)	(0.086)	(0.047)	(0.050)	(0.056)
$30 \leq$ Duration $< 60 \times B$	−0.313***	−0.388***	−0.320***	−0.311***	−0.317***
	(0.032)	(0.080)	(0.027)	(0.029)	(0.036)
$60 \leq$ Duration $< 90 \times B$	−0.158***	−0.333***	−0.148***	−0.144***	−0.161***
	(0.020)	(0.064)	(0.022)	(0.025)	(0.021)
$90 \leq$ Duration $< 120 \times B$	−0.092***	−0.032	−0.098***	−0.105***	−0.102***
	(0.018)	(0.039)	(0.020)	(0.020)	(0.020)
$120 \leq$ Duration $< 150 \times B$	−0.050*	0.027	−0.059**	−0.058**	−0.060**
	(0.021)	(0.036)	(0.019)	(0.021)	(0.020)
$150 \leq$ Duration $< 180 \times B$	−0.029	0.003	−0.035	−0.030	−0.028
	(0.028)	(0.033)	(0.024)	(0.026)	(0.031)
New Covid-19 cases					0.018**
					(0.005)
$C \times$ Holiday home proportion					0.184***
					(0.043)
Unemployment rate					−2.449***
					(0.440)
Population					0.291
					(0.260)
Observations	41996	41996	35487	37596	41004
Stores	400	400	338	400	400
Control group	> 180 minutes	> 180 minutes	> 300 minutes	> 180 minutes	> 180 minutes
Linear time trends	Yes	No	No	No	No
Duration group × week FEs	No	Yes	No	No	No
Time window	Full	Full	Full	Restricted	Full
Tax control	No	No	No	No	Yes

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Note: This table reports results from estimation of Equation 2 with the Natural logarithm of beer sales (in NOK) as the dependent variable. In Column 1, observations from stores that pre-COVID were located between 180 and 300 minutes from the closest Swedish store are dropped. In Column 2, separate linear time trends for duration groups based on the pre-COVID duration to the closest Swedish store are included. The frequency distribution of the groups is reported in Table 2. In Column 3, week × pre-COVID duration group fixed effects are included. In Column 4, observations from the weeks between and including the week starting on Monday, July 27, 2020 and the week starting on Monday, October 5, 2020 are dropped. In these weeks some, but not all, Swedish border counties were open for cross-border shopping. The variable New COVID-19 cases included in Column 5 is the sum of the registered COVID-19 cases in week t and $t-1$ divided by the population of the municipality. C is an indicator variable taking the value one in the weeks after March 17, 2020 (and zero in the weeks before). Holiday home proportion is the proportion of residential dwellings that are holiday homes. The unemployment rate is measured at the municipality-month level. Population is measured at the municipality-quarter level. The standard errors reported in parentheses are clustered at the store level.

Table IA.17: Effect of cross-border shopping on beer sales (in liters) – robustness checks

	(1)	(2)	(3)	(4)	(5)
Duration $< 30 \times B$	−0.494***	−0.536***	−0.520***	−0.522***	−0.519***
	(0.061)	(0.086)	(0.047)	(0.050)	(0.056)
$30 \leq$ Duration $< 60 \times B$	−0.312***	−0.387***	−0.320***	−0.310***	−0.319***
	(0.032)	(0.080)	(0.027)	(0.029)	(0.036)
$60 \leq$ Duration $< 90 \times B$	−0.159***	−0.333***	−0.148***	−0.144***	−0.160***
	(0.020)	(0.064)	(0.022)	(0.025)	(0.021)
$90 \leq$ Duration $< 120 \times B$	−0.092***	−0.032	−0.098***	−0.105***	−0.102***
	(0.018)	(0.039)	(0.020)	(0.020)	(0.020)
$120 \leq$ Duration $< 150 \times B$	−0.051*	0.027	−0.060**	−0.058**	−0.061**
	(0.021)	(0.036)	(0.019)	(0.021)	(0.021)
$150 \leq$ Duration $< 180 \times B$	−0.033	0.002	−0.037	−0.032	−0.029
	(0.027)	(0.033)	(0.024)	(0.026)	(0.032)
New Covid-19 cases					0.018**
					(0.005)
$C \times$ Holiday home proportion					0.186***
					(0.043)
Unemployment rate					−2.451***
					(0.439)
Population					0.289
					(0.261)
Observations	41996	41996	35487	37596	41004
Stores	400	400	338	400	400
Control group	> 180 minutes	> 180 minutes	> 300 minutes	> 180 minutes	> 180 minutes
Linear time trends	Yes	No	No	No	No
Duration group × week FEs	No	Yes	No	No	No
Time window	Full	Full	Full	Restricted	Full
Tax control	No	No	No	No	Yes

