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The impact of free returns on online purchase behavior: Evidence from an intervention at an online retailer

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Abstract

Whether free returns create economic value for online retailers is a question of increasing importance. Using order-level data from an online fashion retailer in Sweden, we investigate the introduction of free returns for customers in Denmark starting 1 November 2017, but not for customers in Sweden, Norway, Finland, France, Germany, and the rest of Europe (the control group). Using difference-in-differences, with and without sample matching, the introduction of free returns increased the order bill by 54.95 Swedish Krona (SEK) (9.151%), product variety per order by 0.057 (8.742%), gross margin per order by 29.90 SEK (9.705%), and returns to 0.195 items per order (7.869%). This likelihood of increased returns was generally similar across different product categories. The findings are robust to parallel trends, event studies, placebo effects, alternative control groups (with Scandinavian countries, Sweden and Norway), country-time trends, and correlations between outcome variables. Based on back-of-the-envelope calculations, the cost of offering free returns is greater than the increase in gross profit driven by free returns. Though our results show that free returns may not be of short-term benefit, retailers must consider the long-term strategic implications of free returns.

Keywords: Online retailing, return policy, free returns, customer behavior

1. INTRODUCTION

Product returns in the United States (U.S.) retail sector reached $309 billion in 2019, or 8% of total retail sales (National Retail Federation, 2019). The growing preference for online purchases has prompted the adoption of lenient return policies. According to some estimates, U.S. customers return 25 to 40% of their online purchases. The corresponding return delivery costs are expected to rise to $550 billion by 2020, a 75.2% increase over the past four years (Cullinane, Browne, Karlsson, & Wang, 2019). These figures are somewhat similar for online retailers in Europe (de Leeuw, Minguela-Rata, Sabet, Boter, & Sigurðardóttir, 2016). Despite the increasingly direct and indirect costs of product returns, free returns remain a quintessential impetus for online purchases. Surveys show that 62% of customers would buy again from retailers offering free returns, 69% would be deterred from buying online if they had to pay for return shipping, 90% highly value free returns, and approximately 96% would shop again with

a retailer if returning was easy (Dotcom Distribution eCommerce Study, 2018; Narvar Consumer Report, 2018).

Academic research on product returns dates to Heal (1977), and interest in research on online product returns has been on the rise in recent years (Abdulla, Ketzenberg, & Abbey, 2019; Janakiraman, Syrdal, & Freling, 2016; Nguyen, de Leeuw, & Dullaert, 2018). Findings on the effects of free returns are mixed, with much research relying on self-report data or having a limited ability to draw causal inferences (Abdulla et al., 2019; Cullinane et al., 2019; Janakiraman et al., 2016; Nguyen et al., 2018). On the one hand, free returns may increase purchases by lowering dissonance and signaling a retailer's quality, trustworthiness, and commitment to customer service. On the other hand, product returns increase direct and indirect costs (e.g., restocking, fraudulent returns, and inventory losses).

To investigate these issues, we analyze a quasi-natural experiment at a Swedish online retailer. The retailer implemented a free returns policy in Denmark but not in its other markets—Sweden, Norway, Finland, France, Germany, and the rest of Europe.[1] The analysis period is 1 January 2017 to 31 December 2018 and the free returns policy was launched on 1 November 2017. The treated group (Danish customers) included 16,638 orders in the pre-treatment period (before 1 November 2017) and 48,096 orders in the post-treatment period (after 1 November 2017), totaling 64,734 orders. The control group (Sweden, Norway, Finland, France, Germany, and the rest of Europe) included 360,312 orders in the pre-treatment period and 610,328 orders in the post-treatment period, totaling 970,640 orders. Our data includes information on a customer identifier, order identifier, time stamp of the order, and details on each item in the order—price, item product category, purchase price, manufacturer's suggested retail price (MSRP), and whether the item was returned. Four outcome variables were considered: total bill of the order, product variety in the order, gross margin (sales price minus

[1] The rest of Europe constitutes countries of the European Union (EU) and Switzerland.

purchase price), and whether the item was returned. By investigating this unique policy change in the form of a quasi-natural experiment, we are, to the best of our knowledge, the first to provide causal inferences on the effects of a free returns policy.

We used a difference-in-differences (DiD) design and with-and-without sample matching. Parallel trends were tested to verify whether orders in the treated and the control group followed a similar trend before the treatment. Placebo testing and event-study analysis were applied to further ensure the validity of our DiD design (Wooldridge, 2007). To control for past customer behavior and period effects, several controls were incorporated into the model. These consist of the log of spending up to the current order, the total count of past returns, the total value of past returns, the average margin on returns up to the current order, the average gap between MSRP and price paid, and quarter, week of the year, day of the week, and month-year fixed effects. Finally, we conducted a series of robustness checks for alternative control group specifications—control for country time trends, control for correlation between outcome variables, and analysis of returns by product categories.

The introduction of free returns increased the order bill by 54.95 SEK (9.151%), product variety per order by 0.057 (8.742%), gross margin per order by 29.90 SEK (9.705%), and returns to 0.195 items per order (7.869%). Considering the net benefit of offering free returns, the gross margin increase per order of approximately 30 SEK should exceed the cost of a return for every five orders (~0.195 items per order). For every five orders, the gross margin (sales minus cost of the item) is approximately 150 SEK (30 SEK*5 orders). The retailer's warehouse is located in Sweden where the most recent average monthly wage for warehouse workers is 28,300 SEK or roughly 177 SEK per hour (assuming 160 hours of work per month). An increased gross margin of 98.41 SEK for every five orders can hardly be sufficient to compensate for even the additional labor costs to handle the increased returns volume. Adding the return shopping cost to the labor cost, the benefits of free returns in the

form of a higher gross margin per order. Though our results show through back-of-the-envelope cost calculations that the costs of offering free returns exceed order-level gains in gross margins, retailers must consider the long-term strategic implications of free returns.

Our goal is to highlight the customer-facing effects of free returns in online retailing. We provide causal evidence that free returns increase the total billed amount per order but also increase product returns. Offering free returns also increased product variety in orders (cf. Ramdas, 2003), indicating the possibility to sell products from the assortment's long tail. The findings contribute to research in inventory management (De Brito & Van Der Laan, 2009), purchase behavior (Griffis, Rao, Goldsby, & Niranjan, 2012), manufacturing processes (Stock & Mulki, 2009), and concentration of product categories (Anderson, 2006), among others. With online retailing growing rapidly and with the increasing need to manage the reverse supply chain, our findings provide causal evidence on the value of free returns and inform online retailers on the workings of customer order dynamics.

2. THEORETICAL BACKGROUND

Returns management is concerned with trade-offs in reverse channel logistics including gatekeeping, processing, and disposal (de Leeuw et al., 2016). Particularly in online retail, returns present an immense cost factor for retailers. Nevertheless, return policies that offer full and hassle-free product returns are prevalent (Shang, Pekgün, Ferguson, & Galbreth, 2017). A lenient return policy is often seen as a signal of quality, thus reducing purchase risk for the customer (Abdulla et al., 2019; Bonifield, Cole, & Schultz, 2010; Davis, Gerstner, & Hagerty, 1995; Li, Xu, & Li, 2013; Zhang, Li, Yan, & Johnston, 2017). However, this has led to returns increasing sharply in recent years (Abdulla et al., 2019).

To counteract negative consequences and reduce the overall quantity of customer returns, retailers deploy return policies that specify the level of price and hassle required to

return an unwanted product (Davis, Hagerty, & Gerstner, 1998). Generally, customers value lenient return policies as they reduce uncertainty and the perceived risk since there is no option to touch or try the desired product in advance (Mukhopadyay & Setaputra, 2007). Further, they evaluate a retailer's return policy from the perspective of "product fit and valuation uncertainty, customer heterogeneity, transaction costs, trial period consumption, return timing, demand and return sensitivity, and risk aversion" (Abdulla et al., 2019). Although losses from lenient return policies may be offset by higher sales or margins, the direction of the effects of a free returns policy is not clear. Many of the prior studies included in Janakiraman et al. (2016) meta-analytic review, for example, focus on product returns in general (i.e., not solely on the effect of free returns) or rely on self-report data from customers. Nevertheless, this rich stream of work provides the basis for illuminating the effects of a free returns policy.

Although the bulk of prior research investigates some form of monetary leniency concerning a retailer's return policy similar to our study (Abdulla et al., 2019), our work is distinct from earlier research in two important ways. First, we do not investigate monetary leniency from the stance of money-back guarantees or partial refunds but investigate a case where the retailer has waived the return shipping fee. This entails a refund that exceeds the price of the product since our retailer already has a full-refund, no-questions-asked return policy in place. Second, empirical research on monetary leniency in the form of free return shipping is limited, with only a few studies addressing the issue. Bower and Maxham III (2012) and Lantz and Hjort (2013) studied the implications of free and fee returns and have concluded that such higher monetary leniency may possibly result in favorable customer behavioral intentions. Nevertheless, these studies do not derive their implications of free returns in online retail by investigating a quasi-natural experiment using a DiD research design. Therefore, our work provides causal inferences on the additional value that accrues from allowing customers to make free returns in online retailing.

We remark that the objective of our empirical analysis is to investigate the effects of a free returns policy, which extends from paying for return shipping to offering free returns at an online retailer. In our empirical model, the trial period and return timing are similar for the treated group and the control group (see Table 1). Consequently, our research does not directly concern factors that drive (set) the return policy. Rather, we are interested in the implications of the change to a more lenient return policy. We focus on the order bill, product variety, order margin, and the count of returned items.

3. RESEARCH BACKGROUND AND QUASI-NATURAL EXPERIMENT

The data in our research come from a European fashion retailer targeting young adults, adolescents, and children. We obtained transaction sales and return records for all online orders from 1 January 2017 to 31 December 2018. The retailer was founded in 2002 in Sweden and gradually expanded into Norway in 2010, Finland in 2011, Denmark in 2013, France in 2017, and Germany in 2018. The retailer operates online stores in six European countries and an international (.com) version of its website that serves the other EU countries and Switzerland. In addition to its online business, the retailer runs two brick-and-mortar stores in Sweden. However, we have excluded all offline transactions from our analysis because the brick-and-mortar store sales are negligible compared to the retailer's overall sales, and because our research is focused on product returns in the online channel.

3.1 Description of company logistics

Throughout the period of observation, the retailer's assortment consisted of approximately 112,000 stock-keeping units (SKUs) ranging from laces to exclusive sneaker collections across more than 320 brands. The retailer generally stocks its warehouse with all items that it presents on the website. As is common in the fashion industry, parts of the retailer's assortment change

according to season. This results in several sales and promotion periods to clear out inventory. Table A1 in the appendix shows descriptive statistics on the largest product categories across all markets in our dataset.

Each online order is packed and shipped from the retailer's sole warehouse, which is located in Sweden. The shipment reaches the customer with an average delivery lead time of 2 to 7 days depending on its destination in the EU. The delivery and return costs that the retailer charges its customers fairly resemble the actual cost that the retailer's logistics partners charge per shipment. If available, the customer can also choose, at a lower cost, to pick up a parcel at a selected access point. Additionally, the retailer offers a minimum order value for free delivery. In line with charging for the delivery cost, the retailer generally charges for return freight costs. If customers want to return a product, they must repack the undesired item(s), attach the pre-print return label to the parcel, and ship it back. Since the retailer has only one warehouse, all returns come back to Sweden, irrespective of the original EU shipping destination. The retailer inspects all returned items for potential damage prior to issuing a refund, with the return freight cost deducted. Table 1 shows the resulting differences in the delivery and returns costs per market. We note that none of the policies changed throughout our analysis period besides the one-time intervention introducing free returns in Denmark.

----------Insert Table 1 about here----------

3.2 Event description: free returns in Denmark

The company launched free returns for Danish customers on 1 November 2017. It assumed that free returns would help customers overcome the hurdle of ordering its products online. Denmark is the only country where the retailer's customers can return at no cost while customers in the other markets pay shipping fees for every order returned. Because the retailer

offers identical assortments (and prices) in all of its markets, the additional costs of offering free returns did not change the retailer's pricing strategy in Denmark in the form of higher product prices (to pass through some of the return costs to the customer). Additionally, given the similarity and proximity of markets, the policy change to free returns in Denmark has not been advertised. Management viewed the policy change positively and retained free returns until our analysis period ended on 31 December 2018 and beyond.

Our dataset consists of 1,035,374 orders from 1 January 2017 to 31 December 2018 with the treatment for Danish customers starting on 1 November 2017. From these orders, 64,734 were placed by Danish customers, of which 16,638 were made before the return policy change on 1 November 2017 and 48,096 orders in the post-treatment period from 1 November 2017. The control group consists of 970,640 orders from customers in Sweden, Norway, Finland, France, and Germany. Additionally, orders from other EU countries and Switzerland were bundled as one market (EU) by the retailer, which we also included in our control group. This corresponds to 360,312 orders in the pre-treatment period and 610,328 orders in the post-treatment period for the control group.

4. IDENTIFICATION STRATEGY

A naive approach to quantify the effects of the free returns policy change would be to compare the differences in customer sales and returns between the (Danish) pre-treatment and post-treatment periods (before 1 November 2017 vs. after 1 November 2017). However, such an approach could reveal deficiencies from other unobservable factors that may have changed on either side of the policy change implementation on 1 November 2017.

To overcome this, a difference-in-differences (DiD) approach was applied to evaluate the effects of the return policy change for Danish customers (i.e., from having to pay for returns to free returns). The DiD methodology allows us to compare the relative changes in the

outcome variables before and after the return policy change between the customers affected by it (i.e., customers in Denmark) and the customers unaffected by it (i.e., customers in Sweden, Norway, Finland, France, Germany, and the rest of Europe). This approach is widely used to measure the effects of policy changes (e.g., Angrist & Pischke, 2008), with a growing number of publications applying the method in a retail context (e.g., Bell, Gallino, & Moreno, 2018; Fisher, Gallino, & Xu, 2019; Gallino & Moreno, 2014).

To investigate the effects of our quasi-experimental setting, we specify the DiD method for four outcome variables. The customer-identifier-order number is the unit variable, and the month-year is the time variable. The DiD is specified as:

$$Outcome_{oim} = c + Denmark_i + Treated\ Period_m + \beta\ Denmark_i \times Treated\ Period_m + C_i + Controls_{oim} + Q_t + W_t + D_t + MY_t + Z_i + e_{oim}$$

Where *o* is the order number, i the customer identifier, and m the month-year time variable. $Denmark_i$ denotes whether a customer ordered from Denmark (= 1, else = 0) and $Treated\ Period_m$ denotes the post-treatment period from 1 November 2017 through 31 December 2018 (= 1, else = 0). Of interest is the estimated β associated with a change in outcome. The outcome variables are (i) order bill amount in SEK; (ii) product variety in the order (based on the Herfindahl-Hirschman Index (HHI)); (iii) gross profit margin per order (sales price minus purchase price); and (iv) count of returned items.

C_i is the customer fixed effect, and $Controls_{oim}$ is the vector of customer level controls related to past purchase behavior up to the current order. Since past purchase behavior can strongly influence future purchases, we control for a variety of customer *i* related measures up to the current order *o*. Specifically, to control for heterogeneity stemming from past customer behavior, we include the log of spending up to the current order, the total count of past returns, the total value of past returns, the average margin of returns up to the current order, and the

average gap between the MSRP and the price paid. Q_t, W_t, D_t, MY_t represent quarter-year, week of the year, day of the week, and month-year fixed-effects, respectively.

5. RESULTS

Descriptive statistics for the control and treated groups are provided in Table 2. In the treated group, there was an increase in the average order bill for Danish customers by 65.96 SEK (10.98%) in the post-treatment period. We also observed an increase in product variety per order (-0.137[2]; 21.01%) and a higher margin per order (29.58 SEK; 9.61%). Finally, the change in the count of returned items per order is substantially higher in the treated group (=0.187 units; 7.37%) compared with the control group.

Using the *diff* routine in Stata 16, two sets of estimates are provided: (i) traditional DiD standard errors clustered by customer id; and (ii) kernel-based propensity score matching DiD with fixed effects for customer id. For the propensity-score matching, we used the control variables and month-year of the order as matching covariates.

