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MICRO-RESPONSES TO SHOCKS: PRICING, PROMOTION, AND ENTRY

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Abstract

We study the response of markets to a firm-specific shock in a natural experiment setting. In 2006, a boycott of Danish products in several Arab countries was devastating for Danish cheese firms. In Saudi Arabia their market share collapsed from 16.5% in January to less than 1% in March and never fully recovered: it was 6.3% in 2009. By analyzing micro-level (scanner) price and expenditure data we find that (i) Danish firms lowered prices but kept the product mix the same; (ii) non-Danish firms kept prices constant but changed their product mix by introducing new products and new product bundles; and (iii) non-Danish firms chose to introduce products that were identical to the Danish in order to compete head-to-head. The finding that Danish firms adjusted to the negative demand shock through the intensive margin and non-Danish to the positive through the extensive is hard to reconcile with existing pricing theories or theories on multi-product firms. We offer two potential explanations that can help reconcile our findings with existing models.

JEL Classification: L10

Keywords: boycotts, multi-product firms, demand shock, Saudi Arabia

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**Micro-responses to shocks:
Pricing, promotion, and entry***

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September 26, 2018

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1. Introduction

A fundamental question in economics is how firms respond to shocks. The answer is important, because how firms respond has implications for firms themselves, for retailers, for consumers, for policy makers, and for the economy in general.

Consider for example a positive demand shock, either aggregate or firm-specific. Firms can respond by adjusting prices, either directly through changes in reference prices or indirectly through changes in the frequency and the depth of promotions, including non-price promotions. Prices can increase during periods of peak demand as traditional competitive equilibrium models predict, or decrease as other competing models suggest.¹ Indeed, there is some evidence to suggest that either prices do not rise or that they fall during such periods.²

But adjusting prices is not the only or the most important channel by which market adjustments take place. Prices are sticky and often times adjustments can come through changes in the product mix. A large literature on multi-product firms documents that adjustments at the extensive

¹ Models that predict counter-cyclical prices include those with cyclical demand elasticities that come from economies of scale in search costs (Bills [1989]; Warner and Barsky [1995]), countercyclical collusion models (Rotemberg and Saloner [1996]; Borenstein and Shepard [1996]; Bernheim and Whinston [1990]), and loss-leader advertising models (Lal and Matutes [1994]; Hosken et al. [2000]; Chevalier et al. [2003]). Chevalier et. al. provide a nice overview of these three classes of models.

² See Warner and Barsky (1995), MacDonald (2000), Chevalier et. al. (2003), Nevo and Hadjitaskos (2006), Peronne (2016).

margin (change in sales attributed to entry and exit of new products) can be at least as important as changes in the intensive (change in sales attributed to goods that exist before and after).³

When firms choose to alter their product mix in response to shocks they have to decide on the type, number, and quality of new varieties to introduce. They must then decide whether to compete “head-to-head” with competitors by introducing identical products or to “fill in the blanks”, by introducing similar, but not identical products. They must also choose which products to drop, what the cannibalization effects may be between newly introduced varieties and existing ones, and what prices to set for new but also for existing varieties. Complicating things further, these decisions may potentially differ for single- versus multi-product firms, for premium-brand versus second-tier manufacturers, and for shocks that are temporary versus permanent; anticipated versus unanticipated; demand versus supply; and positive versus negative.⁴

³ Bernard, Redding, and Schott (2010) find that product adding and dropping is associated with changes in firm size of multi-product firms. The same authors (BRS 2011) also show that product switching within these firms explains a third of the total increase in real US manufacturing shipments between 1972 and 1997.

⁴ For more on the response of premium- versus second-tier manufacturers see Pauwels and Srinivasan (2004) and references therein. The authors study the impact of store brand entry on competitors and find that it benefits premium-brand manufacturers, harms second-tier manufacturers, results in an enlarged product assortment (mix), and intensifies promotional activity. For cannibalization effects associated with new product entry see Feenstra and Ma (2014), Eckel and Neary (2010), and Dhingra (2013). For quality consideration of new product entry see Johnson and Myatt (2003) and Eckel et. al (2015).

Understanding the multiple ways in which firms respond to shocks is important but not easy. While a variety of studies have looked into each one of these potential responses in isolation and yielded very valuable insights, less work has been done to document the multi-dimensional response of firms to shocks, and even less on the response of their competitors.⁵

In this paper we present a unique case study that illustrates the richness in the response of firms to shocks. Using highly disaggregated micro-level (scanner) data, we document the impact on prices, promotions, product entry and exit, for both premium-brand and second-tier manufacturers, in the short-run and in the long-run in response to a substantial and unanticipated demand shock, a successful consumer boycott. Our analysis is not confined only to those firms adversely affected by the shock, but it also covers the response of their competitors.

On January 26th 2006, imams in Saudi Arabia called for a boycott on Danish products during Friday prayers. The reason was the publication of 12 cartoons depicting the prophet Mohammad by *Jyllands-Posten*, Denmark's largest newspaper, which caused outrage amongst Muslims. Within a week, the call for boycott had spread to more than ten Arab countries. Dairy products became a focal point of the boycott campaign because they are Denmark's main export to the Gulf

⁵ Examples include event studies that look at the stock market response to negative news such as aircraft crashes (Borenstein and Zimmerman 1988, Bosch, Eckard and Singal 1998) and labor strikes (de Fusco and Fuess 1991). Other work has looked at the demand effects of negative events: Grafton, Hoffer and Reilly (1981) and Reilly and Hoffer (1983) examined the effect of automobile recalls on automobile demand and Freedman, Kearney, and Lederman (2012) studied the effects of toy recalls on demand for the affected firm's other products. Also related is work by Cawley and Rizzo (2008) that studies the spillover effects of drug withdrawals.

countries.⁶ Most large retailers caved to public pressure and joined the boycott, removing Danish products from the shelves. Images of empty supermarket shelves appeared on TVs around the world. The boycott was called off after four months, in late May 2006.

Using scanner data on cheese sales in Saudi Arabia we first show that the boycott had an immediate and dramatic effect on Danish brands in Saudi Arabia. Their market share collapsed from 16.5% in January to below 1% during the boycott. Lost Danish sales during the boycott were entirely picked up by non-Danish brands. Danish sales recovered somewhat after the boycott was officially called off in May 2006, but never returned to their previous levels. From the end of the boycott and up until December 2009 when our data end, Danish brands accounted for only 6.3% of all cheese sales, just over a third of their 18.4% share in 2005.