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Note: This table reports results from estimation of Equation 2 with the Natural logarithm of beer sales (in liters) as the dependent variable. In Column 1, observations from stores that pre-COVID were located between 180 and 300 minutes from the closest Swedish store are dropped. In Column 2, separate linear time trends for duration groups based on the pre-COVID duration to the closest Swedish store are included. The frequency distribution of the groups is reported in Table 2. In Column 3, week × pre-COVID duration group fixed effects are included. In Column 4, observations from the weeks between and including the week starting on Monday, July 27, 2020 and the week starting on Monday, October 5, 2020 are dropped. In these weeks some, but not all, Swedish border counties were open for cross-border shopping. The variable New COVID-19 cases included in Column 5 is the sum of the registered COVID-19 cases in week t and $t-1$ divided by the population of the municipality. C is an indicator variable taking the value one in the weeks after March 17, 2020 (and zero in the weeks before). Holiday home proportion is the proportion of residential dwellings that are holiday homes. The unemployment rate is measured at the municipality-month level. Population is measured at the municipality-quarter level. The standard errors reported in parentheses are clustered at the store level.

Table IA.18: Effect of cross-border shopping on cigarette sales (in NOK) – robustness checks

	(1)	(2)	(3)	(4)	(5)
Duration $< 30 \times B$	−1.058***	−0.863***	−1.115***	−1.131***	−1.104***
	(0.085)	(0.147)	(0.096)	(0.108)	(0.086)
$30 \leq$ Duration $< 60 \times B$	−0.606***	−0.509***	−0.693***	−0.695***	−0.635***
	(0.040)	(0.080)	(0.038)	(0.042)	(0.040)
$60 \leq$ Duration $< 90 \times B$	−0.256***	−0.286***	−0.322***	−0.341***	−0.256***
	(0.024)	(0.073)	(0.028)	(0.031)	(0.026)
$90 \leq$ Duration $< 120 \times B$	−0.100***	−0.002	−0.153***	−0.166***	−0.107***
	(0.016)	(0.037)	(0.020)	(0.021)	(0.016)
$120 \leq$ Duration $< 150 \times B$	−0.046*	0.046	−0.083***	−0.087***	−0.042*
	(0.018)	(0.033)	(0.022)	(0.025)	(0.016)
$150 \leq$ Duration $< 180 \times B$	−0.031	0.001	−0.058**	−0.055*	−0.018
	(0.017)	(0.031)	(0.022)	(0.024)	(0.018)
New Covid-19 cases					0.011*
					(0.005)
$C \times$ Holiday home proportion					0.208***
					(0.055)
Unemployment rate					−0.497
					(0.341)
Population					0.001
					(0.290)
Observations	41997	41997	35488	37597	41005
Stores	400	400	338	400	400
Control group	> 180 minutes	> 180 minutes	> 300 minutes	> 180 minutes	> 180 minutes
Linear time trends	Yes	No	No	No	No
Duration group × week FEs	No	Yes	No	No	No
Time window	Full	Full	Full	Restricted	Full
Tax control	No	No	No	No	Yes

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Note: This table reports results from estimation of Equation 2 with the Natural logarithm of cigarette sales (in NOK) as the dependent variable. In Column 1, observations from stores that pre-COVID were located between 180 and 300 minutes from the closest Swedish store are dropped. In Column 2, separate linear time trends for duration groups based on the pre-COVID duration to the closest Swedish store are included. The frequency distribution of the groups is reported in Table 2. In Column 3, week × pre-COVID duration group fixed effects are included. In Column 4, observations from the weeks between and including the week starting on Monday, July 27, 2020 and the week starting on Monday, October 5, 2020 are dropped. In these weeks some, but not all, Swedish border counties were open for cross-border shopping. The variable New COVID-19 cases included in Column 5 is the sum of the registered COVID-19 cases in week t and $t-1$ divided by the population of the municipality. C is an indicator variable taking the value one in the weeks after March 17, 2020 (and zero in the weeks before). Holiday home proportion is the proportion of residential dwellings that are holiday homes. The unemployment rate is measured at the municipality-month level. Population is measured at the municipality-quarter level. The standard errors reported in parentheses are clustered at the store level.