----------Insert Tables 2-5 and Figure 1 about here----------

The estimates in Tables 3 (traditional DiD) and 4 (kernel-based propensity score matching DiD) provide the following inferences. We use the lower estimates in Table 4 (compared with Table 3) to draw more conservative inferences. The total order bill increases by about 54.95 SEK (9.151% increase) per order from Danish customers and the decrease in HHI concentration of ordered items across categories per order by 0.057 units, which implies an 8.742% increase in product variety. The gross profit increases by 29.90 SEK (9.705%) per

[2] We note that a higher HHI implies a higher concentration. Therefore, a negative sign implies a decline in the concentration of product variety.

order. Returned items per order increased to 0.195 units per order for the treated group (7.869%). Figure 1 presents the DiD plots supporting these findings.

5.1 Returns by product category

We further delve into assessing whether returned items vary systematically across product categories. Items from certain categories (e.g., clothing or shoes) may be more likely to be returned compared with other items (e.g., accessories) since the likelihood of product unfit is greater for some products than for others. In Figure F1, we present the preliminary distribution of returned items as percentages, relative to the total items in the data. As expected, items in the categories of bottoms, caps and scarves, shoes, hoodies and sweatshirts, and t-shirts had among the highest purchase and return rates, followed by underwear and socks, and backpacks and bags.

We restrict the analysis to categories with at least 500 units in sales over the analysis period. In Table F1, using fixed-effects estimates, we present the estimates for the linear probability of returns by category. In Table F2, we present the margins effects derived from Table F1. For each category, we assess the difference in return probability (bold, italicized rows) before and after the treatment for Denmark. The abridged version of Table F2 is presented in Table 5 where the z-values indicate that the changes in linear probability before and after the treatment for Denmark are significant. Across the product categories, the odds of returns are approximately 1.10 to 1.13 times higher for Denmark after the implementation of the free returns policy. Because the effect sizes of the odds ratios are very close, we do not infer differences in returns probabilities by categories.

6. ROBUSTNESS CHECKS

In the following, we provide robustness checks to further validate and strengthen the results of our main analysis.

6.1 Parallel trends analysis

The underlying assumption of the DiD estimation is that the control group and the treated group must have parallel trends before the treatment. To justify the validity of this assumption, time trends were tested for pre-treatment orders to lower the possibility of different time trends across the treated and control groups. The linear time trend across our outcome variables was as follows:

$$Outcome_{oim} = c + \theta t + \lambda Denmark_i \times t + \xi Denmark_i \times t^2 + C_i + Controls_{oim} + Q_t + W_t + D_t + MY_t + Z_i + e_{oim}$$

Where *t* is the continuous pre-treatment month-year. To control for non-linear effects, we include the linear and the squared term of time. Table 6 presents the estimation results. The estimates of λ and ξ are statistically non-significant in all the models. This indicates that there is no difference in pre-trends in the pre-treatment period for linear and squared-effects of time between Denmark and the countries in the control group.

We further conduct additional parallel trends tests for week-year as the unit of time measurement. The week-year parallel trends may provide additional granularity in terms of potential variations (e.g., promotions) between the control group and the treated group on a weekly basis of variations in retail offerings and pricing. In Table B1, we assess weekly-based trends and do not find them to be significant. In other words, the continuous time trend by week is not significant.

It is also possible that, due to quarterly financial targets by country, the firm may adjust its strategy over time for the treated and control groups. Therefore, compared to month-year or

week-year parallel trends, quarter-year parallel trends could drive a range of retail strategies that could vary between the treated group and the control group. We test for parallel trends by quarter-year (Table B2) and find that the interaction of pre-treatment month-year and Denmark (vs. control group) is not significant. Overall, the parallel trends analysis seems to confirm that the treated and control groups are comparable.

----------Insert Tables 6-8 and Figure 2 about here----------

6.2 Placebo effects

To further substantiate the validity and reliability of the reported results, it is imperative to limit the potential for spurious influences on the tested model. Thus, multiple placebo tests were conducted to ensure that the predicted treatment effect was not present in samples that should not be influenced by the treatment (Athey & Imbens, 2017).

We started by randomly assigning the treatment category to countries other than Denmark. If the non-affected category perceives the placebo effect and changes behavior, then the category level trends would be violated, leading to biased estimates. In Table 7, the interaction effects were not significant, implying that the customers in countries other than Denmark were not affected. We also randomly assigned the treatment category to the three countries that represent the majority of sales— Sweden, Norway, and Finland. When assigning each of these countries individually as the treated group, the interactions were again not significant.

6.3 Event study estimates

The event study 'lines up' treatment at the same time for the treated and control groups. Using fixed effects soaks the time-invariant confounders and provides a test for identifying the assumption that the trending is close to zero before the treatment.

The estimation incorporates a second set of time dummies based on six month-years before and six month-years after the treatment start on 1 November 2017 as follows:

$$Outcome_{oim} = c + \theta t + \lambda_{priort} Denmark_i \times \sum_{priort=-6}^{-1} t_{priort} + \partial_{priort} Denmark_i \times \sum_{postt=1}^{6} t_{postt} + C_i + Controls_{oim} + Q_t + W_t + D_t + MY_t + Z_i + e_{oim}$$

Where the estimates for λ_{priort} are expected to be non-significant and, if no future changes are expected to confound the free returns policy, then ∂_{priort} is expected to be non-significant. Estimates in Table 8 and Figure 2(a) show that the estimates before the treatment are not significant, which indicates no effects of pre-treatment events. Estimates past the treatment (1 to 6 months) are also non-significant, suggesting no significant effects from post-treatment changes.

We conducted an event study with a similar specification but using a week-year basis. The results are shown in Figure 2(b) and we find similar trends as in Figure 2(a). In both figures, the trends are tighter around zero (before and after the treatment). Although the trends are seemingly cyclical (as expected in the retail industry on a month-year or week-year basis), the effects are amplified.

6.4 Past customer outcomes and the effect of free returns

A range of past customer behaviors was used as controls in the main analysis, including controls for customer fixed effects. The purpose was to focus on heterogeneity in customer behavior based on past purchase behaviors that would influence the current order. Although the analysis provided consistent estimates for customer fixed effects, past behaviors may lead to different responses to the treatment in future order outcomes.

----------Insert Table 9 and Figure 3 about here----------

Table 9 presents the log of total spending up to the current order, the count of returned products up to the current order, and the count of past exchanges up to the current order to predict the log of the billed amount, product variety, and the order of returned items. Due to the large sample size, significant effects were expected. However, when plotting the effects in Figure 3, there is a substantial overlap in the confidence intervals indicating no meaningful effect on the interaction and, therefore, limited effects of heterogeneity.

6.5 Alternative control groups

In the proposed DiD specification, we included all non-Danish customers in the control group. Though country-level differences between Danish and, for example, French customers are of interest, testing for pairwise treatment with one country in the control group at a time potentially violates the DiD design by censoring customers that are excluded from the control group. Further, such a specification assumes that one treatment-control pair is more comparable than other combinations. Noting the limitation of this approach, we still test for additional control group combinations. We consider four countries as the control group in creating these combinations—Finland, France, Norway, and Sweden—since these countries have higher sales, whereas Germany and the rest of the EU represent a much smaller percentage of sales.

As a viable alternative control group, we use Scandinavia (i.e., Norway and Sweden). In Appendix C, we show matched-pair DiD estimates for Scandinavia (Table C1), parallel trends tests (Figure C1) as well as month-year (Figure C2(a)) and week-year (Figure C2(b)) event-study plots. Our inferences are generally consistent with the main inferences.

We also conduct similar parallel trends estimates for (i) Finland; (ii) France; (iii) Norway; and (iv) Sweden (Figures C3–C6). In line with our previous results, we find the effects to be consistent with the main parallel trends. This also holds for the month-year and week-year event studies plots, which are available upon request from the authors.

6.6 Month and week trends by country

The time trends at the country level (e.g., demographic factors, news cycles) could influence purchase behaviors. Though we control for month-year fixed effects in our main analysis, variations in countries over time could influence the outcomes. Therefore, we include continuous month-year × country dummies (Table D1) and continuous week-year×country dummies (Table D2). We present the margins effects derived from the regression estimates of key variables for brevity. Of interest is each row that specifies the change for the treated group. As can be seen, the effects are comparable to those reported in Table 4.

6.7 Correlations between outcomes

Although our goal is to assess the effects of the treatment of free returns on a broad range of outcomes, our outcome variables may be correlated. That is to say, the order bill amount may be associated with product variety, margin, and also returns. A higher order margin may also be correlated with the chances of return. We note that parsing endogeneity between order items, prices, basket size, basket variety, and returns is driven by a variety of unobservables in the

error term, and multi-way mutual causality limits us from providing causal estimates of these correlated outcomes.

To assess whether our estimates are robust to control for correlations between the outcomes, we use the *cmp* routine in Stata 16 (Roodman, 2020). In Table E1, we find that the arc-hyperbolic tangent correlation of the error terms is negatively related for the order bill amount and the HHI of product category concentration (-0.512), whereas it is positively related to order margin (0.742) and returned units (0.460). The HHI of product concentration in an order is negatively related to order margin (-0.319) and the likelihood of return (-0.916). Finally, a higher order margin is positively related to the odds of product return (0.461).

Using the estimates in Table E1, we present margins for the treated group before and after the treatment in Table E2. The inferences based on differences in margins are consistent with the main inferences.

7. CONCLUSIONS

We complement previous research on free product returns in online retail by providing robust causal evidence on the effects of free returns on customer purchase behavior. The introduction of free returns increased the order bill by 9.151%, product variety per order by 8.742%, gross margin per order by 9.705 %, and returns per order by 7.869%. Whether a free returns policy is beneficial in the short run depends on the costs of returns, which is difficult to estimate at the item level. However, we find that on average approximately 20% of the items per order are returned (0.19 items per order translates to a probability of approximately 20% for an item being returned for every five orders). Even without the item level cost data, we can assume that in a high labor cost country like Sweden (where the retailer's warehouse is located), the costs of handling returns and the return shipping cost exceed the improvements in gross margins, implying that costs outweighed gains for the retailer in our sample. The findings are robust to

a variety of alternative specifications, and we do not find differences in returns probabilities by product categories. In the sections that follow, we compare our inferences with those from previous studies on returns in retail, discuss the theoretical and managerial implications, and close with the limitations of our study.

7.1 Comparison of effects with other studies

Several studies have investigated the implications of product returns in retailing. In a fashion setting, Lantz and Hjort (2013) found in an experimental study that free return shipping is associated with increased order frequency, probability of return, and the average value of returned items. The authors also found that free returns decrease the average order bill and the average value of purchased items. Their findings on the effects of free returns on the level of product returns are consistent with Mukhopadhyay and Setaputra (2007) who find analytically that free returns are associated with an increased likelihood of product returns. In an empirical study, Hjort and Lantz (2016) divided customers into returners/non-returners and repeat/non-repeat customers of which a certain share of each category received free returns. The authors demonstrate the value of such a customer level analysis. Repeat customers achieve a significantly higher order contribution while returners and customers with free returns have a significantly lower contribution per order. Additionally, repeat customers and returners have a significantly higher total contribution compared to customers who can return free of cost. Thus, the authors concluded that the only real benefit of allowing customers free returns is to attract new customers because the long-term consequence of free returns is that costs outweigh the benefits. These findings contrast the conclusions of Bower and Maxham III (2012) who found that customers paying the return shipping fee significantly decrease their post-return spending while customers with free returns increase it, stressing the potential long-term benefits of offering free return shipping. In Table 10, we provide a summary of our results compared to

other empirical studies on free returns and the meta-analytic review on return policy leniency by Janakiraman et al. (2016).

----------Insert Table 10 about here----------

Our comparison focuses on directional inferences and aims for informational and not inferential purposes due to the studies' different research designs and measures. From Table 10, we derive that the increase in the order bill that we find is consistent with Bower and Maxham III (2012) and Janakiraman et al. (2016). However, it is not consistent with Lantz and Hjort (2013). No study has focused on the product variety of the order basket. Relative to Hjort and Lantz (2016) who find support for a decline in margins, we find support for an increase in gross margin (sale price of units minus cost of units). We find consistent support for an increase in product returns across all studies. Related to the net benefits of free returns, though we lack full data on the cost of returns, the increase in margins may not compensate for the costs of processing returns when considering the labor and return shipping costs. Further discussion on this can be found in section 7.3. Our study concludes that due to the high costs of free returns, we see limited short-term benefits while Hjort and Lantz (2016) inferred no long-term benefit from free returns. Among the studies to date, ours is, to the best of our knowledge, the first to provide causal evidence.

7.2 Theoretical implications

Our results show that the introduction of free returns increased the order bill by 9.151% for the treated group (i.e., Danish customers). Offering free returns may lower the purchase risk for customers since they are unable to check the desired products physically in online retail (Griffis et al., 2012). Thus, a free returns policy and ease of returns may serve as important drivers of

purchase and repurchase intentions. Further, providing free returns may be central to the long-term retention of customers as they will adjust their repurchase behavior in response to a retailer's return policy (Bower & Maxham III, 2012). Pei, Paswan, and Yan (2014) also find that a full refund return policy increases future purchase intentions. Overall, our results confirm and provide causal evidence that customers perceive free returns as a strong motivator to increase the order bill (Mukhopadhyay & Setaputra, 2007).

One of the challenges for online retailers is to manage their long tail of products, or product variety (cf. Ramdas, 2003). This includes managing a large number of unique items (the tail) in relation to the small number of high selling items. Our findings show that product variety per order increases by 8.742% and we are not aware of any other study that has investigated product variety in the context of free returns. Increasing product variety in customer orders is important to improve not only inventory costs but also to maintain competitiveness. Because a retailer's high-selling items are likely to be sold by other retailers as well, the tail offers a niche-based advantage by increasing product variety (Brynjolfsson, Hu, & Smith, 2010). Thus, free returns could be advantageous to encourage customers to try different products as they may foresee lower risks in product evaluation.

In our setting, the gross margin per order also increased (9.705%) with the implementation of free returns in Denmark. This finding relates to Moorthy and Srinivasan (1995) who emphasize the role of quality signaling in the form of money-back guarantees. As a result, monetary leniency (i.e., free returns) signals product quality, which may increase product purchases and, ultimately, overall order margin. Additionally, free returns could lower cognitive dissonance towards a purchased product (Kim & Wansink, 2012; Powers & Jack, 2013), which may translate into more and higher purchases that consequently affect a retailer's margins.

Research on the effect of lenient return policies on the number of product returns is inconclusive. On the one hand, Wood (2001) and Wang (2009) find in experimental studies that lenient return policies increase purchases but not returns. On the other hand, Petersen and Kumar (2010) concluded that lenient return policies increase both purchases and returns. In a meta-analysis of studies on return policy leniency, Janakiraman et al. (2016) found that return policy leniency increases purchase proclivity more than it does return proclivity. Our results show that returns per order increased by 7.869% with free returns and are thus consistent with Petersen and Kumar (2010) and Janakiraman et al. (2016) who also find an increase in purchases but also returns.

7.3 Managerial implications

Our results can inform online retailers in designing their return policies. With approximately $100 billion worth of returns over just the 2019 Christmas holiday period in the U.S. (Gray, 2019), returns are a bane for retailers but also a necessary competitive lever to attract customers. Return policy design should reflect how free returns affect sales, returns, and product variety. Although our results show the desired effects of an increase in order size, margin, and product variety, it is crucial for practitioners to consider the effects of free returns on the absolute number of returns as well as the general short- and long-term effects of return policies. We note that our results mainly apply to short-term effects at the order level, and additional longer-term strategic implications must be considered in interpreting the higher costs associated with free returns.

7.3.1 Back-of-the-envelope estimates of effect sizes on short-term outcomes

Our results show that the introduction of free returns increases the gross profit per order by 29.90 SEK and the returned items to 0.195 units per order. On average, if 0.195 items are

returned per order, there is a 20% chance of a return on every five orders (i.e., one out of five order will be returned). Simple back-of-the-envelope calculations indicate lower gains from free returns. The return shipping cost was 39 Danish Krona (DKK) before the treatment. The return shipping cost in SEK is 1.31*39 = 51.09 SEK (November 3, 2017, 1 DKK equaled 1.31 SEK). In tandem, the gross margin per order increased by 29.90 SEK. With one out of five orders being returned, we subtract the return shipping cost of 51.09 SEK from the overall increase in gross profit for five orders, which is 29.90 SEK*5 = 149.50 SEK. This results in a gross profit increase of 98.41 SEK for five orders or 19.68 SEK per order.