The adverse, substantial shift in demand away from Danish products and into non-Danish provides a perfect setting for studying how firms responded during and after the boycott. In particular, we examine pricing responses, promotional activity, and potential changes in the product mix, both for the Danish firms that experienced a drop in demand and the non-Danish that experienced an opportunity to increase sales.

Our analysis reveals a striking difference in the response of Danish and non-Danish firms: we find that Danish firms lowered prices moderately and kept the product mix the same after the boycott

⁶ Cheese and curd accounted for almost half of the Danish exports to the Gulf Cooperation Council countries in 2005 (UN COMTRADE). The Gulf Cooperation Council (GCC) countries are Bahrain, Kuwait, Oman, Qatar, Saudi Arabia, and the United Arab Emirates. Of these, Saudi Arabia is by far the biggest economy. It accounts for about 84%, 70%, and 50% of the total land, population, and GDP of the GCC.

ended (their products were withdrawn from shelves for a significant part of the boycott period). On the other hand, we find that non-Danish firms kept reference prices constant but altered the product mix substantially both during and after the boycott by introducing new varieties (barcodes) and new promotional bundles. In other words, we observe that the drop in Danish sales came solely from the intensive margin, while the rise in non-Danish sales from the extensive margin.

Given the substantial product entry we document in the response of the non-Danish firms, we proceed to examine in more detail the characteristics of these new varieties. Are these new varieties (barcode) different products or repackaging of existing products into new promotional bundles? For the barcodes that represent new products, did the non-Danish brands choose to introduce products identical to the Danish product line (same package type, weight, and description) or they introduced similar, but not identical products? Following the convention in the marketing literature, we refer to the former as *head-to-head* competition and the latter as *fill in the blanks* competition.

We find that while a significant number of these new barcodes represented new promotional bundles of existing products, especially immediately after the end of the boycott, the vast majority represents genuinely new products. And for these new products we find that the non-Danish firms chose to directly compete with Danish brands by introducing predominately identical, rather than similar products.

Our main finding from this study – that Danish firms adjusted to an unanticipated decrease in demand through the intensive margin and non-Danish to an unanticipated increase through the extensive -- is hard to reconcile with existing pricing theories or theories on multi-product firms. Such theories would predict that the adjustment happens at the same margin (either intensive or extensive, but in opposite direction for these two types of firms). Partly, this is due to the particular nature of the case study that cannot be easily generalized to other settings. But there are a couple of interesting interpretations of our results that encourage further consideration and

study. First, our results may hint at a significant difference in how management perceives shocks of the same magnitude but of opposite direction. It may be the case that negative demand shocks are perceived as more temporary in nature and generate a muted response, whereas positive shocks of the same magnitude are perceived as more permanent and generate a larger response. This may help explain why Danish firms did not change the product mix but non-Danish firms did and chose to compete head-to-head. Second, it may be the case that securing shelf space in retailers is very costly and once these sunk costs are incurred by brands, brands have less of an incentive to drop products in bad times than to introduce new in good times (where these fixed costs may conceivably be lower).

To summarize, this study provides one of the most striking example of a successful boycott ever documented in the literature. Most importantly, because the boycott had such a sharp effect on sales of Danish products and because the data are available at the scanner level and across hundreds of outlets, we were able to analyze the response of Danish and non-Danish firms and complement a growing body of the literature that examines how firms respond to economic shocks, while highlighting the behavior of prices, promotions, and product entry and exit.

The remainder of the paper is organized as follows. In Section 2 we present some background information on the boycott against Danish products and in section 3 we describe the market for cheese products in Saudi Arabia and the data we are using. Section 4 documents the impact of the boycott on sales and then proceeds to discuss the impact of Danish and non-Danish firms on prices, promotions, and product mix. Section 5 offers an interpretation of our results and concludes.

2. The boycott

On September 30th 2005, *Jyllands-Posten*, Denmark's largest newspaper printed 12 drawings depicting the Prophet Mohammad. Danish Muslim groups called the depiction of the Prophet in

cartoons blasphemous and protested against the *Jyllands-Posten* publications. The debate between those who supported freedom of speech and those who supported respect for religion went global when the cartoons were reprinted in various publications in more than fifty countries in early 2006.

On January 26th 2006, Saudi Arabia recalled its ambassador from Denmark and initiated a boycott of Danish products. The call for the boycott was spearheaded by the imams during the Friday prayers. Within a week the boycott spread to Iraq, Yemen, Syria, Palestine, Bahrain, Qatar, the United Arab Emirates, Jordan, Algeria, Morocco, Tunisia, and Oman. On January 28th, the Denmark-based Arla Dairy Group placed advertisements in Middle Eastern newspapers in an effort to stop the boycott of its products. Two days later, the EU Trade Commissioner threatened to take the issue to the World Trade Organization if the boycott persisted. The next day Saudi hospitals refused to buy Danish insulin. In the days that followed violence broke out in many regions, including Syria, Lebanon, Pakistan, Iran and Gaza, where the Danish embassies were set on fire. It is believed that more than 140 people died during the violent protests. On April 24th an Al-Qaeda video of Osama Bin Laden emerged urging Islamic nations to continue the boycott.

In response to the public outcry against Denmark, and after observing that consumers had stopped buying Danish goods, most retail outlets in Saudi Arabia joined the boycott in mid-March by removing all Danish products from their shelves. In May, Yusuf Al-Qaradawi, the most prominent Sunni religious cleric called off the boycott. Despite the end of the boycott, a local supermarket chain decided to keep Danish products off its shelves indefinitely. This particular chain accounted for about 40% of all supermarkets in Saudi Arabia.

3. Market and data

Our study of the impact of the boycott focuses on the market for processed cheese products in Saudi Arabia. We chose Saudi Arabia because it is a large country that was at the boycott's

epicenter. We chose processed cheese because it is the product with the strongest presence by Danish firms in Saudi grocery stores.

The data come from *Nielsen* and cover the years 2005-2009. The frequency is monthly and each observation describes the total quantity of a product (barcode) sold at a retail outlet in a given month and its price during the day of the audit. *Nielsen* also provides information on the brand, the distributor or manufacturer, weight, package, variant, and on whether the product is under a promotion or not. “Kraft White 240 Glass Jar Blue” and “Lavachequirit White 240 Glass Jar Blue” are descriptions of two such barcodes. We eliminated extreme price movements by dropping observations where the monthly price change is above +300% or below -75%.⁷

We also have information on outlets. Each outlet is classified as supermarket, large grocery, small grocery, or mini-market/self-service, based on size. We can identify outlets belonging to the same chain and the region where each operates. The majority of the chains are local, but international retailers such as Carrefour also operate in Saudi Arabia. There is substantial outlet churning, especially among the smaller outlets; only 352 out of 1795 outlets are in the sample in all months between January of 2005 and December 2009.⁸ Most of our analysis will utilize a balanced set of

⁷ These thresholds are recommended by Statistics Netherlands on their work on inflation measures using monthly scanner data (de Hann and van der Grient 2009).