Table IA.19: Effect of cross-border shopping on cigarette sales (in items) – robustness checks

	(1)	(2)	(3)	(4)	(5)
Duration $< 30 \times B$	−1.059***	−0.863***	−1.115***	−1.131***	−1.097***
	(0.086)	(0.146)	(0.096)	(0.108)	(0.082)
$30 \leq$ Duration $< 60 \times B$	−0.607***	−0.508***	−0.694***	−0.695***	−0.636***
	(0.041)	(0.080)	(0.038)	(0.042)	(0.040)
$60 \leq$ Duration $< 90 \times B$	−0.259***	−0.288***	−0.323***	−0.343***	−0.257***
	(0.024)	(0.074)	(0.028)	(0.030)	(0.025)
$90 \leq$ Duration $< 120 \times B$	−0.100***	−0.002	−0.153***	−0.167***	−0.105***
	(0.016)	(0.037)	(0.020)	(0.021)	(0.016)
$120 \leq$ Duration $< 150 \times B$	−0.045*	0.046	−0.083***	−0.087***	−0.041*
	(0.018)	(0.033)	(0.022)	(0.025)	(0.016)
$150 \leq$ Duration $< 180 \times B$	−0.031	0.001	−0.058**	−0.055*	−0.021
	(0.016)	(0.031)	(0.022)	(0.024)	(0.018)
New Covid-19 cases					0.011*
					(0.005)
$C \times$ Holiday home proportion					0.207***
					(0.055)
Unemployment rate					−0.487
					(0.338)
Population					−0.006
					(0.284)
Observations	41997	41997	35488	37597	41004
Stores	400	400	338	400	400
Control group	> 180 minutes	> 180 minutes	> 300 minutes	> 180 minutes	> 180 minutes
Linear time trends	Yes	No	No	No	No
Duration group × week FEs	No	Yes	No	No	No
Time window	Full	Full	Full	Restricted	Full
Tax control	No	No	No	No	Yes

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Note: This table reports results from estimation of Equation 2 with the Natural logarithm of cigarette sales (in items) as the dependent variable. In Column 1, observations from stores that pre-COVID were located between 180 and 300 minutes from the closest Swedish store are dropped. In Column 2, separate linear time trends for duration groups based on the pre-COVID duration to the closest Swedish store are included. The frequency distribution of the groups is reported in Table 2. In Column 3, week × pre-COVID duration group fixed effects are included. In Column 4, observations from the weeks between and including the week starting on Monday, July 27, 2020 and the week starting on Monday, October 5, 2020 are dropped. In these weeks some, but not all, Swedish border counties were open for cross-border shopping. The variable New COVID-19 cases included in Column 5 is the sum of the registered COVID-19 cases in week t and $t-1$ divided by the population of the municipality. C is an indicator variable taking the value one in the weeks after March 17, 2020 (and zero in the weeks before). Holiday home proportion is the proportion of residential dwellings that are holiday homes. The unemployment rate is measured at the municipality-month level. Population is measured at the municipality-quarter level. The standard errors reported in parentheses are clustered at the store level.

Table IA.20: Effect of cross-border shopping on snus sales (in NOK) – robustness checks

	(1)	(2)	(3)	(4)	(5)
Duration $< 30 \times B$	−1.063***	−0.934***	−1.135***	−1.100***	−1.114***
	(0.091)	(0.277)	(0.058)	(0.053)	(0.074)
$30 \leq$ Duration $< 60 \times B$	−0.653***	−0.420***	−0.807***	−0.797***	−0.722***
	(0.052)	(0.090)	(0.048)	(0.056)	(0.051)
$60 \leq$ Duration $< 90 \times B$	−0.258***	−0.288***	−0.339***	−0.341***	−0.269***
	(0.026)	(0.076)	(0.030)	(0.034)	(0.026)
$90 \leq$ Duration $< 120 \times B$	−0.108***	−0.004	−0.174***	−0.165***	−0.132***
	(0.018)	(0.033)	(0.022)	(0.024)	(0.017)
$120 \leq$ Duration $< 150 \times B$	−0.066***	0.017	−0.120***	−0.103***	−0.073***
	(0.019)	(0.027)	(0.023)	(0.028)	(0.017)
$150 \leq$ Duration $< 180 \times B$	−0.040	−0.003	−0.080**	−0.059	−0.027
	(0.022)	(0.028)	(0.026)	(0.031)	(0.022)
New Covid-19 cases					0.009
					(0.005)
$C \times$ Holiday home proportion					0.267***
					(0.055)
Unemployment rate					−1.836***
					(0.414)
Population					0.123
					(0.242)
Observations	41927	41927	35417	37527	40927
Stores	400	400	338	400	400
Control group	$>$ 180 minutes	$>$ 180 minutes	$>$ 300 minutes	$>$ 180 minutes	$>$ 180 minutes
Linear time trends	Yes	No	No	No	No
Duration group × week FEs	No	Yes	No	No	No
Time window	Full	Full	Full	Restricted	Full
Tax control	No	No	No	No	Yes