We caution that the 19.68 SEK per order is the gross profit, which does not include sales and general administrative expenses or the cost of processing returns. The data on the total cost of returns is not straightforward to compute due to a variety of direct and indirect costs in managing the reverse supply chain. Thus, the firm at the time of data collection could not provide the costs of processing returns on an item level. Even though these data are not available, we use the following logic. In Sweden, where the retailer's warehouse is located, the most recent average monthly wage for warehouse workers is 28,300 SEK[3] based on a 40 hour week. If we assume for simplicity that a month has four weeks (i.e., 160 working hours), then the hourly salary equals roughly 177 SEK. If we consider the time it takes by multiple workers to process returns (e.g., gatekeeping, collecting, sorting, and disposing), an increased gross margin of 98.41 SEK for every five orders can hardly be sufficient to compensate for the additional labor costs to handle the increased returns volume. Thus, our findings demonstrate that net profit gains may not be realized from free returns. However, offering free returns could have important strategic implications.

7.3.2 Long-term implications to consider

[3] Source: https://handelsnytt.se/2019/12/17/snittlonen-for-lagerarbetare-minskar/

As noted earlier, our data do not allow us to assess the long-term implications of the investigated return policy change. Our findings in section 7.3.1 could dissuade firms from introducing a free returns policy. Yet, notwithstanding these limited short-term gains, the long-term strategic implications must be considered. For example, the world´s largest retailer, Amazon, accepted lower profits on orders due to a lenient free shipping and free returns policy and thus, failed to break even on operating profits for two decades. However, Amazon for long shared the belief that a free returns policy does not only improve brand perception and trust in the long-term. It primarily acts as a barrier to entry for new competitors who may be unable to sustain the cost structure from a loss-making free returns policy. Consequently, we call on practitioners to not only reflect on the losses from free returns (i.e., cost of returns exceeding the gains in profits) but also to strongly consider the strategic implications of initiating or maintaining a free returns policy.

7.4 Limitations

Our study has limitations that provide scholars with avenues for future research. First, our data do not provide the cost of returns at the item level to allow us to conduct a break-even analysis. Thus, our study has concentrated on the revenue-side factors of a free returns policy and the effects on customer purchase behavior instead of focusing and optimizing returns strictly on a cost basis. Besides emphasizing the cost-side, future studies could look into the effects of offering partial return fees, which may be economically sensible, however, could also be strategically counterproductive as customers seem to be sensitive to free returns. Second, although we control for customer-level fixed effects, due to strict privacy policies in Europe, we do not have demographic or within-country location information on customers. Gender and location-based differences could provide additional explanations of purchase behaviors. Future studies could explore the role of demographic and locational factors along with the role of the

purchasing context, impulse purchases, and the time of purchase. In conclusion, we hope that our empirical analysis offers practical guidance to retail managers on whether to offer free returns.

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Table 1. Shipping and return policies

	Freight policy (home delivery)	Return policy
Sweden	Free delivery above 500 SEK Freight fee 39 SEK	Return fee 39 SEK within 30 days
Norway	Free delivery above 1000 NOK Freight fee 49 NOK	Return fee 49 NOK within 30 days
Finland	Free delivery above 70 EUR Freight fee 4.95 EUR	Return fee 3.95 EUR within 30 days
Denmark	**Free delivery above 500 DKK** **Freight fee 39 DKK**	**Before treatment: Return fee 39 DKK within 30 days** ***After treatment: Free within 30 days***
Germany	Free delivery above 100 EUR Freight fee 7.95 EUR	Return fee 5.95 EUR within 30 days
France	Free delivery above 100 EUR Freight fee 6.95 EUR	Return fee 4.95 EUR within 30 days
EU	Free delivery above 100 EUR Freight fee 6.95 EUR	Return fee 4.95 EUR within 30 days

Table 2. Summary of differences between treated and control group

	Bill amount for the order	Log of the bill amount for the order	Concentration of product category in an order	Margin on the order	Count of returned items on the order	Log of total spending up to the current order	Count of past returns up to the current order	Total average value of returned items up to the current order	Average margin of the products purchased up to the current order
Treated: Denmark									
Before treatment	600.515	6.024	0.652	307.898	2.536	1.538	1.014	5.741	5.609
	[460.362]	[1.142]	[0.233]	[265.256]	[1.297]	[2.658]	[2.830]	[17.040]	[17.425]
After treatment	666.474	6.291	0.515	337.473	2.723	1.914	1.651	0.689	0.65
	[431.420]	[0.860]	[0.211]	[254.957]	[1.282]	[3.100]	[4.604]	[6.465]	[7.260]
Difference [after - before]	65.959	0.267	-0.137	29.575	0.187	0.376	0.637	-5.052	-4.959
% Difference [after - before][2]	10.98%	4.43%	-21.01%	9.61%	7.37%	24.45%	62.82%	-88.00%	-88.41%
Control: Norway, Sweden, Finland, France, Germany, and the rest of Europe									
Before treatment	663.994	6.048	0.579	309.267	3.024	2.605	2.699	17.637	16.989
	[587.749]	[1.215]	[0.249]	[308.591]	[1.808]	[3.201]	[7.055]	[112.713]	[106.719]
After treatment	663.382	6.12	0.504	296.313	3.033	3.461	5.182	13.516	12.956
	[555.450]	[1.120]	[0.240]	[294.620]	[1.771]	[3.588]	[12.115]	[92.959]	[90.122]
Difference [after - before]	-0.612	0.072	-0.075	-12.954	0.009	0.856	2.483	-4.121	-4.033
% Difference [after - before]	-0.09%	1.19%	-12.95%	-4.19%	0.30%	32.86%	92.00%	-23.37%	-23.74%

[2] Difference [after - before] amount divided by Before treatment amount

Table 3. Difference–in-differences estimates

		Billed (SEK)					Log of billed amount (SEK)					Product variety (lower concentration of the order basket across product categories)			
			s.e.	t	p			s.e.	t	p			s.e.	t	p
Before															
	Control	647.926					6.026					0.593			
	Treated	608.755					6.06					0.652			
	Diff (T-C)	-39.171	3.731	-10.5	0.000***		0.034	0.009	3.8	0.000***		0.059	0.002	31.29	0.000***
After															
	Control	579.395					5.948					0.57			
	Treated	624.69					6.209					0.564			
	Diff (T-C)	45.296	2.362	19.17	0.000***		0.261	0.005	53.44	0.000***		-0.007	0.001	5.93	0.000***
Diff-in-Diff		84.467	4.304	19.62	0.000***		0.227	0.01	22.61	0.000***		-0.065	0.002	30.58	0.000***
%Diff-in-Diff		13.875%					3.745%					-9.969%			
	R-square:		0.04					0.05					0.08		

		Order Margin					Order return item count			
			s.e.	t	p			s.e.	t	p
Before	Control	255.63					3.099			
	Treated	262.687					2.704			
	Diff (T-C)	7.057	2.173	3.25	0.001***		-0.395	0.011	-35.33	0.000***
After	Control	243.923					2.753			
	Treated	298.777					2.639			
	Diff (T-C)	54.854	1.371	40.02	0.000***		-0.114	0.007	15.83	0.000***
Diff-in-Diff		47.797	2.505	19.08	0.000***		0.281	0.013	21.81	0.000***
%Diff-in-Diff		18.264%					10.392%			
	R-square:		0.03					0.05		

Notes. *** $p < 0.01$ (two-tailed)
%Diff-in-Diff = Diff-in-Diff divided by value before treatment of the treated group. For example, for Billed (SEK) the value of 13.875% is derived from 84.467 divided by 608.755 (mean value of the order before treatment for Denmark)

Table 4. Kernel-based propensity score matching difference-in-differences

		Billed (SEK)				Log of billed amount (SEK)				The concentration of the order basket across product categories			
			s.e.	t	p		s.e.	t	p		s.e.	t	p
Before													
	Control	648.716				6.02				0.586			
	Treated	600.434				6.023				0.652			
		-48.282	1.657	-29.14	0.000***	0.004	0.004	1.07	0.283	0.065	0.001	85.85	0.000***
After													
	Control	695.292				6.153				0.491			
	Treated	701.958				6.303				0.499			
	Diff (T-C)	6.666	2.788	2.39	0.017**	0.15	0.006	24.34	0.000***	0.008	0.001	6.07	0.000***
Diff-in-Diff		54.948	3.243	16.94	0.000***	0.147	0.007	20.39	0.000***	-0.057	0.001	38.63	0.000***
%Diff-in-Diff		9.151%				2.441%				-8.742%			
	R-square:		0.01				0.01				0.06		

		Order Margin				Order return item count			
			s.e.	t	p		s.e.	t	p
Before	Control	302.905				2.973			
	Treated	308.115				2.536			
		5.209	0.908	5.74	0.000***	-0.437	0.005	-86.1	0.000***
After	Control	306.003				3.231			
	Treated	341.115				2.99			
	Diff (T-C)	35.112	1.527	22.99	0.000***	-0.241	0.009	28.26	0.000***
Diff-in-Diff		29.903	1.777	16.83	0.000***	0.195	0.01	19.7	0.000***
%Diff-in-Diff		9.705%				7.689%			
	R-square:		0.00				0.01		

Notes. *** $p < 0.01$ (two-tailed)

%Diff-in-Diff = Diff-in-Diff divided by value before treatment for the treated group. For example, for Billed (SEK) the value of 9.151% is derived from 54.948 divided by 600.434 (mean value of the order before treatment for Denmark)

Table 5: Returns by categories

Change in returns for Denmark	Margin [Difference: After – Before]	Odds ratio of returns	z
Swimwear	0.1041	1.1098	4.7897
Misc. clothing	0.0995	1.1046	4.5345
Bottoms	0.1118	1.1183	5.5568
Winter accessories	0.1243	1.1324	3.7637
Caps and scarves	0.1134	1.1201	5.5682
Dresses	0.1106	1.1169	5.2498
Watches	0.1006	1.1058	2.9655
Skateboards	0.1012	1.1065	4.6129
Shirts	0.1140	1.1208	5.2401
Shoes	0.1134	1.1201	5.6125
Sunglasses	0.1165	1.1236	5.2220
Hoodies and sweatshirts	0.1154	1.1224	5.7270
T-shirts	0.1141	1.1209	5.6791
Underwear and socks	0.1150	1.1219	5.6434
Backpacks and bags	0.1104	1.1167	5.2660

Note.
The full estimates are available in Table F.2

Table 6. Parallel trends estimates – fixed-effects estimates

	Billed	Log of the billed amount	Product Variety (lower category concentration)	Order margin	Order returned items
	(1)	(2)	(3)	(4)	(5)
Continuous pre-treatment month-year	-267,545	835.2	124.5	-652,882	-591.5
	(799,024)	(2,083)	(393.1)	(447,899)	(2,419)
Denmark	-16.28	-0.00360	-0.00192	-9.263	-0.0199
	(29.42)	(0.0635)	(0.0121)	(15.04)	(0.0811)
Continuous pre-treatment month-year × Denmark	796.7	-2.362	-0.366	1,906	1.756
	(2,321)	(6.049)	(1.142)	(1,301)	(7.023)
Continuous pre-treatment month-year square × Denmark	-0.593	0.00167	0.000270	-1.391	-0.00130
	(1.685)	(0.00439)	(0.000829)	(0.945)	(0.00510)
Constant	12,026	9.249	1.779	6,695	17.38
	(20,123)	(43.44)	(8.256)	(10,286)	(55.44)
Observations	376,950	375,884	376,950	376,950	376,950
R-squared	0.623	0.574	0.657	0.645	0.644

Notes.
The controls included in the model are the log of spending up to the current order, the total count of past returns, the total value of past returns, the average margin on returns up to the current order, the average gap between the MSRP and price paid, and a quarter, week of the year, day of the week, and month-year fixed effects.
Robust standard errors in parentheses.
*** p<0.01, ** p<0.05, * p<0.1

Table 7. Placebo estimates – fixed effects

	Billed				Log of the billed amount				Product variety (lower category concentration)				Order margin			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
Treated	477.8	516.2	458.1	587.6	3.964*	4.158*	4.132	4.776*	0.790***	0.806***	0.737**	1.037***	132.5	173.4	151.8	332.5
	(506.9)	(502.5)	(618.2)	(556.2)	(2.356)	(2.348)	(2.892)	(2.600)	(0.237)	(0.229)	(0.287)	(0.256)	(267.3)	(262.5)	(323.9)	(290.3)
Random treatment to the non-Denmark country	106.7				0.542				-0.0110				67.07			
	(161.0)				(0.748)				(0.0752)				(84.87)			
Treated × Random treatment to the non-Denmark country	-142.3				-1.685				0.0972				-82.15			
	(238.7)				(1.109)				(0.111)				(125.9)			
Treated × Placebo treatment to Finland		34.37				2.466				0.947***				413.7		
		(688.5)				(3.215)				(0.314)				(359.6)		
Treated × Placebo treatment to Norway			94.28				-0.0124				0.0912				26.41	
			(589.0)				(2.754)				(0.274)				(308.6)	
Treated × Placebo treatment to Sweden				-180.7				-1.639				-0.613**				-414.2
				(601.1)				(2.809)				(0.276)				(313.8)
Constant	-2,193**	-2,127**	-2,155**	-2,166**	-18.37***	-18.55***	-19.11***	-19.39***	-1.181***	-1.050***	-1.284***	-1.369***	-1,497***	-1,322***	-1,421***	-1,487***
	(860.5)	(853.5)	(848.4)	(845.3)	(3.999)	(3.989)	(3.970)	(3.953)	(0.402)	(0.389)	(0.394)	(0.389)	(453.7)	(445.8)	(444.5)	(441.2)
Observations	969,263	1,033,916	1,033,916	1,033,916	966,431	1,030,916	1,030,916	1,030,916	969,263	1,033,916	1,033,916	1,033,916	969,263	1,033,916	1,033,916	1,033,916
R-squared	0.401	0.393	0.393	0.393	0.563	0.562	0.560	0.561	0.835	0.841	0.835	0.838	0.399	0.398	0.395	0.399
Number of custid_ordernum	968,971	1,033,616	1,033,616	1,033,616	966,141	1,030,618	1,030,618	1,030,618	968,971	1,033,616	1,033,616	1,033,616	968,971	1,033,616	1,033,616	1,033,616

	Order return count			
	(17)	(18)	(19)	(20)
Treated	-2.640	-2.690	-1.964	-4.168*
	(2.041)	(1.997)	(2.468)	(2.209)
Random treatment to the non-Denmark country	-0.0659			
	(0.648)			
Treated × Random treatment to non-Denmark country	0.588			
	(0.961)			
Treated × Placebo treatment to Finland		-4.123		
		(2.736)		
Treated × Placebo treatment to Norway			-1.098	
			(2.352)	
Treated × Placebo treatment to Sweden				3.856
				(2.388)
Constant	13.57***	12.74***	13.90***	14.33***
	(3.464)	(3.392)	(3.388)	(3.357)
Observations	969,263	1,033,916	1,033,916	1,033,916
R-squared	0.703	0.707	0.704	0.708
Number of custid_ordernum	968,971	1,033,616	1,033,616	1,033,616