⁸ A new outlet entry in the dataset does not imply that the outlet is newly established. While this may be one reason, another reason may be that Nielsen decided to include it as part of their sampling strategy, or because the company just received permission to audit the outlet. Similarly, an exit could imply that the outlet went out of business, it dropped from the sample that Nielsen chooses to follow, or the management decided to stop sharing information with Nielsen. The dataset covers sales of cheese products across 1795 retail outlets. The number of outlets is reduced to 334 when we restrict the sample to these outlets that existed in all periods. Most of

outlets (those present in the sample throughout) in order to ensure that our results are not driven by entry and exit of outlets. In cases where the entire sample is used, it is stated explicitly.

Table 1 presents descriptive statistics for the balanced data. In 2005 550 cheese products (EAN codes) were sold in Saudi Arabia. These products belonged to 68 brands and 28 distributors or manufacturers. Over time the number of products increased, the number of brands dropped slightly, and the number of distributors/manufacturers remained fairly constant.

Table 1: Descriptive Statistics for the Market of Cheese Products in SA: 2005-2009

	Products	Brands	Suppliers	Outlets	Chains	Channels	Regions
2005	550	68	28	334	6	4	4
2006	539	60	27	334	6	4	4
2007	670	71	28	334	6	4	4
2008	718	73	28	334	6	4	4
2009	699	63	27	334	6	4	4

Products can be divided into seven segments on the basis of packaging: glass jar, plastic jar, slices, triangles, squares, tubes, and tin (cans). The glass jar segment is by far the largest, with about 45% of the product category (Table 2). Slices, triangles, tins and squares have 10-15% of the market each. Plastic jars and tubes have a market share of the order of 2% each.

Table 2: Market shares of product segments

	2005	2006	2007	2008	2009
GLASS JAR	0.447	0.441	0.445	0.453	0.461
TRIANGLE	0.156	0.156	0.149	0.147	0.141
TIN	0.133	0.138	0.146	0.138	0.138
SQUARE	0.119	0.120	0.124	0.119	0.122
SLICES	0.103	0.108	0.106	0.108	0.111
TUB	0.021	0.017	0.016	0.015	0.014
PLASTIC JAR	0.020	0.020	0.014	0.020	0.013

the outlets dropped represent mini-markets and groceries, and account for a very small fraction of total sales.

Table 3 shows the market share of Danish firms within each segment. Danish firms are very strong in the glass jar segment, where they had 38.3% of the market in 2005. They also have a substantial presence in tubes (18.3%) and to a lesser extent in squares (9.3%) and triangles (4.7%). The existence of these segments is important because they can serve as a (quasi) control group.

Table 3: Share of Danish products within segments					
	2005	2006	2007	2008	2009
GLASS JAR	0.383	0.194	0.186	0.142	0.161
TUB	0.183	0.081	0.059	0.061	0.048
SQUARE	0.093	0.047	0.027	0.012	0.003
TRIANGLE	0.047	0.011	0.025	0.006	0.000
TIN	0.009	0.006	0.010	0.014	0.000
SLICES	-	0.000	0.000	0.000	0.000
PLASTIC JAR	-	-	-	-	-
Overall	0.282	0.136	0.123	0.095	0.121

Note: a dash indicates that no Danish products are available in that segment. Segments are ordered by Danish market share in 2005.

Within segment, products are standardized. There are some exceptions, such as different flavors, but the main products in each segment are observationally identical except in the brand name. For example, 19 brands offer a *500g glass jar blue cheese spread* during our sample period; most of those products are not differentiated in our data except by the brand name attached to them.

Five brands belonging to four firms accounted for about 90% of sales in this market in 2005. The firms are Kraft (US), Almarai (Saudi), Arla (Denmark) and Bel (France). Kraft and Almarai market their products under their name; Arla uses the brand name Puck; and Bel has several brands, the two most important of which are La vache qui rit and Kiri. Another four firms had about 9% (1.3-4.5% each) and the remaining 1.3% was split among about 50 fringe firms with under 0.2% each. Danish brands sold 68 different cheese products, accounting for 12% of all products sold, and

17% of all revenue.¹⁰ Half the brands were multi-product, in the sense that they sold multiple cheese varieties.

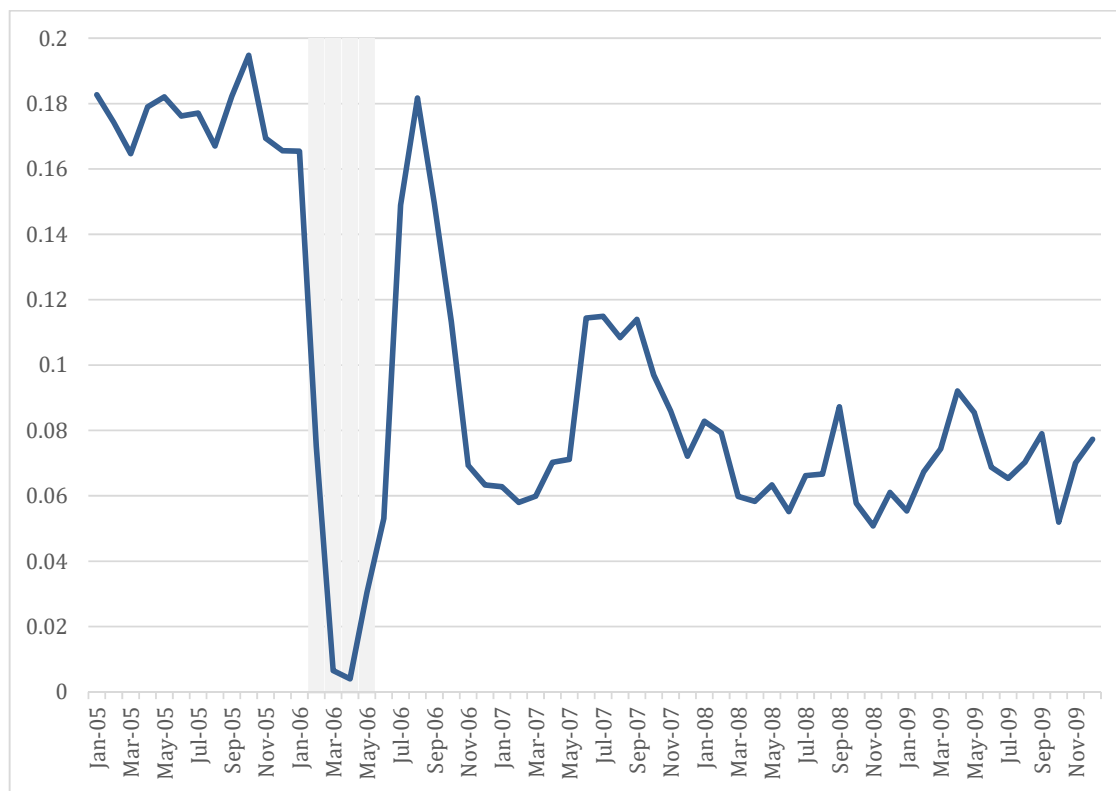
Finally, it is worth noting that the retail market in Saudi Arabia does not seem particularly different from markets in more advanced economies. There is a large presence of international brands, of international retailers, and of expat managers. A few stores account for the majority of sales, and these stores carry more brands and more products within brands. Within product categories a small portion of products accounts for the majority of sales, and these products for the most part tend to be foreign branded goods.