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Note: This table reports results from estimation of Equation 2 with the Natural logarithm of snus sales (in NOK) as the dependent variable. In Column 1, observations from stores that pre-COVID were located between 180 and 300 minutes from the closest Swedish store are dropped. In Column 2, separate linear time trends for duration groups based on the pre-COVID duration to the closest Swedish store are included. The frequency distribution of the groups is reported in Table 2. In Column 3, week × pre-COVID duration group fixed effects are included. In Column 4, observations from the weeks between and including the week starting on Monday, July 27, 2020 and the week starting on Monday, October 5, 2020 are dropped. In these weeks some, but not all, Swedish border counties were open for cross-border shopping. The variable New COVID-19 cases included in Column 5 is the sum of the registered COVID-19 cases in week t and $t-1$ divided by the population in the municipality. C is an indicator variable taking the value one in weeks after March 17, 2020 (and zero in weeks before). Holiday home proportion is the proportion of residential dwellings that are holiday homes. The unemployment rate is measured at the municipality-month level. Population is measured at the municipality-quarter level. The standard errors reported in parentheses are clustered at the store level.

Table IA.21: Effect of cross-border shopping on snus sales (in kilograms) – robustness checks

	(1)	(2)	(3)	(4)	(5)
Duration $< 30 \times B$	−1.054***	−0.943***	−1.131***	−1.096***	−1.117***
	(0.091)	(0.275)	(0.058)	(0.053)	(0.078)
$30 \leq$ Duration $< 60 \times B$	−0.651***	−0.420***	−0.806***	−0.796***	−0.723***
	(0.052)	(0.091)	(0.048)	(0.056)	(0.053)
$60 \leq$ Duration $< 90 \times B$	−0.258***	−0.289***	−0.338***	−0.341***	−0.269***
	(0.026)	(0.075)	(0.030)	(0.035)	(0.027)
$90 \leq$ Duration $< 120 \times B$	−0.107***	−0.005	−0.173***	−0.164***	−0.132***
	(0.018)	(0.033)	(0.022)	(0.024)	(0.017)
$120 \leq$ Duration $< 150 \times B$	−0.064**	0.016	−0.118***	−0.101***	−0.073***
	(0.019)	(0.027)	(0.023)	(0.028)	(0.017)
$150 \leq$ Duration $< 180 \times B$	−0.039	−0.004	−0.079**	−0.058	−0.027
	(0.022)	(0.028)	(0.025)	(0.030)	(0.022)
New Covid-19 cases					0.009
					(0.005)
$C \times$ Holiday home proportion					0.265***
					(0.055)
Unemployment rate					−1.850***
					(0.414)
Population					0.117
					(0.245)
Observations	41927	41927	35417	37527	40928
Stores	400	400	338	400	400
Control group	$>$ 180 minutes	$>$ 180 minutes	$>$ 300 minutes	$>$ 180 minutes	$>$ 180 minutes
Linear time trends	Yes	No	No	No	No
Duration group × week FEs	No	Yes	No	No	No
Time window	Full	Full	Full	Restricted	Full
Tax control	No	No	No	No	Yes

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Note: This table reports results from estimation of Equation 2 with the Natural logarithm of snus sales (in kilograms) as the dependent variable. In Column 1, observations from stores that pre-COVID were located between 180 and 300 minutes from the closest Swedish store are dropped. In Column 2, separate linear time trends for duration groups based on the pre-COVID duration to the closest Swedish store are included. The frequency distribution of the groups is reported in Table 2. In Column 3, week × pre-COVID duration group fixed effects are included. In Column 4, observations from the weeks between and including the week starting on Monday, July 27, 2020 and the week starting on Monday, October 5, 2020 are dropped. In these weeks some, but not all, Swedish border counties were open for cross-border shopping. The variable New COVID-19 cases included in Column 5 is the sum of the registered COVID-19 cases in week t and $t-1$ divided by the population of the municipality. C is an indicator variable taking the value one in the weeks after March 17, 2020 (and zero in the weeks before). Holiday home proportion is the proportion of residential dwellings that are holiday homes. The unemployment rate is measured at the municipality-month level. Population is measured at the municipality-quarter level. The standard errors reported in parentheses are clustered at the store level.

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NORGES HANDELSHØYSKOLE
Norwegian School of Economics

Helleveien 30
NO-5045 Bergen
Norway

T +47 55 95 90 00
E nhh.postmottak@nhh.no
W www.nhh.no