Notes.
Standard errors in parentheses.
*** p<0.01, ** p<0.05, * p<0.1

Table 8. Event study estimates

	Billed (SEK)		Log of billed amount (SEK)		The concentration of the order basket across product categories		Order margin		Order return item count	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Treatment (= Denmark)	146.0*	171.4**	1.378***	1.460***	0.0943**	0.0892**	56.95	69.24	-0.384	-0.327
	(85.19)	(85.54)	(0.370)	(0.369)	(0.0437)	(0.0438)	(48.61)	(49.09)	(0.352)	(0.351)
After	-26.27	-22.58	-0.0123	0.0296	0.0107	-0.0121*	7.948	-13.72	-0.227***	0.0810
	(22.79)	(17.68)	(0.0452)	(0.0331)	(0.00919)	(0.00671)	(11.64)	(9.092)	(0.0649)	(0.0499)
Treatment × After	51.40***	90.00***	0.0968***	0.266***	-0.0244***	-0.0553***	27.66***	54.50***	0.0552	0.174*
	(12.50)	(31.77)	(0.0278)	(0.0777)	(0.00608)	(0.0157)	(7.248)	(18.82)	(0.0386)	(0.0957)
6 months before treatment		-26.04		-0.0994**		0.0179**		4.198		-0.211***
		(21.16)		(0.0448)		(0.00907)		(10.47)		(0.0677)
5 months before treatment		8.226		0.0510		0.00135		12.05		-0.0564
		(14.82)		(0.0331)		(0.00653)		(7.665)		(0.0509)
4 months before treatment		-52.20		-0.156*		0.0943***		27.78		-0.679***
		(39.52)		(0.0806)		(0.0163)		(20.49)		(0.126)
3 months before treatment		4.271		0.0803**		0.00120		15.49*		-0.0230
		(15.71)		(0.0375)		(0.00681)		(7.964)		(0.0524)
2 months before treatment		-44.65**		-0.0659*		-0.00171		-24.72***		-0.0311
		(17.67)		(0.0361)		(0.00720)		(9.244)		(0.0506)
1 month before treatment		-155.8***		-0.794***		0.0349		-167.1***		0.155
		(58.06)		(0.121)		(0.0242)		(29.76)		(0.182)
6 months after treatment		-9.251		-0.00394		-0.00123		28.06**		-0.138*
		(24.96)		(0.0535)		(0.0109)		(12.53)		(0.0828)
5 months after treatment		-236.0***		-0.888***		0.128***		-154.6***		-0.516***
		(35.50)		(0.0778)		(0.0154)		(17.93)		(0.115)
4 months after treatment		21.94		0.0566		-0.00129		14.71*		-0.0726
		(16.98)		(0.0371)		(0.00725)		(8.812)		(0.0532)
3 months after treatment		61.41***		0.104***		-0.0119*		43.38***		0.0245
		(15.38)		(0.0350)		(0.00689)		(7.739)		(0.0491)
2 months after treatment		-1.516		-0.0252		-0.0153***		-2.591		0.116***
		(10.30)		(0.0234)		(0.00463)		(5.193)		(0.0329)
1 month after treatment		-4.156		-0.0449		0.0228***		21.01***		-0.307***
		(14.88)		(0.0318)		(0.00649)		(7.518)		(0.0435)
Treatment (Denmark) × 6 months before treatment		1.363		-0.0495		0.0105		1.112		-0.0296
		(29.00)		(0.0665)		(0.0130)		(16.27)		(0.0835)
Treatment (Denmark) × 5 months before treatment		-81.85**		-0.190**		0.00940		-35.07*		-0.177*
		(36.67)		(0.0831)		(0.0161)		(20.33)		(0.104)
Treatment (Denmark) × 4 months before treatment		62.87*		0.137		-0.0209		28.40		0.113

		(35.15)		(0.0894)		(0.0174)		(20.07)		(0.107)
Treatment (Denmark) × 3 months before treatment		-7.536		0.0547		0.00534		-0.0243		-0.0236
		(34.84)		(0.0937)		(0.0186)		(19.85)		(0.106)
Treatment (Denmark) × 2 months before treatment		-33.29		-0.0607		-0.0170		-21.54		0.0650
		(32.81)		(0.0872)		(0.0177)		(19.20)		(0.0951)
Treatment (Denmark) × 1 month before treatment		6.987		-0.0433		0.0111		0.0585		0.0783
		(35.40)		(0.0860)		(0.0171)		(21.38)		(0.0959)
Treatment (Denmark) × 6 months after treatment		-34.37		-0.0968**		0.0258**		-43.13***		-0.0682
		(22.37)		(0.0485)		(0.0109)		(12.72)		(0.0694)
Treatment (Denmark) × 5 months after treatment		-14.88		-0.0413		-0.0167		12.85		0.00139
		(32.49)		(0.0696)		(0.0161)		(18.96)		(0.101)
Treatment (Denmark) × 4 months after treatment		39.74		0.109		-0.00862		50.36**		-0.191
		(38.13)		(0.0863)		(0.0190)		(23.64)		(0.132)
Treatment (Denmark) × 3 months after treatment		-22.78		-0.00801		0.0207		-22.35		0.208*
		(36.21)		(0.0982)		(0.0186)		(22.40)		(0.126)
Treatment (Denmark) × 2 months after treatment		23.36		-0.0413		-0.00663		-13.01		-0.0514
		(27.57)		(0.0836)		(0.0144)		(16.24)		(0.0846)
Treatment (Denmark) × 1 month after treatment		-17.76		-0.0667		0.0318***		-4.771		-0.167**
		(24.55)		(0.0609)		(0.0121)		(14.59)		(0.0746)
Controls	Included	Included	Included	Included	Included	Included	Included	Included	Included	Included
Quarter	Included	Included	Included	Included	Included	Included	Included	Included	Included	Included
Week of the year	Included	Included	Included	Included	Included	Included	Included	Included	Included	Included
Remaining Month-year	Included	Included	Included	Included	Included	Included	Included	Included	Included	Included
Constant	791.3***	791.0***	6.574***	6.573***	0.481***	0.482***	324.1***	323.9***	3.592***	3.592***
	(11.48)	(11.47)	(0.0333)	(0.0333)	(0.00526)	(0.00525)	(5.832)	(5.837)	(0.0389)	(0.0389)
Observations	1,035,374	1,035,374	1,032,378	1,032,378	1,035,374	1,035,374	1,035,374	1,035,374	1,035,374	1,035,374
R-squared	0.578	0.578	0.523	0.523	0.604	0.604	0.596	0.596	0.591	0.591

Notes.
Robust standard errors in parentheses.
*** p<0.01, ** p<0.05, * p<0.1

Table 9. Fixed-effects estimates for past customer activity

	Log of the billed amount			Product variety (category concentration)			Order returned items		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Treatment = Denmark	1.205***	1.321***	1.321***	0.118***	0.0746*	0.0746*	-0.461	-0.237	-0.237
	(0.373)	(0.371)	(0.371)	(0.0432)	(0.0420)	(0.0420)	(0.355)	(0.324)	(0.324)
After	0.0226	0.0395	0.0395	0.0294***	0.0238**	0.0238**	-0.218***	-0.318***	-0.318***
	(0.0461)	(0.0465)	(0.0465)	(0.00930)	(0.00931)	(0.00931)	(0.0656)	(0.0662)	(0.0662)
Treatment × After	0.775***	0.186***	0.186***	-0.141***	-0.0612***	-0.0612***	0.605***	0.326***	0.326***
	(0.0406)	(0.0361)	(0.0361)	(0.00771)	(0.00713)	(0.00713)	(0.0469)	(0.0444)	(0.0444)
Log of total spent up to current order	0.142***	0.132***	0.132***	-0.0302***	-0.0322***	-0.0322***	0.151***	0.151***	0.151***
	(0.00178)	(0.00141)	(0.00141)	(0.000320)	(0.000236)	(0.000236)	(0.00203)	(0.00156)	(0.00156)
Treatment × log of the total spent up to the current order	0.0117**			0.00146			-0.0238***		
	(0.00539)			(0.00103)			(0.00611)		
After × log of the total spent up to the current order	-0.00808***			-0.00350***			-0.00296		
	(0.00167)			(0.000304)			(0.00227)		
Treatment × After × log of the total spent up to the current order	-0.108***			0.0158***			-0.0655***		
	(0.00612)			(0.00119)			(0.00723)		
Treatment × Count of returned products up to the current order		0.0236***			0.00880***			-0.0652***	
		(0.00740)			(0.00120)			(0.00943)	
After × Count of returned products up to the current order		-0.00690***			-0.00161***			0.0113***	
		(0.00167)			(0.000231)			(0.00203)	
Treatment × After × Count of returned products up to the current order		-0.0306***			-0.00275**			0.0203**	
		(0.00623)			(0.00111)			(0.00846)	
Treatment × Count of past exchanges to the current order			0.0236***			0.00880***			-0.0652***
			(0.00740)			(0.00120)			(0.00943)
After × Count of past exchanges to the current order			-0.00690***			-0.00161***			0.0113***
			(0.00167)			(0.000231)			(0.00203)
Treatment × After × Count of past exchanges to the current order			-0.0306***			-0.00275**			0.0203**
			(0.00623)			(0.00111)			(0.00846)
Count of past exchanges to the current order			0.0277***			0.000557**			-0.0137***
			(0.00178)			(0.000267)			(0.00257)
Remaining controls	Included	Included	Included	Included	Included	Included	Included	Included	Included
Quarter	Included	Included	Included	Included	Included	Included	Included	Included	Included
Week of the year	Included	Included	Included	Included	Included	Included	Included	Included	Included

Day of the week	Included	Included	Included	Included	Included	Included	Included	Included	Included
Month-year	Included	Included	Included	Included	Included	Included	Included	Included	Included
Constant	6.555***	6.575***	6.575***	0.479***	0.484***	0.484***	3.578***	3.574***	3.574***
	(0.0332)	(0.0333)	(0.0333)	(0.00518)	(0.00519)	(0.00519)	(0.0388)	(0.0378)	(0.0378)
Observations	1,032,378	1,032,378	1,032,378	1,035,374	1,035,374	1,035,374	1,035,374	1,035,374	1,035,374
R-squared	0.524	0.523	0.523	0.605	0.605	0.605	0.592	0.592	0.592

Notes.
Robust standard errors in parentheses.
*** p<0.01, ** p<0.05, * p<0.1

Table 10. Comparison of findings from the current study with representative studies

	Order bill	Product variety	Order margin	Returned items	Net benefit	Causal evidence
Lantz and Hjort (2013)	–	n/a	n/a	+	n/a	No
Hjort and Lantz (2016)			– [1]		No long-term benefit	No [1]
Bower and Maxham III (2012)	+ [2]				n/a	No
Janakiraman et al. (2016) [3]	+			+	n/a	n/a
Current study	+	+	+	+	No short-term benefit	Yes

Notes.

[1] The authors focus on profitability from returning and non-returning customers, and they infer that "returners and customers who enjoy free returns generate a significantly lower contribution per order" (page 4980), and that "return policies that are free of charge do not necessarily benefit retailers in terms of long-term profitability".

[2] "customers who paid for their own return decreased their post-return spending at that retailer 75%–100% by the end of two years. In contrast, returns that were free to the consumer resulted in post-return customer spending that was 158%–457% of pre-return spending." (page 110).

[3] Return leniency in retail (not necessarily online), a meta-analysis of 21 studies; results based on "meta-analysis of 21 papers examining the effect of leniency on purchase and return decisions, and demonstrate that overall, leniency increases purchase more than return." (page 226).