4. Boycott impact

We start the analysis by documenting the immediate and devastating impact the call for boycott had on Danish sales of cheese products in Saudi Arabia. Figure 1 plots the market share of Danish brands in the processed cheese category in all outlets included in the Nielsen survey from January 2005 to December 2009. The share of Danish products collapsed from an average of 18.4% in 2005 to 7.5% in February 2006 (the first full month of the boycott) and to less than 1% in March-April 2006 (by which point all major retailers joined in). Practically overnight, Danish brands went from dominating to vanishing.

Figure 1 – Market Share of Danish Cheese Products in SA between Jan 05 and Dec 09

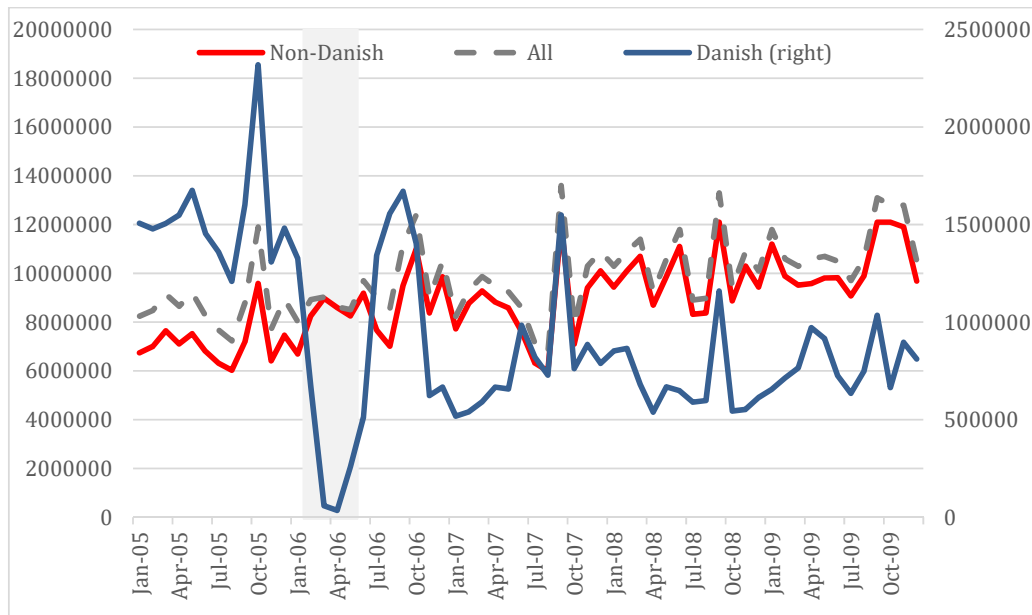
¹⁰ Using a balanced panel of outlets, the Saudi market for cheese products in 2005 was about US \$30 million. Based on data from all the outlets in our sample, and discussions we had with Nielsen, we estimate the total Saudi market for cheese products in 2005 to be closer to US \$100 million and to have doubled in value by 2009.



When the boycott ended in May, there was a partial but short-lived recovery. For a couple of months after the boycott was called off, sales of Danish cheese products rebounded to nearly 15% of the market, but then started to fall again. Evidence that we show next suggests that the temporary rebound was caused by lower prices offered by Danish producers in the weeks following the end of the boycott. From the end of 2007 until the end of our sample two years later, the market share of Danish brands fluctuated around 6.5%, roughly at one third of its 2005 level.¹¹

¹¹ As far as we are aware, this is perhaps the most successful example of boycott ever documented in the literature. Most studies that analyze boycotts, including those cited earlier in the paper, either find no effects of the boycott on sales, or they find modest, short-term effects that dissipate with time. An exception is Handel, Lach, and Spiegel (2017). The authors study the impact of a call for boycott against a sudden increase in cottage cheese prices in Israel and find that overnight

Figure 2 – Category revenue by Danish/non-Danish



The drop in Danish market share was entirely picked up by non-Danish brands, while overall sales of cheese products in Saudi Arabia remained constant. This is shown in *Figure 2* where total revenue in the processed cheese category is broken down by Danish and non-Danish brands. Annual spikes in sales correspond to the holy month of Ramadan, a period with increased demand for groceries. Danish revenue collapsed from about 18% to almost zero during the boycott while non-Danish revenue rose by the same magnitude. Overall, total category revenue did not deviate from its trend levels, which strongly suggests that the drop in Danish sales was picked up entirely by the non-Danish brands.

Therefore, we deduce that the boycott was a zero sum game: losses for Danish firms were recouped by non-Danish. This is a key observation that allows us to simultaneously study both the response of firms to a negative demand shock and to a positive by comparing and contrasting

retailers lowered prices by 25% in response to the pressure from consumers and the backlash that followed the price hike.

the reaction of both Danish and non-Danish producers. For that, we take advantage of the very detailed dataset we have available. First, we study the impact of the boycott on prices, then on promotional activity, and finally on entry and exit of products and firms.

4.1 Price response

As in the case of any shock, changes in the overall price level can come from multiple sources: changes in reference prices, changes in the composition of the basket, substitution away from some goods, and promotions.