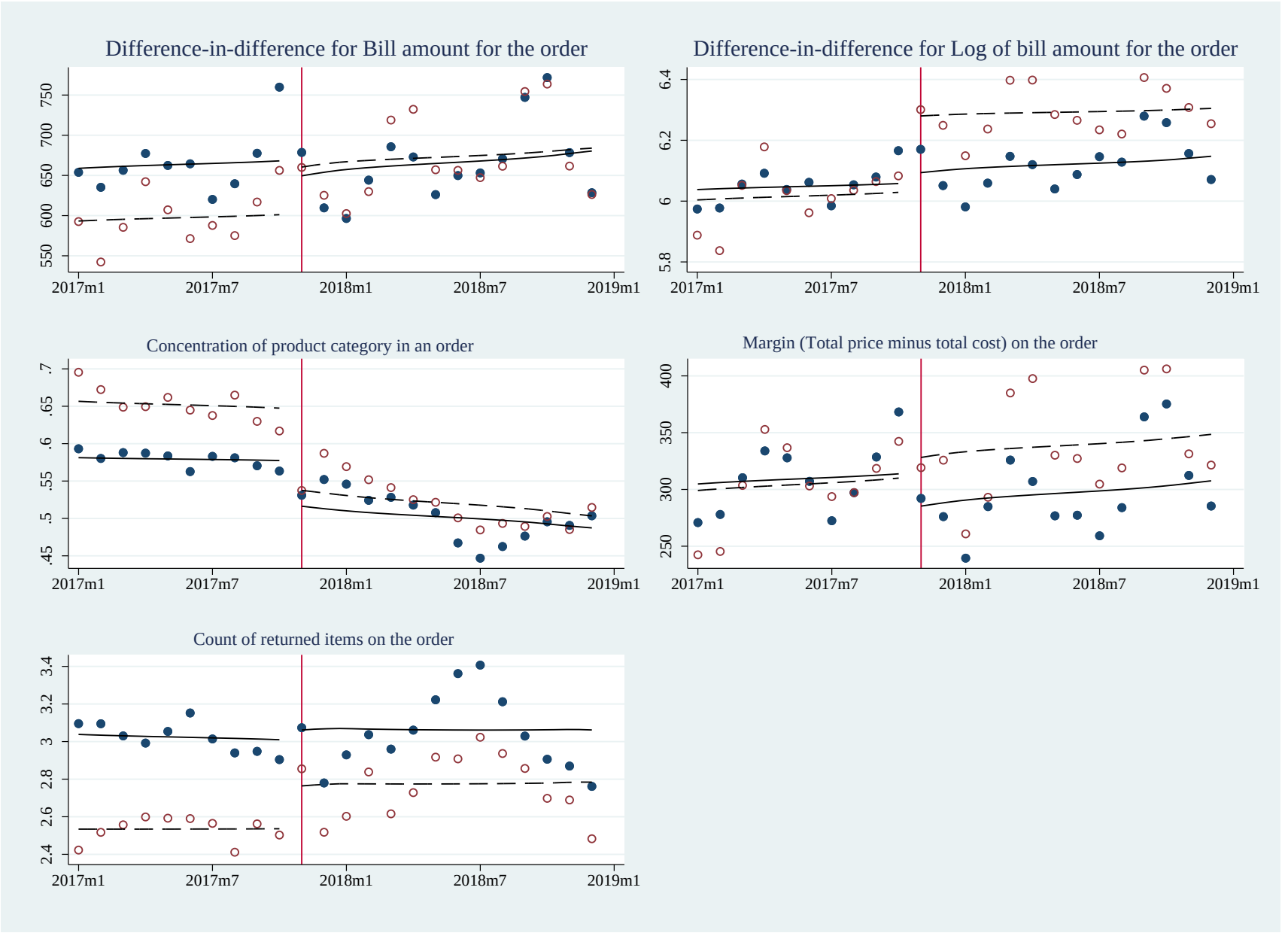


Figure 1. Difference-in-differences plots

Figure 2. Event study plots
Figure 2(a): Event study plot by month-year

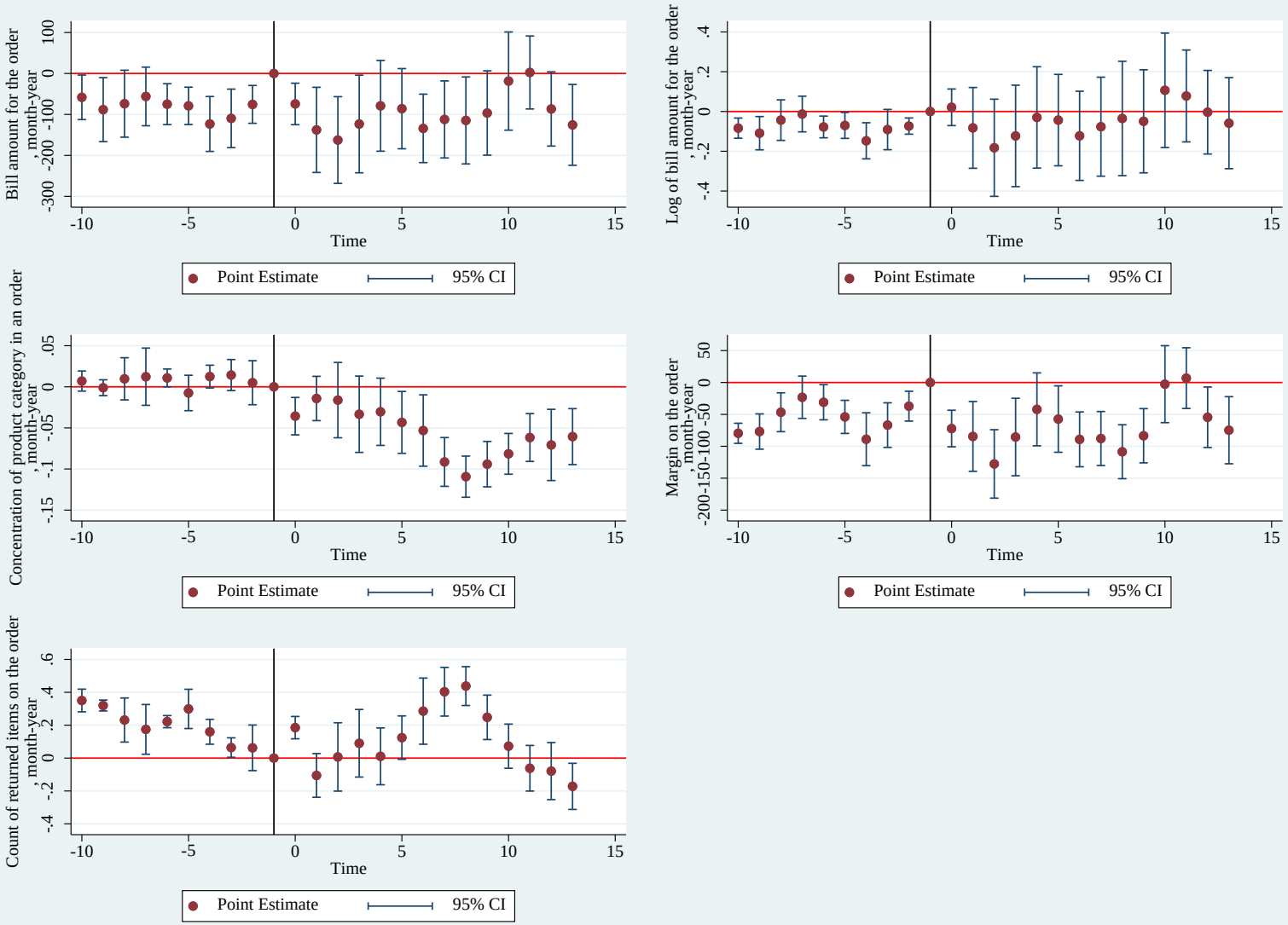
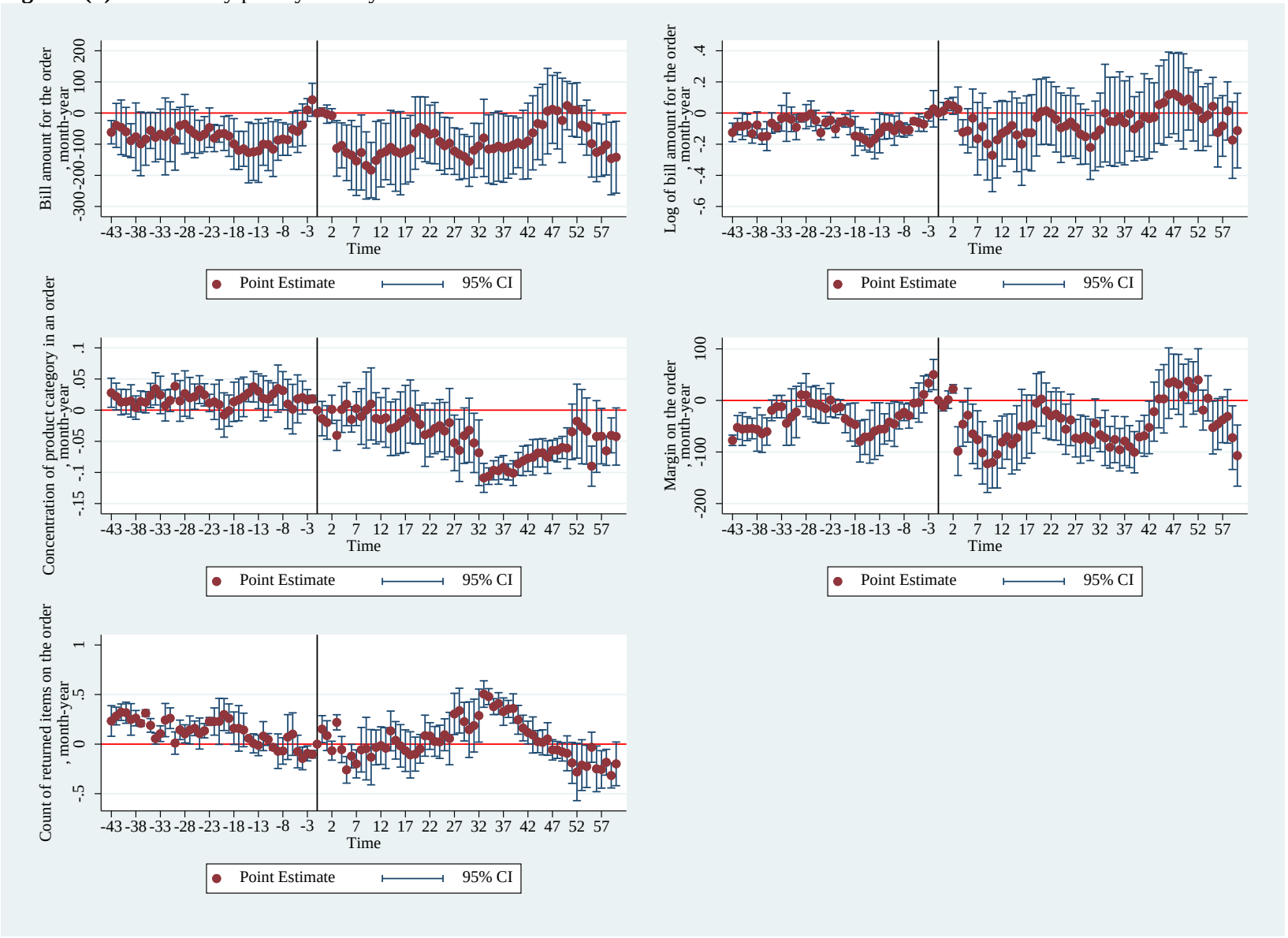


Figure 2(b): Event study plot by week-year



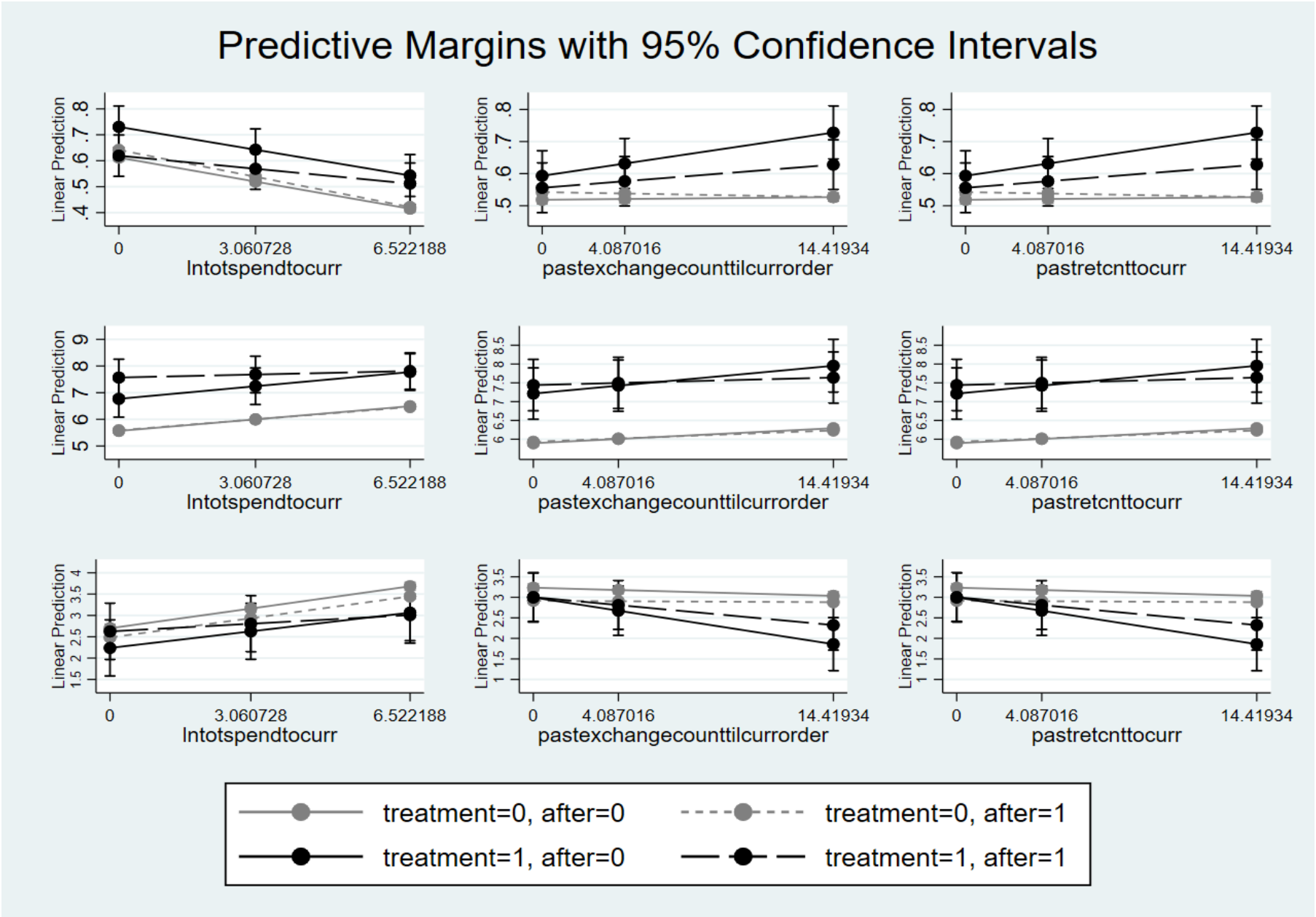


Figure 3. Interaction plots for customer behavior up to the current order

Table A1. Category descriptive statistics

			Sales price (SEK)		Purchase price (SEK)		
Product Category	Sales (%)	Returns (%)	Mean	Std	Mean	Std	Gross Margin (%)
T-shirts	14.14	9.56	190.06	85.39	102.65	42.72	85.15
Hoodies	10.76	7.80	453.72	169.46	233.29	78.38	94.49
Sneakers	9.40	12.10	653.68	248.89	379.61	114.97	72.20
Snapback caps	5.38	3.00	164.24	88.54	98.85	52.88	66.15
Crews and sweatshirts	4.98	5.02	374.65	172.53	203.57	85.61	84.04
Longsleeves	4.74	3.50	224.21	111.70	114.61	55.95	95.63
Track and Sweatpants	4.30	6.91	405.82	151.92	218.57	69.96	85.67
Socks	3.13	0.57	92.82	42.60	46.91	24.19	97.87
Jackets	2.87	4.40	586.40	374.12	362.40	222.42	61.81
Jeans (slim)	2.16	3.73	330.05	186.96	183.61	124.23	79.76
Other categories	38.14	43.41	173.61	325.49	93.45	182.01	85.78
Total	100	100	343.50	275.59	192.57	155.90	78.38

Appendix B
Additional Pre-trends

Table B1. Parallel trends estimates – fixed-effects estimates for week of the year

	Billed	Log of the billed amount	Product variety (lower category concentration)	Order margin	Order returned items
	(1)	(2)	(3)	(4)	(5)
Denmark	-393,718	775.9	191.3	-778,553*	-1,743
	(787,780)	(2,094)	(395.3)	(434,443)	(2,408)
Continuous pre-treatment year-week	-754.1*	-1.445*	0.156	-95.47	0.0915
	(398.3)	(0.844)	(0.160)	(204.8)	(1.176)
Continuous pre-treatment year-week × Denmark	268.5	-0.504	-0.129	524.0*	1.177
	(527.7)	(1.403)	(0.265)	(291.1)	(1.613)
Continuous pre-treatment year-week square	0.124*	0.000233*	-2.51e-05	0.0149	-2.02e-05
	(0.0667)	(0.000141)	(2.67e-05)	(0.0343)	(0.000197)
Continuous pre-treatment year-week square × Denmark	-0.0458	8.20e-05	2.19e-05	-0.0881*	-0.000199
	(0.0884)	(0.000235)	(4.44e-05)	(0.0488)	(0.000270)
Constant	1.146e+06*	2,239*	-242.6	152,352	-89.99
	(594,537)	(1,259)	(238.3)	(305,716)	(1,756)
Observations	376,950	375,884	376,950	376,950	376,950
R-squared	0.622	0.574	0.657	0.644	0.644

Notes.
Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1
The controls included in the model are the log of spending up to the current order, the total count of past returns, the total value of past returns, the average margin on returns up to the current order, the average gap between the MSRP and price paid, quarter, day of the week, and month-year fixed effects.

Table B2. Parallel trends estimates – fixed-effects estimates of quarter-year

	Billed	Log of the billed amount	Product variety (lower category concentration)	Order margin	Order returned items
	(1)	(2)	(3)	(4)	(5)
Continuous pre-treatment quarter-year	-478,191	-1,062	284.0	-516,559	-389.3
	(667,148)	(1,715)	(333.2)	(389,717)	(1,965)
Denmark	-22.11	0.0372	0.0347*	25.99	-0.367**
	(47.21)	(0.103)	(0.0195)	(24.35)	(0.144)
Continuous pre-treatment quarter-year × Denmark	4,207	9.395	-2.488	4,525	3.482
	(5,819)	(14.96)	(2.905)	(3,400)	(17.13)
Continuous pre-treatment quarter-year square × Denmark	-9.252	-0.0208	0.00545	-9.909	-0.00779
	(12.69)	(0.0326)	(0.00633)	(7.414)	(0.0373)
Constant	5,935	-1.683	-7.443*	-5,567	87.37***
	(10,763)	(23.50)	(4.454)	(5,550)	(32.88)
Observations	376,950	375,884	376,950	376,950	376,950
R-squared	0.623	0.574	0.657	0.645	0.644

Notes.
The controls included in the model are the log of spending up to the current order, the total count of past returns, the total value of past returns, the average margin on returns up to the current order, the average gap between the MSRP and price paid, week of the year, day of the week, and month-year fixed effects.
Robust standard errors in parentheses.
*** p<0.01, ** p<0.05, * p<0.1

	Billed	Log of the billed amount	Product variety (lower category concentration)	Order margin	Order returned items
	(1)	(2)	(3)	(4)	(5)
Continuous pre-treatment month-year	-267,545	835.2	124.5	-652,882	-591.5
	(799,024)	(2,083)	(393.1)	(447,899)	(2,419)
Denmark	-16.28	-0.00360	-0.00192	-9.263	-0.0199
	(29.42)	(0.0635)	(0.0121)	(15.04)	(0.0811)
Continuous pre-treatment month-year × Denmark	796.7	-2.362	-0.366	1,906	1.756
	(2,321)	(6.049)	(1.142)	(1,301)	(7.023)
Continuous pre-treatment month-year square × Denmark	-0.593	0.00167	0.000270	-1.391	-0.00130
	(1.685)	(0.00439)	(0.000829)	(0.945)	(0.00510)
Constant	12,026	9.249	1.779	6,695	17.38
	(20,123)	(43.44)	(8.256)	(10,286)	(55.44)
Observations	376,950	375,884	376,950	376,950	376,950
R-squared	0.623	0.574	0.657	0.645	0.644

Notes.
The controls included in the model are the log of spending up to the current order, the total count of past returns, the total value of past returns, the average margin on returns up to the current order, the average gap between the MSRP and price paid, and quarter, week of the year, day of the week, and month-year fixed effects.
Robust standard errors in parentheses.
*** p<0.01, ** p<0.05, * p<0.1

Appendix C
Alternative control groups

Table C1. Kernel-based propensity score matching difference-in-differences (Scandinavia as a control group)

The treatment start month is November 2017. The treated group (Danish customers) includes 16,638 orders in the pre-treatment period and 48,096 orders in the post-treatment period, totaling 64,734 orders. The control group (Norway, Sweden, Finland, France, Germany, and the rest of Europe) includes 360,312 orders in the pre-treatment period and 610,328 orders in the post-treatment period, totaling 970,640 orders. The full sample includes 1,035,374 orders from 1 January 2017 through 31 December 2018. The matching covariates include the log of spending up to the current order, the total count of past returns, the total value of past returns, the average margin on returns up to the current order, the average gap between the MSRP and price paid, and month-year fixed effects.