To understand what happened to prices and investigate the impact of these sources, we first compute a simple price index of cheese products in Saudi Arabia that fixes the expenditure shares based on pre-boycott, 2005 sales. Let p_{ist} be the price per kilogram of cheese product i sold in store s at time t . The price index at time t is

$$P_t = \sum_{i,s} w_{is,2005} * p_{ist}$$

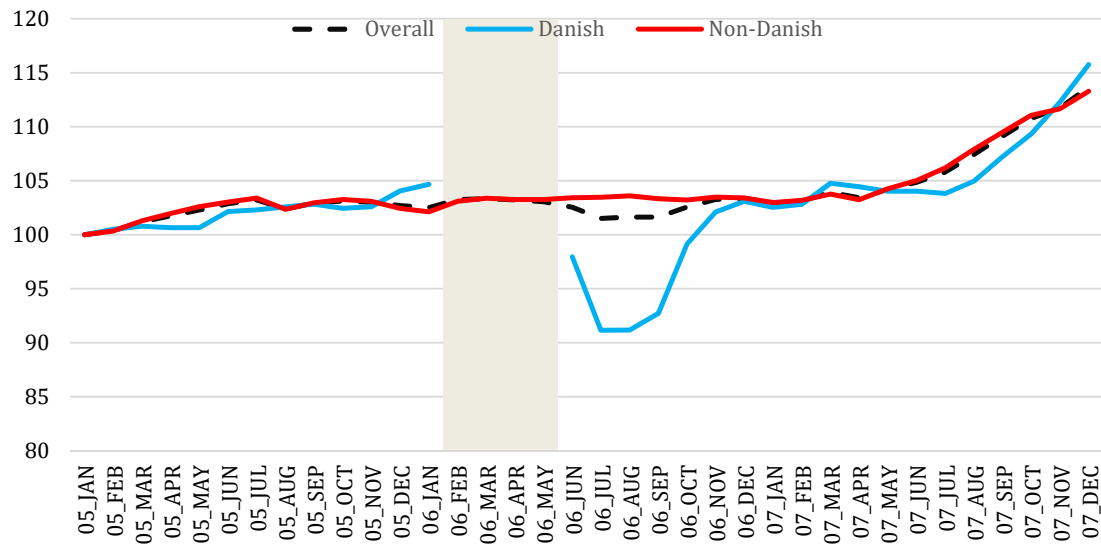
where $w_{is,2005}$ are expenditure weights, computed based on 2005 sales.¹²

Figure 4 depicts the price index for (i) all cheese products, (ii) for Danish, and (iii) for non-Danish each month between January 2005 and December 2007. Prices are normalized to 100 in the beginning of the period and omitted for Danish goods during the boycott.

Figure 4 – Price index for cheese products

¹² The results are identical if expenditure shares are computed based on sales averaged across 2005, 2006, and 2007, instead of just 2005.

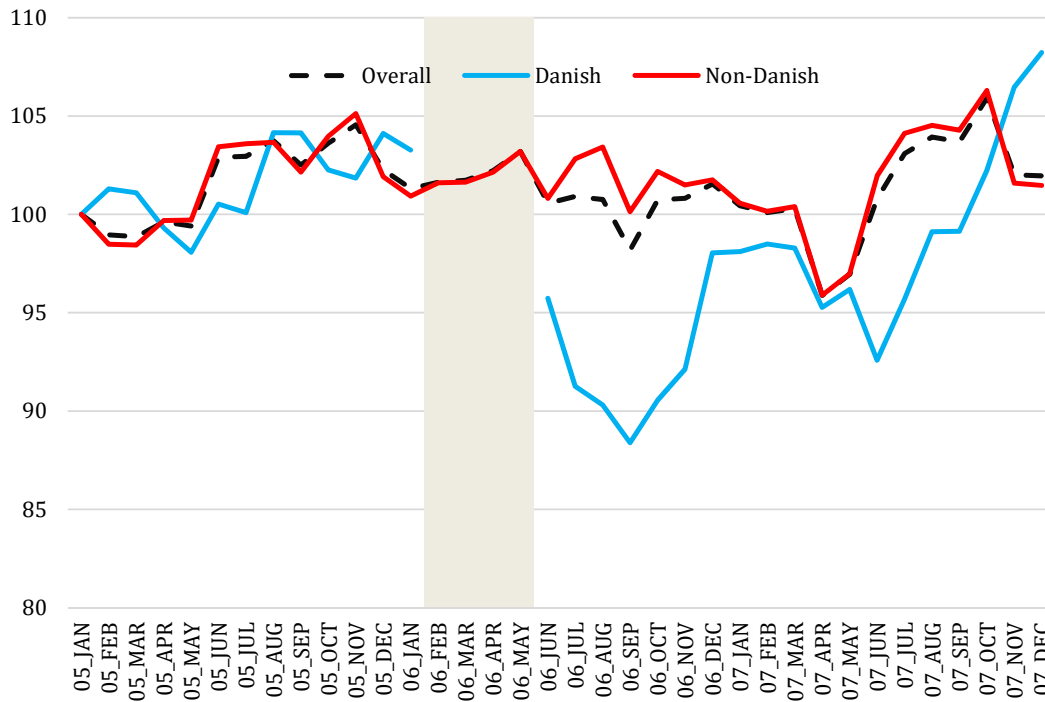
(a) Varying weights as per sales in each month



As the Figure shows, the price level of cheese products did not change much during the boycott. It was similar to that of the months before. However, in the months following the lift of the boycott, a clear pattern emerges: Danish firms lowered prices by about 8% and non-Danish firms kept prices constant. As a result, there was a decline of about 2% in the overall price index following the end of the boycott.

By keeping weights constant, the price index calculated above accurately captures changes in prices of goods that existed in 2005, but does not account for changes in the true cost of cheese. This is because a price index using fixed weights does not account for changes that may have resulted from anticipated entry and exit of new products and promotional bundles (the extensive margin) or from substitution away from Danish goods as the economy adjusted to the shock.

Figure 5 – Price index for cheese products, Fixed weights as per 2005 sales



To account for these, we re-calculate the price index but this time we let the weights vary at each period t based on the expenditure share of each product during that period. The results, which are plotted in *Figure 5* are very similar to the ones above, although here Danish prices post the boycott dropped by more than 10% and non-Danish prices during the boycott seem to have somewhat declined during the boycott.

The fact that the indexes are very similar whether fixed or varying weights are used suggests that (1) consumers were switching away from Danish cheese products into other premium-brand cheese products of similar prices and not toward cheaper substitutes from second-tier brands, and (2) new entrants that resulted from market adjustments to the boycott were priced similarly to current products or products they replaced.

Overall, and consistently with a large body of work, we fail to find evidence of price increases in response to an increase in demand (as in the case of non-Danish producers).¹³ But we do find evidence of moderate price decreases in response to a drop in demand (as in the case of Danish producers), at least in the short run.