		Billed (kronas)				Log of billed amount (kronas)				Concentration of the order basket across product categories			
			s.e.	t	p		s.e.	t	p		s.e.	t	p
Before													
	Control	645.244				6.013				0.582			
	Treated	600.322				6.023				0.652			
		-44.922	1.832	-24.52	0.000***	0.01	0.004	2.51	0.012**	0.07	0.001	82.67	0.000***
After													
	Control	675.607				6.11				0.494			
	Treated	701.958				6.303				0.499			
	Diff (T-C)	26.351	3.086	8.54	0.000***	0.193	0.007	28.04	0.000***	0.005	0.001	3.29	0.001***
Diff-in-Diff		71.273	3.589	19.86	0.000***	0.183	0.008	22.84	0.000***	-0.065	0.002	39.37	0.000***
%Diff-in-Diff		11.872%				3.038%				-9.969%			
R-square:			0				0.01				0.06		

		Order Margin				Order return item count			
		Order Margin	s.e.	t	p		s.e.	t	p
Before	Control	305.803				2.996			
	Treated	307.958				2.536			
		2.154	1.005	2.14	0.032**	-0.459	0.006	-81.49	0.000***
After	Control	300.586				3.222			
	Treated	341.115				2.99			
	Diff (T-C)	40.529	1.693	23.94	0.000***	-0.232	0.009	24.43	0.000***
Diff-in-Diff		38.375	1.969	19.49	0.000***	0.227	0.011	20.61	0.000***
%Diff-in-Diff		12.461%				8.951%			
R-square:			0				0.03		

Notes.

*** $p < 0.01$ (two-tailed)

%Diff-in-Diff = Diff-in-Diff divided by value before treatment for treated group. For example, for Billed (SEK) the value of 11.872% is derived from 71.273 divided by 600.322 (mean value of order before treatment for Denmark)

Figure C1. Difference-in-differences plot Scandinavia (Sweden and Norway) as control group.