4.2 Promotions

Promotions are an important component of supermarket pricing behavior that has received great attention over the years.¹⁵ Because firms are often reluctant to decrease the nominal price of their products as it might signal to consumers a drop in quality it may cause the consumers to perceive

¹³ In their seminal paper, Chevalier, Kashyap, and Rossi (AER 2003) use scanner data from a large supermarket chain in the Chicago area to study the response of prices to periods of (anticipated) peak demand. Using an index with varying weights in each period they find that “in general, prices tend to be lower rather than higher during periods of peak demand.” The authors argue that their results are consistent with loss-leader models where positive shifts in demand trigger price reductions as the reach and impact of promotions and sales is higher during those times. Using the same data but an index with fixed weights, Nevo and Hatzitaskos (2006) confirm that prices tend to be lower during periods of peak demand. However, the authors argue that the observed drop in prices is not driven by actual price reductions, but rather by substitution effect: a relative increase in the demand for cheaper products during those times (e.g. spike in the demand for cheaper tuna used during Lent to make traditional casserole dishes or tuna salads). They conclude that the loss-leader model is not supported by their results.

¹⁵ The marketing literature has been interested in promotions for a long time. Industrial organization economists started paying attention in the 2000s (Pesendorfer 2002, Hendel and Nevo 2006) and macroeconomists followed thereafter.

the subsequent increase in price as unfair, they rely more on promotions to sell their products and to draw more consumers into their stores.

Promotions either take the form of temporary price cuts (price promotions) or other special offers that are typically initiated by the manufacturer (non-price promotions) *and must have a different barcode*. Examples of non-price promotions include:

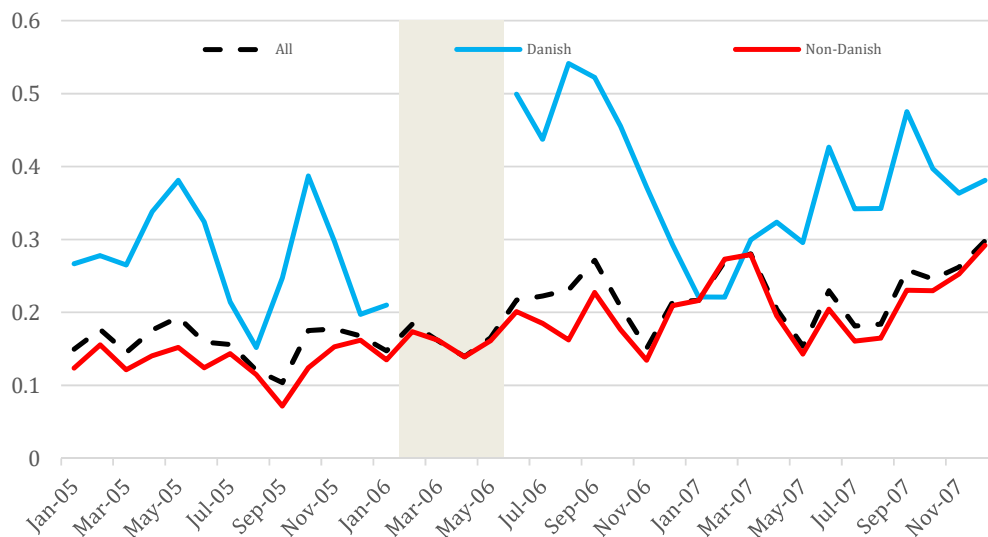
- (1) promotion bundle: e.g. Kraft cheddar glass jar gold 500mg x 2 + Kraft cheddar glass jar blue 140mg,
- (2) promotion free: e.g. Kraft cheddar glass jar gold 500mg + Kraft 113mg tin free,
- (3) promotion price: e.g. Kraft cheddar glass jar gold 500mg 10% off special price,
- (4) promotion same: e.g. Kraft cheddar glass jar gold 500mg + 100mg free,
- (5) promotion unit: e.g. Kraft cheddar glass jar gold 500mg x 2,
- (6) promotion volume: e.g. Kraft cheddar glass jar gold 500mg + 20% extra.

In Figure 5a below we compute the share of sales that came from promoted products, and in Figure 5b the percentage of products (barcodes) that are promoted each month. Information on promotions in the dataset is provided by Nielsen through a variable that flags non-price promotions. Information on price promotions is obtained through an algorithm that flags a v-shape price pattern as price sale.¹⁶

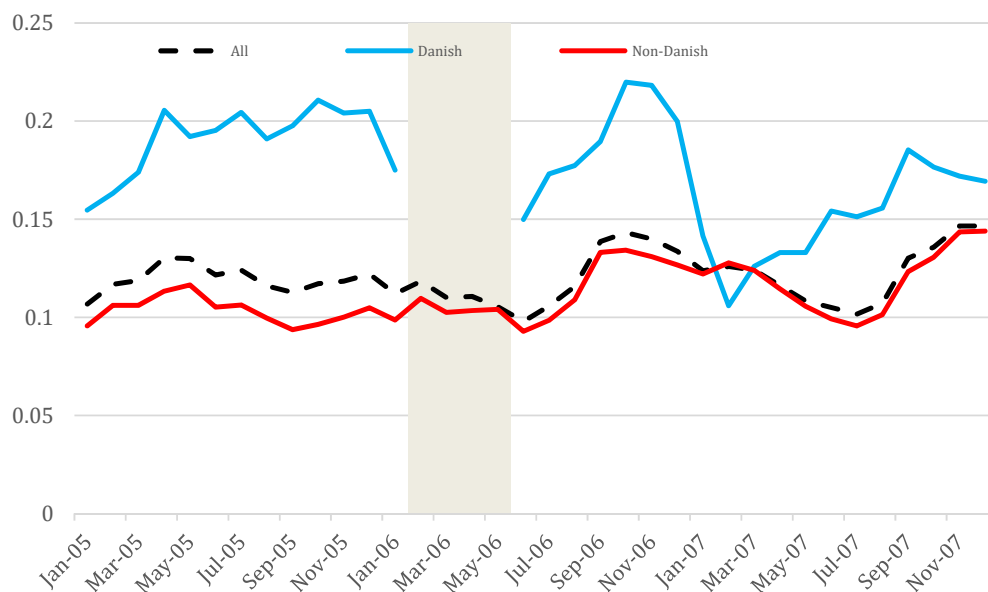
Figure 5 – Promotions

(a) As percentage of total sales

¹⁶ For more information on the price sale filter, see Klenow and Kryvstov (2008) and Nakamura and Steinsson (2008).



(b) As percentage of total products



According to figures 5a and 5b, promotions (black dotted line) accounted for about 18% - 20% of total cheese sales, with about 12% of all items on the shelves being promotions. When the boycott ended, promotional activity for non-Danish firms (red line) and Danish firms (blue) line increased, although the increase in sales coming from promotions was substantially larger for Danish than non-Danish firms. Following the end of the boycott sales from promoted products

more than doubled for Danish brands. Surprisingly, the number of promotions offered by these brands as share of total products available did not increase. For example, in June 2006 about 15% of all Danish barcodes represented promoted goods (Figure 5b), while sales from these promotions accounted to 53% of total Danish sales (Figure 5a). A year ago, promoted goods accounted for 20% of all Danish products, but accounted for only 30% in sales. We investigated this further and found that the Danish cheese producers did not increase the number of promotions, but rather they strategically offered non-price promotions on their best sellers. These were items not frequently promoted before. So while the number of promotions did not increase, sales from promotions contributed to more than half of overall sales.

4.3 Intra-firm adjustments

In our sample, the vast majority of cheese sales come from multi-product firms (MPFs). The top 5 brands, all multi-product, account for about 90% of sales. The prevalence of MPFs is consistent with broader evidence in the literature which also finds that product switching within firms is a far more important channel for adjustments than entry and exit of firms.¹⁷

¹⁷ Bernard, Redding, and Schott (2011) use US data from 1972 to 1997 to show that multi-product firms (MPFs) are very common and important: they comprise 41% of all firms in the manufacturing sector and they account for 91% of output. They also show that intra-firm product switching explains a third of the total increase in real US manufacturing shipments during that period. Similarly, Goldberg et. al. (2010) using detailed firm-level Indian data find that MPFs tend to be larger, more productive, and more likely to export. Broda and Weinstein (2010), using scanner data similar to ours, find that 46% of the products in their sample in 1999 disappeared by 2003 while 50% of the products in 2003 did not exist in 1999. For theoretical models on MPFs see Eckel and Neary 2014; Bernard, Redding, and Schott 2010, 2011; Nocke and Yeaple 2014; Allanson and Montagna 2005; Feenstra, Xu, Antoniadis (2017); and references within. Many of

Given the muted response of prices we observed so far and the evidence in the literature on the importance of intra-firm adjustments, we proceed next to examine the impact of the boycott on the product mix of firms. Following Broda and Weinstein (2010), we break down total sales growth between two periods into sales of products that survive and products that are new or disappear. Specifically,

$$(3) \quad \underbrace{\frac{V_t - V_s}{V_s}}_{\text{Total growth}} \equiv \underbrace{\frac{C_t - C_s}{V_s}}_{\text{Common products growth}} - \underbrace{\frac{D_s}{V_s}}_{\text{Destruction}} + \underbrace{\frac{N_t}{V_s}}_{\text{Creation}}$$

where V_t and V_s measure total sales in periods t and s , respectively. C_t and C_s measure total sales in periods t and s of products that are common in both periods. D_s measures total sales of products that existed in period s but disappeared in period t , and N_t measures sales of new products that appear in period t but not in period s . We also define the intensive and extensive margins of growth as:

$$\text{Intensive} = \text{Common Products Growth}$$

$$\text{Extensive} = \text{Creation} - \text{Destruction}$$

The intensive margin accounts for the share of the growth that is driven by growth in sales of products that existed in both periods. The extensive margin accounts for the share of the growth

these authors study the response of MPFs to globalization where both market size effects and competition effects are combined and hard to be separated or distinguished. Our work complements this literature by considering the response of MPFs to a pure demand shock.

that is driven by the creation of new products, after taking into account losses in sales of products that exit the market.

We first compute the growth in total sales of Danish and non-Danish brands between 2005 and 2006. Then, we decompose the growth into intensive and extensive margins based on the formulas above. We also extend the analysis by looking at two-, three-, and four-year horizons. The results are shown in *Table 4, panel (i)*.

Table 4: Sales Growth into Intensive and Extensive Margin by Brand Type						
Year	Danish			Non-Danish		
	Total	Intensive	Extensive	Total	Intensive	Extensive
<i>(i) Product definition = barcode</i>						
2005-2006	-0.43	-0.35	-0.08	0.21	0.05	0.15
2005-2007	-0.47	-0.48	0.02	0.19	-0.06	0.25
2005-2008	-0.54	-0.47	-0.06	0.37	-0.08	0.45
2005-2009	-0.47	-0.41	-0.06	0.46	-0.06	0.52
<i>(ii) Product definition = brand + weight + package type</i>						
2005-2006	-0.44	-0.39	-0.04	0.20	0.16	0.05
2005-2007	-0.48	-0.45	-0.03	0.19	0.05	0.14
2005-2008	-0.54	-0.44	-0.10	0.37	0.09	0.28
2005-2009	-0.48	-0.33	-0.14	0.45	0.08	0.37

When we look at the table we see that intra-brand adjustments for the brands that experienced a negative (the Danish) and a positive (the non-Danish) demand shock took place at opposite margins. The drop in sales of Danish brands in 2006 (43%) is explained mainly by the intensive margin (35%), whereas gains by non-Danish brands (21%) by the extensive margin (15%). The decomposition suggests that Danish brands continued to sell the same products, but revenue per product dropped as a result of the boycott. In contrast, non-Danish brands expanded their product mix in order to fill the void left by the change in preferences against Danish products and to attract new customers. In other words, the positive demand shock impacted the product mix of firms (intra-firm adjustments) and not prices. The conclusions remain the same whether we look at 2- or 3- years ahead.

It is also worth noticing that we find strong evidence of cannibalization generated by the entry of new products by firms. This is shown by the -6%, -8%, and -6% growth on the intensive margin for non-Danish firms between 2005 and 2007, 2008, 2009, respectively.

4.4 Product entry characteristics

We have documented that the boycott against Danish cheese products in Saudi Arabia resulted in higher sales for non-Danish brands, and that the majority of these added sales came from the introduction of new products, the so called extensive margin.¹⁹

Of interest then is to examine the characteristics of these new products. In particular, we want to know (i) whether these new products (barcodes) are genuinely new products or re-introductions of existing ones but in new promotional bundles, and (ii) if competitors chose to introduce products to compete directly with Danish firms or they chose products that were similar but not identical. Following the convention in the marketing literature, we refer to the former case as *head-to-head* competition and the latter as *fill in the blanks*. For example, a Danish product with high sales before the boycott contained the following product description “240 gram GLS (glass jar) Blue”. As the boycott takes place and non-Danish firms considered what new products to introduce, our data allow us to examine whether these firms chose to offer consumers the exact

¹⁹While we consider non-Danish firms as a homogenous group, within the group there were winners and losers, especially among small brands. In the online appendix, we explain the reasons behind this. We find that consumers switched away from Danish cheese products and toward other premium-branded cheese products. This benefited the premium-brands competitors. But small brands also tried to benefit by introducing new products and some, by raising prices. However, overall cheese sales among fringe brands did not increase much, while competition was now tougher due to the substantial product entry in that segment. Fringe brands that raised prices, were therefore punished by the market and all suffered from fragmented sales.

same product (240 gram GLS Blue) or something similar (e.g. 240 gram GLS Gold or 150 gram GLS Blue).