Figure C2(a). Event-study plot by month-year

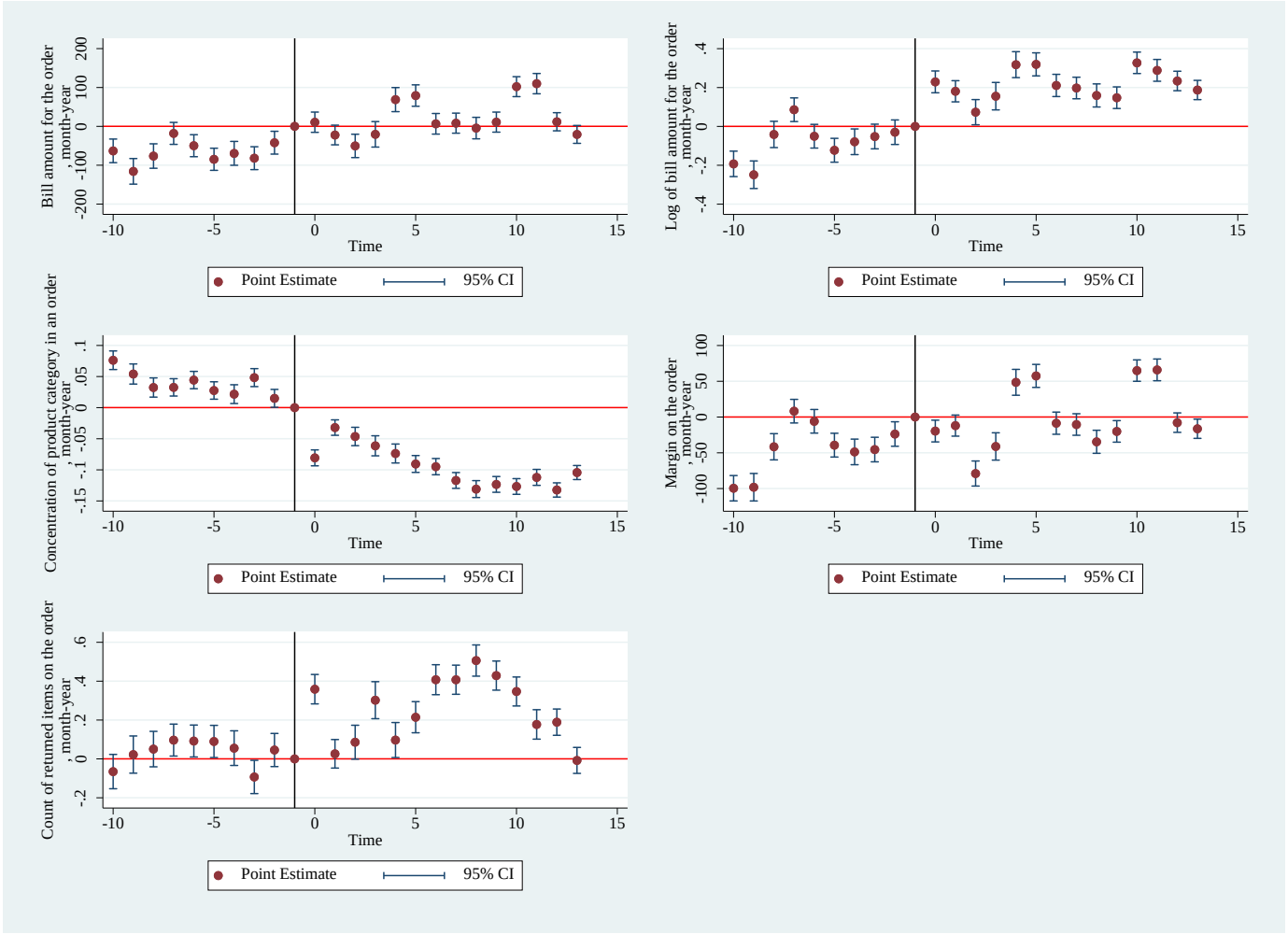


Figure C2(b). Event-study plot by week-year

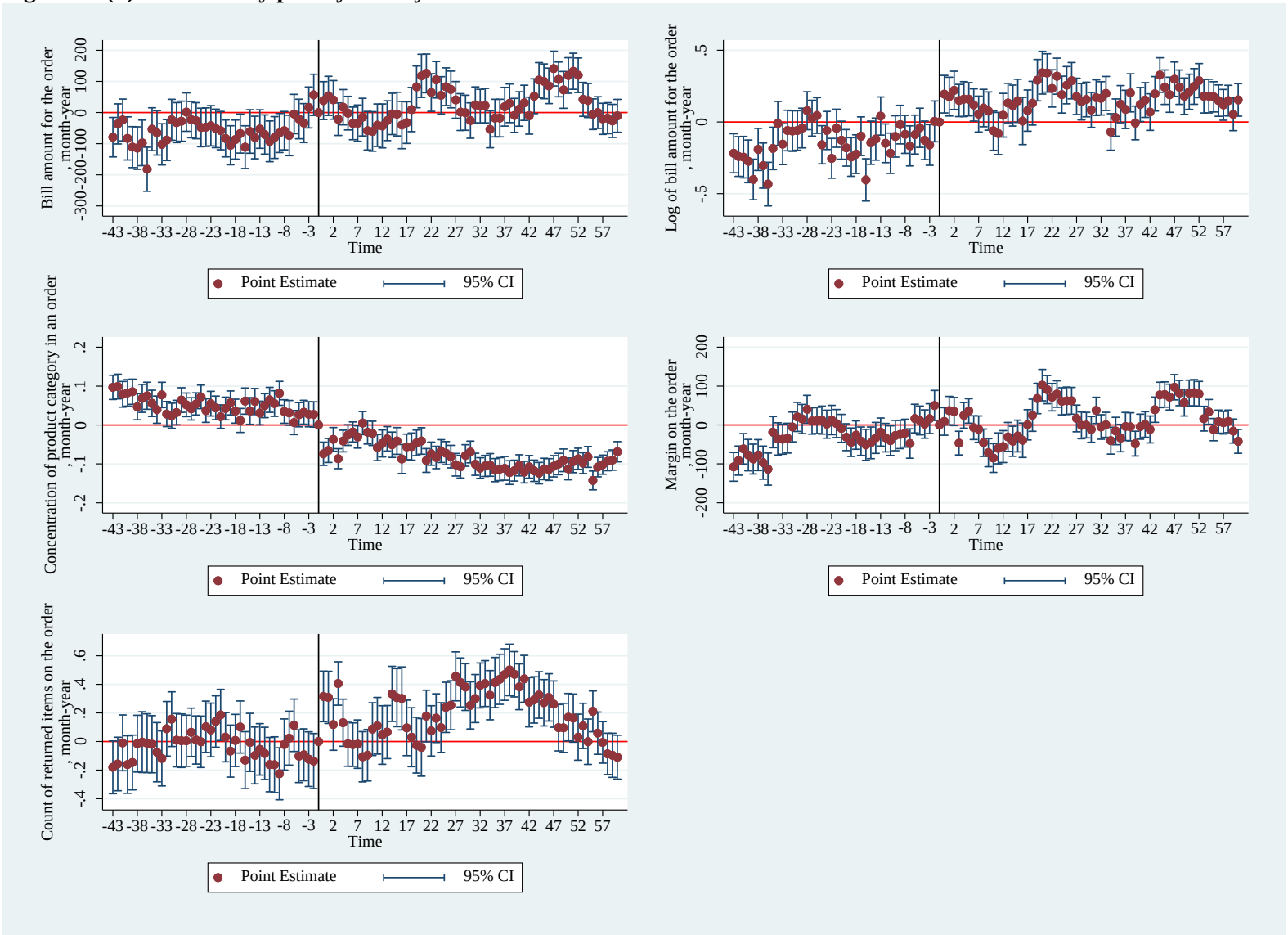


Figure C3 Difference-in-differences plot France as control group

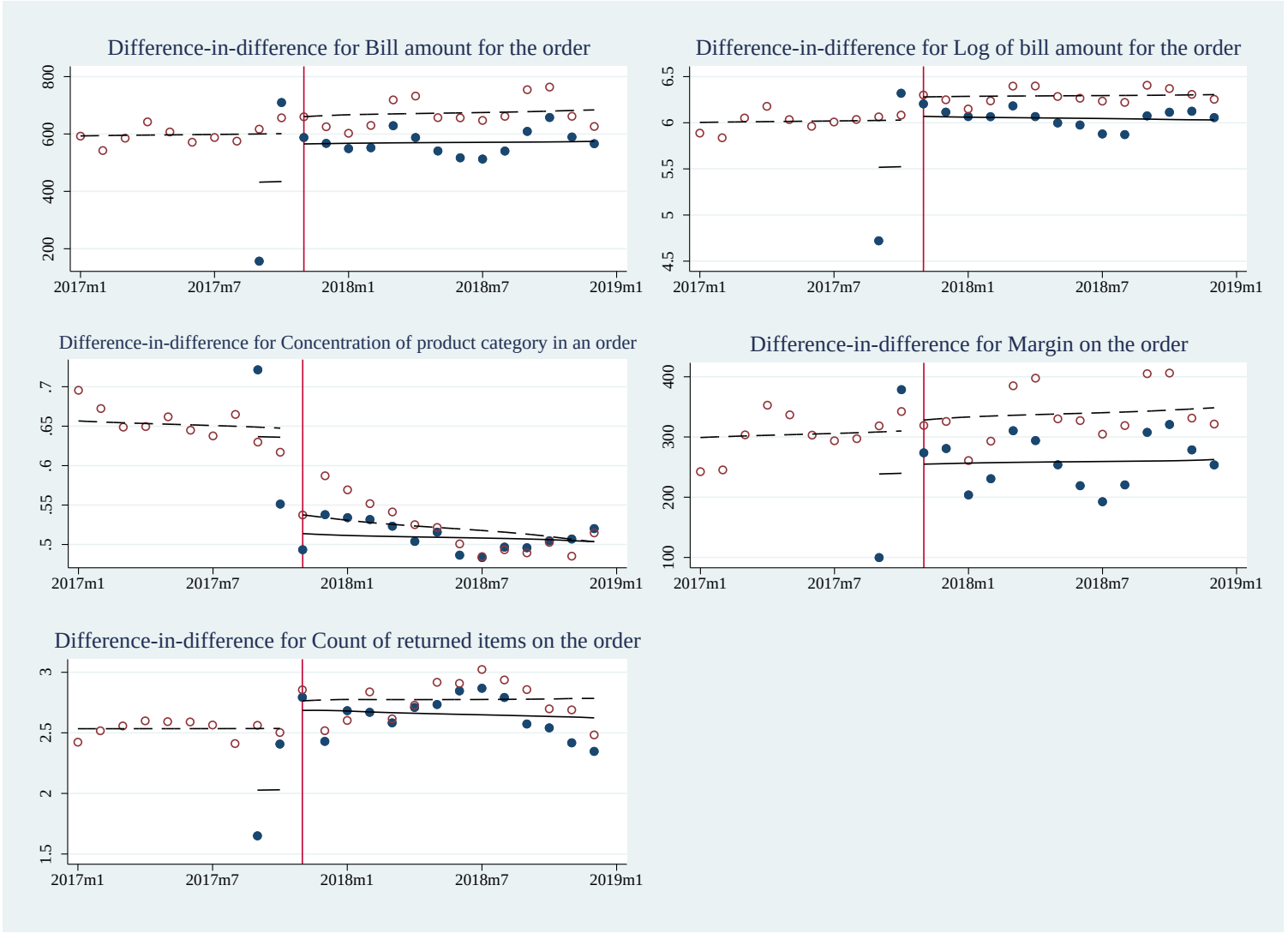


Figure C4 Difference-in-differences plot Finland as control group

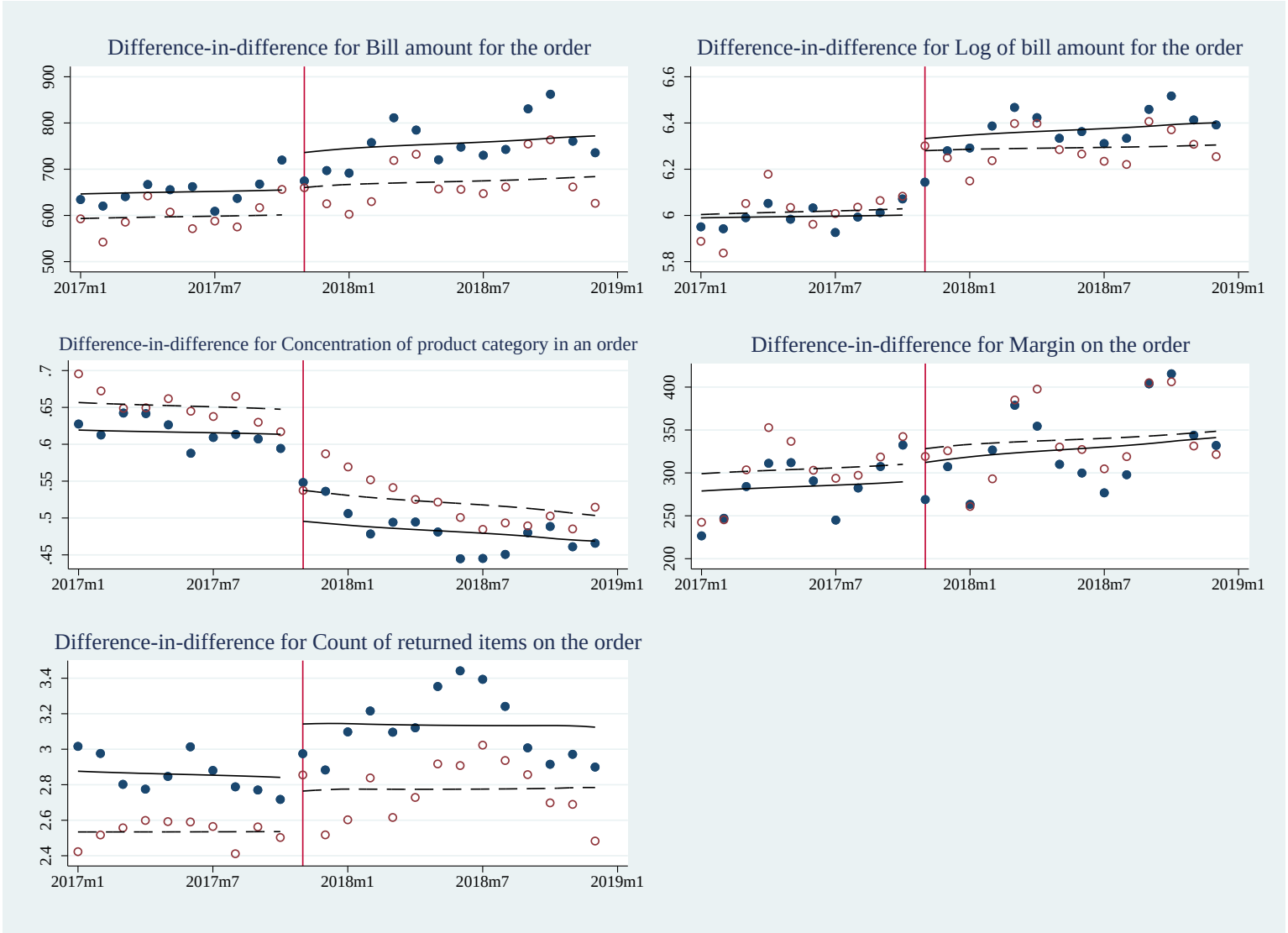


Figure C5 Difference-in-differences plot Sweden as control group

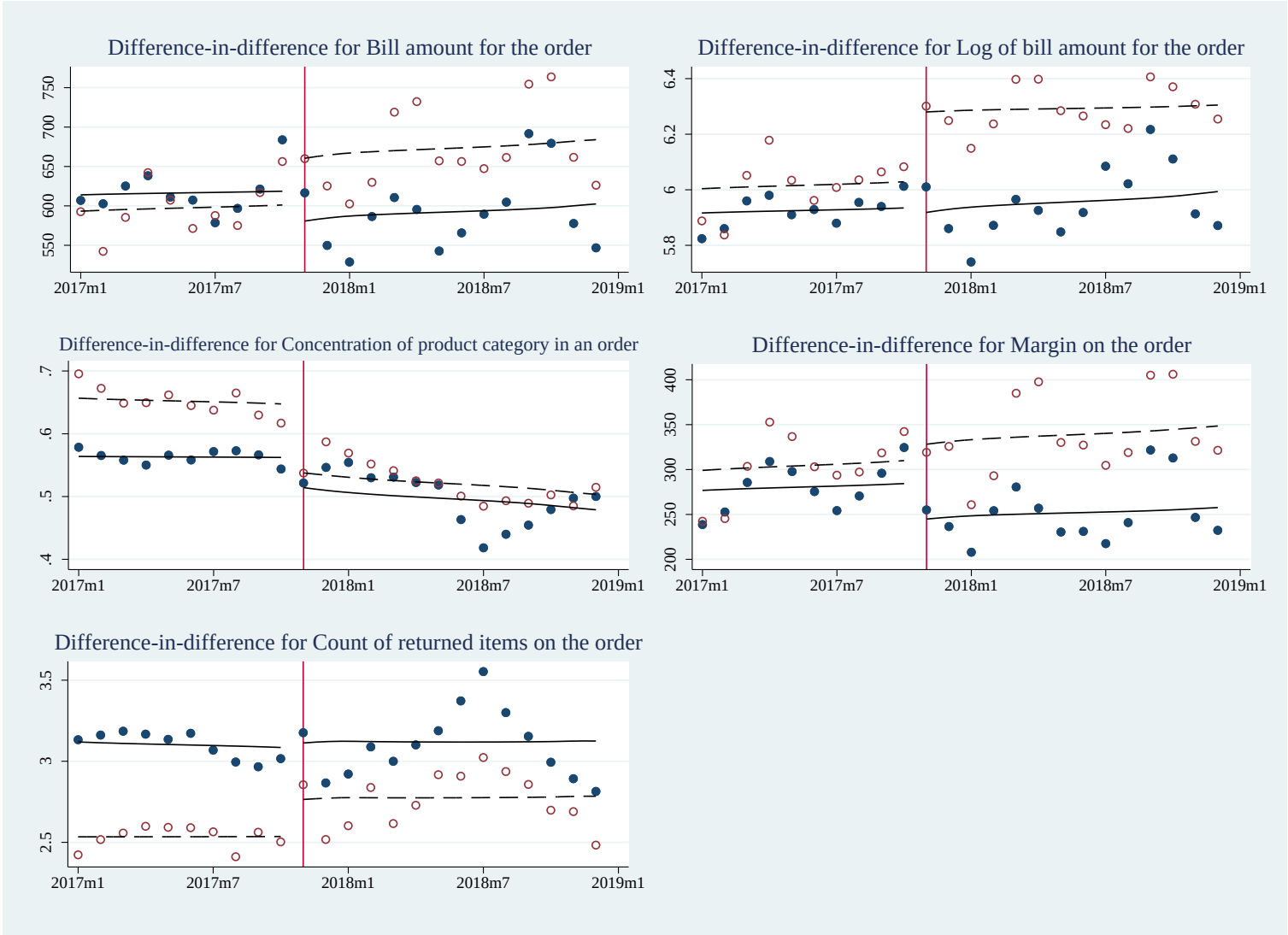


Figure C6 Difference-in-differences plot Norway as control group



Appendix D
Controls for month-year and week-year trends by country

Table D1. Month-year trends by country, margins estimates from difference-in-differences

Billed (SEK)							
						95% CI	
		Margin	Delta method standard error	z	P>|z|	Low CI	High CI
Before	Control group	697.8228	2.0524	340	<0.001	693.8002	701.8454
Before	Denmark	631.5782	18.2477	34.61	<0.001	595.8135	667.3430
After	Control group	645.4688	1.5394	419.31	<0.001	642.4517	648.4859
After	Denmark	697.8228	2.0524	340	<0.001	693.8002	701.8454
	Change for the treated group	66.2446			<0.001		
Log of billed amount (SEK)							
						95% CI	
		Margin	Delta method standard error	z	P>|z|	Low CI	High CI
Before	Control group	6.0385	0.0045	1349.3700	<0.001	6.0297	6.0473
Before	Denmark	5.7432	0.0398	144.2000	<0.001	5.6651	5.8212
After	Control group	6.0079	0.0034	1789.2400	<0.001	6.0013	6.0145
After	Denmark	6.0385	0.0045	1349.3700	<0.001	6.0297	6.0473
	Change for the treated group	0.2953			<0.001		
Product variety (lower concentration of the order basket across product categories)							
						95% CI	
		Margin	Delta method standard error	z	P>|z|	Low CI	High CI
Before	Control group	0.5541	0.0009	636.62	<0.001	0.5524	0.5558
Before	Denmark	0.6380	0.0077	82.45	<0.001	0.6229	0.6532
After	Control group	0.5333	0.0007	816.99	<0.001	0.5320	0.5346
After	Denmark	0.5541	0.0009	636.62	<0.001	0.5524	0.5558
	Change for the treated group	-0.0840			<0.001		
Order Margin							
						95% CI	
		Margin	Delta method standard error	z	P>|z|	Low CI	High CI
Before	Control group	334.7817	1.0676	313.5800	<0.001	332.6893	336.8742
Before	Denmark	321.9902	9.4919	33.9200	<0.001	303.3864	340.5939
After	Control group	280.5320	0.8007	350.3400	<0.001	278.9626	282.1014
After	Denmark	334.7817	1.0676	313.5800	<0.001	332.6893	336.8742
	Change for the treated group	12.7915					
Order return item count							
						95% CI	
		Margin	Delta method standard error	z	P>|z|	Low CI	High CI
Before	Control group	2.9861	0.0064	469.5100	<0.001	2.9736	2.9985
Before	Denmark	2.5658	0.0565	45.3800	<0.001	2.4550	2.6767
After	Control group	3.1076	0.0048	651.4700	<0.001	3.0983	3.1170
After	Denmark	2.9861	0.0064	469.5100	<0.001	2.9736	2.9985
	Change for the treated group	0.4202			<0.001		

Table D2. Week-year trends by country, margin estimates from difference-in-differences

Billed (SEK)							
						95% CI	
		Margin	Delta method standard error	z	P>|z|	Low CI	High CI
Before	Control group	697.3026	2.048829	340.34	0	693.287	701.3182
Before	Denmark	628.4011	18.23548	34.46	0	592.6602	664.142
After	Control group	645.8994	1.536935	420.25	0	642.8871	648.9118
After	Denmark	697.3026	2.048829	340.34	0	693.287	701.3182
	Change for the treated group	68.9015				<0.001	
Log of billed amount (SEK)							
						95% CI	
		Margin	Delta method standard error	z	P>|z|	Low CI	High CI
Before	Control group	6.037154	0.004467	1351.59	<0.001	6.0284	6.045909
Before	Denmark	5.735083	0.039796	144.11	<0.001	5.657084	5.813081
After	Control group	6.009044	0.003352	1792.62	<0.001	6.002474	6.015614
After	Denmark	6.037154	0.004467	1351.59	<0.001	6.0284	6.045909
	Change for the treated group	0.302071				<0.001	
Product variety (lower concentration of the order basket across product categories)							
						95% CI	
		Margin	Delta method standard error	z	P>|z|	Low CI	High CI
Before	Control group	0.554001	0.000869	637.64	<0.001	0.552298	0.555704
Before	Denmark	0.638596	0.007733	82.58	<0.001	0.62344	0.653752
After	Control group	0.533355	0.000652	818.33	<0.001	0.532077	0.534632
After	Denmark	0.554001	0.000869	637.64	<0.001	0.552298	0.555704
	Change for the treated group	-0.08459				<0.001	
Order Margin							
						95% CI	
		Margin	Delta method standard error	z	P>|z|	Low CI	High CI
Before	Control group	334.0542	1.065723	313.45	<0.001	331.9654	336.1429
Before	Denmark	318.7765	9.485398	33.61	<0.001	300.1855	337.3676
After	Control group	281.1066	0.799455	351.62	<0.001	279.5397	282.6735
After	Denmark	334.0542	1.065723	313.45	<0.001	331.9654	336.1429
	Change for the treated group	15.2777				<0.001	
Order return item count							
						95% CI	
		Margin	Delta method standard error	z	P>|z|	Low CI	High CI
Before	Control group	2.987378	0.006349	470.52	<0.001	2.974934	2.999823
Before	Denmark	2.566372	0.05651	45.41	<0.001	2.455614	2.67713
After	Control group	3.106711	0.004763	652.28	<0.001	3.097376	3.116046
After	Denmark	2.987378	0.006349	470.52	<0.001	2.974934	2.999823
	Change for the treated group	0.421006				<0.001	

Appendix E

Table E1. Correlated outcomes with *cmp* routines

VARIABLES	(1) Log of billed amount (SEK)	(2) Product variety (lower concentration of the order basket across product categories)	(3) Order margin	(4) Order return item count
Control × Denmark	0.0315***	0.0584***	6.790***	-0.392***
	(0.00905)	(0.00188)	(2.175)	(0.0112)
After × Control	0.0852***	-0.0202***	-6.440**	0.0951***
	(0.00950)	(0.00192)	(2.816)	(0.0134)
After × Denmark	0.344***	-0.0266***	48.66***	-0.0208
	(0.0107)	(0.00222)	(3.119)	(0.0151)
Controls	Included	Included	Included	Included
Week dummies	Included	Included	Included	Included
Day of the week	Included	Included	Included	Included
Year	Included	Included	Included	Included
Quarter dummies	Included	Included	Included	Included
lnsig	0.114***	-1.449***	5.678***	0.538***
	(0.00194)	(0.000717)	(0.00404)	(0.00468)
atanhrho (arc-hyperbolic tangent correlation of the error terms)				
model (1) and model (2)		-0.512***		
		(0.00183)		
model (1) and model (3)			0.742***	
			(0.00277)	
model (1) and model (4)				0.460***
				(0.00259)
model (2) and model (3)			-0.319***	
			(0.00151)	
model (2) and model (4)				-0.916***
				(0.00571)
model (3 and model (4)				0.461***
				(0.00422)
Constant	5.876***	0.582***	233.9***	2.673***
	(0.0321)	(0.00776)	(10.52)	(0.0649)
Observations	1,035,374	1,035,374	1,035,374	1,035,374

Notes.
Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table E2. Margins for *cmp* estimates

Log of billed amount (SEK)							
						95% CI	
		Margin	Delta method standard error	z	P>|z|	Low CI	High CI
Before	Control group	6.0306	0.0062	969.1800	<0.001	6.0184	6.0428
Before	Denmark	6.0620	0.0106	574.5100	<0.001	6.0414	6.0827
After	Control group	6.1157	0.0037	1642.1700	<0.001	6.1084	6.1230
After	Denmark	6.3746	0.0059	1085.4400	<0.001	6.3631	6.3861
	Change for the treated group	0.3126				<0.001	

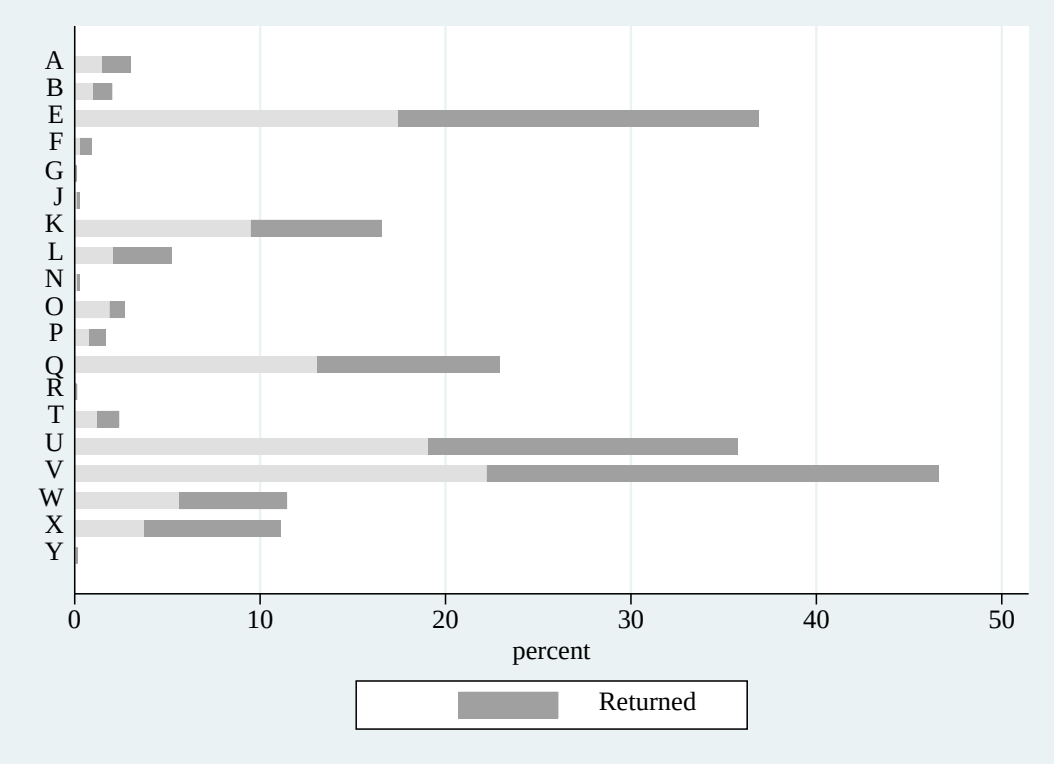
Product variety (lower concentration of the order basket across product categories)							
						95% CI	
		Margin	Delta method standard error	z	P>|z|	Low CI	High CI
Before	Control group	0.5456	0.0013	434.62	<0.001	0.5431	0.5480
Before	Denmark	0.6040	0.0022	277.15	<0.001	0.5997	0.6083
After	Control group	0.5254	0.0008	694.04	<0.001	0.5239	0.5269
After	Denmark	0.5190	0.0013	401.21	<0.001	0.5165	0.5216
	Change for the treated group	-0.0850				<0.001	

Order margin							
						95% CI	
		Margin	Delta method standard error	z	P>|z|	Low CI	High CI
Before	Control group	304.5487	1.8330	166.14	<0.001	300.9560	308.1414
Before	Denmark	311.3386	2.7195	114.48	<0.001	306.0084	316.6688
After	Control group	298.1089	1.0934	272.64	<0.001	295.9659	300.2519
After	Denmark	353.2122	1.6965	208.21	<0.001	349.8872	356.5372
	Change for the treated group	41.8736				<0.001	

Order return item count							
						95% CI	
		Margin	Delta method standard error	z	P>|z|	Low CI	High CI
Before	Control group	2.9584	0.0088	336.21	<0.001	2.9412	2.9757
Before	Denmark	2.5666	0.0135	190.59	<0.001	2.5402	2.5930
After	Control group	3.0535	0.0054	566.11	<0.001	3.0429	3.0641
After	Denmark	2.9376	0.0087	337.33	<0.001	2.9206	2.9547
	Change for the treated group	0.3710				<0.001	

Appendix F
Additional returns analysis

Figure F1. Returns descriptive statistics (raw data for categories with at least 500 units of sales)



Notes.
The complete list of categories including less than 500 units of sales is as follows:

A Accessories
B Swimwear
C Misc. clothing
D Media
E Bottoms
F Cosmetics
G Protective gear (camera, helmets)
H Headphones
I Jackets
J Winter accessories
K Caps and scarves
L Dresses
M Games and figures
N Watches
O Skateboards
P Shirts
Q Shoes
R Snowboards
S Ski materials
T Sunglasses
U Hoodies and sweatshirts
V T-shirts
W Underwear and socks
X Backpacks and bags
Y Wakeboards

Table F1. Linear probability of returns by category

	(1) Probability of a return on an order
B Swimwear × Control group × After	1.124***
	(0.0238)
B Swimwear × Denmark × Before	0.904***
	(0.0106)
B Swimwear × Denmark × After	1.003
	(0.0197)
C Misc. clothing × Control group × Before	1.003
	(0.00247)
C Misc. clothing × Control group × After	1.122***
	(0.0238)
C Misc. clothing × Denmark × Before	0.902***
	(0.0105)
C Misc. clothing × Denmark × After	0.997
	(0.0199)
E Bottoms × Control group × Before	1.001
	(0.00193)
E Bottoms × Control group × After	1.120***
	(0.0237)
E Bottoms × Denmark × Before	0.895***
	(0.00769)
E Bottoms × Denmark × After	1.001
	(0.0196)
F Cosmetics × Control group × After	1.127***
	(0.0240)
F Cosmetics × Denmark × After	1.008
	(0.0205)
G Protective gear (camera, helmets) × Control group × Before	1.005
	(0.00511)
G Protective gear (camera, helmets) × Control group × After	1.116***
	(0.0265)
G Protective gear (camera, helmets) × Denmark × Before	0.900***
	(0.0314)
G Protective gear (camera, helmets) × Denmark × After	0.958
	(0.111)
J Winter accessories × Control group × Before	1.005
	(0.00404)
J Winter accessories × Control group × After	1.125***
	(0.0240)
J Winter accessories × Denmark × Before	0.893***
	(0.0229)
J Winter accessories × Denmark × After	1.012
	(0.0223)
K Caps and Scarves × Control group × Before	1.001
	(0.00195)
K Caps and scarves × Control group × After	1.122***
	(0.0238)
K Caps and scarves × Denmark × Before	0.898***
	(0.00808)
K Caps and scarves × Denmark × After	1.005
	(0.0197)
L Dresses × Control group × Before	1.001
	(0.00205)
L Dresses × Control group × After	1.122***
	(0.0238)
L Dresses × Denmark × Before	0.896***
	(0.00908)
L Dresses × Denmark × After	1.000
	(0.0198)
N Watches × Control group × Before	1.001
	(0.00368)
N Watches × Control group × After	1.125***
	(0.0241)
N Watches × Denmark × Before	0.901***
	(0.0204)
N Watches × Denmark × After	0.997
	(0.0262)
O Skateboards × Control group × Before	1.004*
	(0.00223)
O Skateboards × Control group × After	1.119***
	(0.0238)
O Skateboards × Denmark × Before	0.916***

	(0.0102)
O Skateboards × Denmark × After	1.014
	(0.0206)
P Shirts × Control group × Before	1.003
	(0.00227)
P Shirts × Control group × After	1.120***
	(0.0238)
P Shirts × Denmark × Before	0.898***
	(0.00997)
P Shirts × Denmark × After	1.006
	(0.0202)
Q Shoes × Control group × Before	0.999
	(0.00194)
Q Shoes × Control group × After	1.118***
	(0.0237)
Q Shoes × Denmark × Before	0.895***
	(0.00782)
Q Shoes × Denmark × After	1.002
	(0.0196)
R Snowboards × Control group × Before	1.000
	(0.00529)
R Snowboards × Control group × After	1.083
	(0.0846)
R Snowboards × Denmark × Before	0.909**
	(0.0432)
T Sunglasses × Control group × Before	1.003
	(0.00214)
T Sunglasses × Control group × After	1.121***
	(0.0238)
T Sunglasses × Denmark × Before	0.895***
	(0.0102)
T Sunglasses × Denmark × After	1.006
	(0.0206)
Hoodies and sweatshirts × Control group × Before	1.001
	(0.00193)
Hoodies and sweatshirts × Control group × After	1.120***
	(0.0238)
Hoodies and sweatshirts × Denmark × Before	0.894***
	(0.00773)
Hoodies and sweatshirts × Denmark × After	1.003
	(0.0197)
V T-shirts × Control group × Before	1.002
	(0.00193)
V T-shirts × Control group × After	1.122***
	(0.0238)
V T-shirts × Denmark × Before	0.896***
	(0.00764)
V T-shirts × Denmark × After	1.004
	(0.0197)
W Underwear and socks × Control group × Before	1.002
	(0.00199)
W Underwear and socks × Control group × After	1.123***
	(0.0238)
W Underwear and socks × Denmark × Before	0.896***
	(0.00816)
W Underwear and socks × Denmark × After	1.005
	(0.0197)
× Backpacks and bags × Control group × Before	1.000
	(0.00207)
× Backpacks and bags × Control group × After	1.139***
	(0.0242)
× Backpacks and bags × Denmark × Before	0.900***
	(0.00918)
× Backpacks and bags × Denmark × After	1.005
	(0.0198)
Y Wakeboards × Control group × Before	1.000
	(0.00413)
Y Wakeboards × Control group × After	1.120***
	(0.0241)
Y Wakeboards × Denmark × Before	0.899***
	(0.0171)
Y Wakeboards × Denmark × After	1.001
	(0.0135)
Customer id	Included
quarter	Included

week	Included
day of week	Included
month year	Included
Observations	1,610,134
R-squared	0.413

Notes.
Standard errors in parentheses; Estimates are presented as odds ratios.
*** p<0.01, ** p<0.05, * p<0.1

Table F2. Margins for returns

						95% CI	
	Margin	Odds ratio of returns	Delta method standard error	z	P>|z|	Low CI	High CI
B Swimwear × Control group × After	0.0571	1.0588	0.0078	7.3100	<0.001	0.0418	0.0725
B Swimwear × Denmark × Before	-0.1608	0.8514	0.0199	-8.0900	<0.001	-0.1998	-0.1218
B Swimwear × Denmark × After	-0.0567	0.9449	0.0088	-6.4500	<0.001	-0.0739	-0.0395
Change in returns for Denmark [after minus before]	***0.1041***	***1.1098***		***4.7897***			
C Misc. clothing × Control group × Before	-0.0561	0.9454	0.0136	-4.1300	<0.001	-0.0828	-0.0295
C Misc. clothing × Control group × After	0.0559	1.0575	0.0079	7.1200	<0.001	0.0405	0.0713
C Misc. clothing × Denmark × Before	-0.1622	0.8503	0.0198	-8.1900	<0.001	-0.2010	-0.1234
C Misc. clothing × Denmark × After	-0.0627	0.9392	0.0094	-6.6500	<0.001	-0.0812	-0.0442
Change in returns for Denmark [after minus before]	***0.0995***	***1.1046***		***4.5345***			
E Bottoms × Control group × Before	-0.0584	0.9432	0.0135	-4.3300	<0.001	-0.0849	-0.0320
E Bottoms × Control group × After	0.0536	1.0551	0.0078	6.8800	<0.001	0.0383	0.0689
E Bottoms × Denmark × Before	-0.1698	0.8438	0.0182	-9.3300	<0.001	-0.2055	-0.1342
E Bottoms × Denmark × After	-0.0580	0.9436	0.0086	-6.7600	<0.001	-0.0749	-0.0412
Change in returns for Denmark [after minus before]	***0.1118***	***1.1183***		***5.5568***			
F Cosmetics × Control group × After	0.0605	1.0624	0.0079	7.6400	<0.001	0.0450	0.0761
F Cosmetics × Denmark × After	-0.0519	0.9494	0.0103	-5.0400	<0.001	-0.0721	-0.0317
Change in returns for Denmark [after minus before]	***n/a***						
G Protective gear (camera, helmets) × Control group × Before	-0.0543	0.9472	0.0143	-3.8000	<0.001	-0.0823	-0.0263
G Protective gear (camera, helmets) × Control group × After	0.0507	1.0520	0.0132	3.8500	<0.001	0.0249	0.0765
G Protective gear (camera, helmets) × Denmark × Before	-0.1645	0.8483	0.0384	-4.2800	<0.001	-0.2398	-0.0892
Change in returns for Denmark [after minus before]	***n/a***						
J Winter accessories × Control group × Before	-0.0545	0.9470	0.0140	-3.9000	<0.001	-0.0819	-0.0271
J Winter accessories × Control group × After	0.0582	1.0600	0.0083	7.0400	<0.001	0.0420	0.0744
J Winter accessories × Denmark × Before	-0.1722	0.8418	0.0302	-5.7000	<0.001	-0.2314	-0.1129
J Winter accessories × Denmark × After	-0.0479	0.9533	0.0133	-3.6000	<0.001	-0.0740	-0.0218
Change in returns for Denmark [after minus before]	***0.1243***	***1.1324***		***3.7637***			
K Caps and scarves × Control group × Before	-0.0580	0.9436	0.0135	-4.2900	<0.001	-0.0845	-0.0315
K Caps and scarves × Control group × After	0.0557	1.0573	0.0078	7.1400	<0.001	0.0404	0.0710
K Caps and scarves × Denmark × Before	-0.1674	0.8459	0.0184	-9.1000	<0.001	-0.2034	-0.1313
K Caps and scarves × Denmark × After	-0.0540	0.9475	0.0087	-6.1700	<0.001	-0.0711	-0.0368
Change in returns for Denmark [after minus before]	***0.1134***	***1.1201***		***5.5682***			
L Dresses × Control group × Before	-0.0584	0.9432	0.0135	-4.3200	<0.001	-0.0850	-0.0319
L Dresses × Control group × After	0.0556	1.0572	0.0078	7.1100	<0.001	0.0403	0.0710
L Dresses × Denmark × Before	-0.1696	0.8440	0.0190	-8.9500	<0.001	-0.2068	-0.1325
L Dresses × Denmark × After	-0.0591	0.9426	0.0092	-6.4400	<0.001	-0.0770	-0.0411
Change in returns for Denmark [after minus before]	***0.1106***	***1.1169***		***5.2498***			
N Watches × Control group × Before	-0.0585	0.9432	0.0139	-4.2200	<0.001	-0.0857	-0.0313
N Watches × Control group × After	0.0588	1.0605	0.0083	7.1100	<0.001	0.0426	0.0750
N Watches × Denmark × Before	-0.1633	0.8493	0.0277	-5.9000	<0.001	-0.2176	-0.1091
N Watches × Denmark × After	-0.0627	0.9392	0.0196	-3.2000	0.0010	-0.1011	-0.0244
Change in returns for Denmark [after minus before]	***0.1006***	***1.1058***		***2.9655***			
O Skateboards × Control group × Before	-0.0557	0.9458	0.0136	-4.1100	<0.001	-0.0823	-0.0291
O Skateboards × Control group × After	0.0533	1.0548	0.0079	6.7900	<0.001	0.0379	0.0687
O Skateboards × Denmark × Before	-0.1469	0.8634	0.0194	-7.5600	<0.001	-0.1850	-0.1088
O Skateboards × Denmark × After	-0.0457	0.9553	0.0102	-4.4900	<0.001	-0.0657	-0.0258
Change in returns for Denmark [after minus before]	***0.1012***	***1.1065***		***4.6129***			
P Shirts × Control group × Before	-0.0568	0.9448	0.0136	-4.1900	<0.001	-0.0834	-0.0302
P Shirts × Control group × After	0.0541	1.0556	0.0079	6.8800	<0.001	0.0387	0.0696
P Shirts × Denmark × Before	-0.1673	0.8460	0.0195	-8.5800	<0.001	-0.2055	-0.1291
P Shirts × Denmark × After	-0.0533	0.9481	0.0097	-5.5200	<0.001	-0.0722	-0.0344
Change in returns for Denmark [after minus before]	***0.1140***	***1.1208***		***5.2401***			
Q Shoes × Control group × Before	-0.0601	0.9417	0.0135	-4.4500	<0.001	-0.0866	-0.0336
Q Shoes × Control group × After	0.0525	1.0539	0.0078	6.7300	<0.001	0.0372	0.0677
Q Shoes × Denmark × Before	-0.1705	0.8432	0.0183	-9.3300	<0.001	-0.2063	-0.1347
Q Shoes × Denmark × After	-0.0571	0.9445	0.0086	-6.6200	<0.001	-0.0740	-0.0402
Change in returns for Denmark [after minus before]	***0.1134***	***1.1201***		***5.6125***			
R Snowboards × Control group × Before	-0.0598	0.9419	0.0144	-4.1600	<0.001	-0.0880	-0.0316
R Snowboards × Denmark × Before	-0.1548	0.8566	0.0501	-3.0900	0.0020	-0.2531	-0.0565
Change in returns for Denmark [after minus before]	***n/a***						
T Sunglasses × Control group × Before	-0.0567	0.9448	0.0135	-4.1900	<0.001	-0.0833	-0.0302

T Sunglasses × Control group × After	0.0552	1.0568	0.0079	7.0400	<0.001	0.0399	0.0706
T Sunglasses × Denmark × Before	-0.1700	0.8436	0.0197	-8.6500	<0.001	-0.2086	-0.1315
T Sunglasses × Denmark × After	-0.0535	0.9479	0.0106	-5.0600	<0.001	-0.0742	-0.0328
Change in returns for Denmark [after minus before]	***0.1165***	***1.1236***		***5.2220***			
Hoodies and sweatshirts × Control group × Before	-0.0586	0.9431	0.0135	-4.3300	<0.001	-0.0850	-0.0321
Hoodies and sweatshirts × Control group × After	0.0543	1.0558	0.0078	6.9600	<0.001	0.0390	0.0696
Hoodies and sweatshirts × Denmark × Before	-0.1715	0.8424	0.0182	-9.4100	<0.001	-0.2072	-0.1357
Hoodies and sweatshirts × Denmark × After	-0.0560	0.9455	0.0086	-6.5100	<0.001	-0.0729	-0.0391
Change in returns for Denmark [after minus before]	***0.1154***	***1.1224***		***5.7270***			
V T-shirts × Control group × Before	-0.0573	0.9443	0.0135	-4.2400	<0.001	-0.0838	-0.0308
V T-shirts × Control group × After	0.0560	1.0576	0.0078	7.1800	<0.001	0.0407	0.0713
V T-shirts × Denmark × Before	-0.1692	0.8443	0.0182	-9.3100	<0.001	-0.2049	-0.1336
V T-shirts × Denmark × After	-0.0551	0.9464	0.0086	-6.4300	<0.001	-0.0719	-0.0383
Change in returns for Denmark [after minus before]	***0.1141***	***1.1209***		***5.6791***			
W Underwear and socks × Control group × Before	-0.0571	0.9445	0.0135	-4.2200	<0.001	-0.0836	-0.0306
W Underwear and socks × Control group × After	0.0568	1.0584	0.0078	7.2700	<0.001	0.0415	0.0720
W Underwear and socks × Denmark × Before	-0.1691	0.8445	0.0184	-9.1700	<0.001	-0.2052	-0.1329
W Underwear and socks × Denmark × After	-0.0540	0.9474	0.0087	-6.2300	<0.001	-0.0710	-0.0370
Change in returns for Denmark [after minus before]	***0.1150***	***1.1219***		***5.6434***			
Backpacks and bags × Control group × Before	-0.0589	0.9428	0.0135	-4.3600	<0.001	-0.0855	-0.0324
Backpacks and bags × Control group × After	0.0708	1.0734	0.0078	9.0700	<0.001	0.0555	0.0861
Backpacks and bags × Denmark × Before	-0.1653	0.8477	0.0190	-8.6900	<0.001	-0.2026	-0.1280
Backpacks and bags × Denmark × After	-0.0549	0.9466	0.0088	-6.2300	<0.001	-0.0722	-0.0376
Change in returns for Denmark [after minus before]	***0.1104***	***1.1167***		***5.2660***			
Y Wakeboards × Control group × Before	-0.0593	0.9424	0.0140	-4.2400	<0.001	-0.0867	-0.0319
Y Wakeboards × Control group × After	0.0540	1.0554	0.0087	6.2000	<0.001	0.0369	0.0710
Y Wakeboards × Denmark × Before	-0.1661	0.8470	0.0249	-6.6700	<0.001	-0.2149	-0.1172
Change in returns for Denmark [after minus before]	***n/a***						