(i) *Promotional bundles*

So far, and consistently with existing work on scanner data, we considered each barcode to be a unique product. But not all new barcodes represent a new product variety. For example, KRAFT may offer a *500mg blue cheese* and a *200mg gold cheese* in Period 1, and then offer again these two products in Period 2 but also a promotional bundle combining these two products (e.g. 500mg blue + 200mg gold free). This new bundle will carry a unique barcode and it will appear as new product entry in our analysis above.

Because an important aspect of our investigation is to understand better growth at the extensive margin, we proceed to distinguish between growth that comes from new barcodes and from genuinely new products. Therefore, here we take a more restrictive definition of what a new product is. Specifically, to count as new product, a barcode must have a brand-weight-package triplet that did not exist before. For example, “Kraft 500mg blue + 200mg gold free” or any other promotional bundle combinations of Kraft 500 will not count as new products as long as Kraft 500mg existed before. Note that this strict definition of product variety will understate new products as it will not flag various new flavors as new products (e.g. Kraft 500 light cheese).

The results from the strict definition of what a new product is are reported in *Table 4, panel (ii)*. Even with the stricter definition on what counts as new product, we still conclude that for non-Danish firms, growth in sales post the boycott, happened at the extensive margin. So our results are not driven by how strict or not our definition of new product is.

(ii) *“Head-to-head” versus “fill-in-the-blank competition”*

There are a couple of ways we can investigate this and both ways lead to the conclusion that firms chose to compete head-to-head. First, we counted the number of cheese brands and products in 2005 and then again in 2007 for each of the six cheese sub-categories. This is shown in Table 5 below. According to the table, the JAR sub-category, where the Danish brands had the highest market share pre-boycott, attracted the highest entry of both brands and products. Therefore, we conclude that entry was not randomly placed within the cheese category but it specifically targeted the sub-category of cheeses where the Danish had significant presence.

Table 5: Brands and items by segment, 2005-2007

Segment	Category share	Danish share	Brands		Items	
			2005	2007	2005	2007
JAR	0.466	0.348	16	28	186	294
TUBE	0.020	0.175	9	8	27	22
SQUARE	0.122	0.095	5	6	33	46
TRIANGLE	0.151	0.043	47	51	113	138
TIN	0.142	0.007	9	12	60	80
SLICES	0.099	0	16	20	106	137

Another way to establish the same fact is to allocate cheese products into two categories: (i) those varieties that are identical to Danish cheese products sold in 2005 and those that are not. First, we create a triplet of weight, package type, and variant such as blue, gold, and low. For example, “Glass Jar .24 gold”, “Glass Jar .24 blue,” and “Glass Jar 0.24 low” are three such product triplets. In total, all the 328 cheese products sold in Saudi Arabia in 2005 belonged to 105 such distinct triplets.

Next, we flag the product triplets sold by Danish firms in 2005 and call this the Danish product space pre-boycott. Out of the 105 product triplets, Danish firms in 2005 sold cheese products in only 24 of these triplets.

Finally, we count the total varieties in the Danish product space in 2005 and 2007 and compare it with that to the number of varieties outside the Danish product space. The results are available in Table 6 below.

As the table shows, the number of varieties in the Danish product space jumped from 152 in 2005 to 202 in 2007, while the number of varieties outside the Danish product space fell from 176 to 169. Note that our definition of head-to-head competition is very strict as we consider same items of different weight to be different triples and not to count as head-to-head competition. Yet, even with such strict definition of what an identical product is, the results indicate beyond any doubt that non-Danish firms chose to compete head-to-head with the Danish firms and not to fill in the blanks.

Table 6 – Orientation of New Products

Danish Product Space	# of triplets in 2005	# of varieties	
		2005	2007
Yes	24	152	202
No	81	176	169
<i>Total</i>	<i>105</i>	<i>328</i>	<i>371</i>

5. Conclusion

Firms have a few ways of responding to changes in economic conditions or shocks: they can adjust prices of existing products, they can adjust the frequency, depth, and type of promotional activity, and they can adjust the variety of products on offer.

In this paper we have used a successful boycott against Danish cheese products in Saudi Arabia to study how both Danish and non-Danish firms responded during and after the boycott. Our analysis, which benefited from micro- (scanner-) level data, revealed some interesting findings. First, and perhaps as expected, Danish firms lowered prices and increased the depth of promotions (but not the share of goods promoted). Interestingly, they did not change their product mix, the number of products that were available for sale.

More surprising was the response of the non-Danish firms. These firms, who benefited from the boycott, did not increase or decrease their prices, and they did not change their promotional activity. Instead, they responded to the boycott by adding new products and changing their product mix. And they chose to introduced new cheese products with identical description to those sold by Danish firms, hence competing head-to-head. To put the two together, the response of the Danish firms to the negative shock came at the intensive margin, and the response of the non-Danish to the positive shock at the extensive.

The fact that firms may respond to shocks of different direction using different margins is hard to reconcile with existing models. While the boycott we study is a very special case, and additional work is needed to establish whether this finding is robust or not to various other settings, a couple of potential mechanisms may be at play here. First, our results may hint at a significant difference in how management perceives shocks of the same magnitude but of opposite direction. It may be the case that negative demand shocks are perceived as more temporary in nature and generate a muted response, whereas positive shocks of the same magnitude are perceived as more permanent and generate a larger response. This may help explain why Danish firms did not change the product mix but non-Danish firms did. The fact that the non-Danish firms chose to compete head-to-head with the Danish seems to suggest they were anticipating significant and long-lasting effects of the boycott. Second, it may be the case that securing shelf space in retailers is very costly and once these sunk costs are incurred by brands, brands have less of an incentive to drop products in bad times than to introduce new in good times (where these fixed costs may conceivably be lower).

To conclude, we believe that the pattern of market dynamics at display here make a significant contribution to our understanding of the market adjustment process in response to a major shock and can provide key insights to enhance our understanding and our theories on pricing behavior and multi-product firms.

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