The Effects of Mandatory Disclosure of Supermarket Prices

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Abstract

We study how online mandatory disclosure of supermarket prices affected prices and price dispersion in brick-and-mortar stores. Using data collected before and after the regulation, a differences-in-differences research design and various control groups, we document a sharp decline in price dispersion and a 4% to 5% drop in prices. The decline in prices is concentrated among chains that initially set higher prices, and in stores facing weaker local competition. Finally, we present evidence suggesting that the drop in prices is smaller in products whose prices are harder to compare across retailers, and in products that consumers likely searched frequently already before the regulation. We discuss alternative channels through which transparency affected prices and show that the decline in prices was larger when more consumers used the price comparison websites. We also highlight the role of the media in disciplining prices.

keywords: Price Transparency; Information; Mandatory Disclosure; Retail Food; Supermarkets

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1 Introduction

The advent of the Internet and information technology since the late 1990's has dramatically changed markets and the role of information in these markets. Numerous websites and online platforms that now provide information on prices, availability and quality measures have had a tremendous impact on retail markets, consumers and firms. As is often the case, the response of the public sector to these technological changes lagged behind the private sector and only recently government agencies and legislators have begun pushing more aggressively towards regulations that would take advantage of the Internet as a means to disclose and disseminate information. Among these initiatives, a prime though contentious example is mandatory disclosure, and specifically the mandatory disclosure of retail prices.[1] Are these transparency regulations welfare improving? What is their effect on price levels and price dispersion? On the one hand, more information is likely to foster competition because firms are incentivized to set lower prices when consumers can observe price reductions. On the other hand, more price information can also be detrimental to competition as firms can use this information to coordinate prices. If the pro-competitive impact of price transparency is stronger then policy makers may want to advance policies that mandate price disclosure. On the other hand, if such initiatives actually help firms to tacitly collude then surely, from a social point of view, such policies should be abandoned. Surprisingly, although these questions are at the center of economics in general, and specifically in the field of IO, there is hardly relevant empirical evidence on this issue.

In this paper, we study the impact of a mandatory price disclosure regulation in the Israeli supermarket industry. Food items are important not only because consumers spend about one sixth of their disposable income on food but also because the steep rise in food prices between 2005 and 2011 was associated with social unrest and often violence in both western and developed countries (Bellemare (2015)).[2] In March 2014, the Israeli parliament enacted the Food Act, requiring supermarket chains to post online and continuously update their prices. Supermarket chains were given an adjustment period of more than a year and since June 2015, Israeli supermarkets post and continuously update the prices of each and every item sold in their stores. Starting in August

[1] For instance, gasoline prices in Germany, Italy, Australia and Chile are now available online. Also related are prices charged by large UK supermarket chains in the online segment are similar to those charged in large brick-and-mortar outlets. Another important class of transparency regulation is aimed at disclosing information on public spending, in an attempt to increase accountability and curtail spending. For instance, the 2014 DATA Act requires the U.S. federal government to transform its spending into open data (https://www.datacoalition.org/issues/data-act). Also in 2014, the CMS disclosed payment information for the first time on its Open Payment Program. https://www.cms.gov/Newsroom/MediaReleaseDatabase/Press-releases/2014-Press-releases-items/2014-09-30.html. Another recent effort by regulators is ensuring the competitive environment of E-commerce. See for instance, the Sector Inquiry published by the European Commission in May 2017.

[2] For instance, Spain and Greece have witnessed social unrest that is often linked to the rise in food prices. Though price increases are partially explained by increased demand from emerging economies, drought conditions and changes in commodity markets, policy makers are looking for ways to improve the functioning of food markets and ensuring that food prices do not soar. The OECD, for instance, published a lengthy report (OECD2013) describing the policies taken by each OECD country to improve the operations of the retail food market in that country.

2015, independent websites have developed price comparison services, which are freely available to consumers. We take advantage of this change in transparency to evaluate its impact on prices, and also examine how these changes depend on the pre-existing market structure conditions.

There are several challenges in identifying the impact of transparency on prices. First, we need access to price data both before and after the change in transparency. We overcome this challenge by collecting through a market survey firm the prices of multiple item sold in traditional stores in the year preceding the regulation. In the post-transparency period, we use data from one of the price comparison platforms. A second challenge is taking into account the various factors (e.g., local competition, costs, seasonality and consumers' tastes) that might also affect pricing decisions. In particular, because these factors may also change over time it is inherently difficult to attribute changes in prices to a change in transparency over the same time period. To illustrate these concerns, Figure 1 presents a time series of the average basket price for each of the supermarket chains in our data, in the year prior to the regulation and in the year after. According to the figure, both prices and price dispersion have fallen after the transparency regulation. Price dispersion declined soon after the retailers began posting prices, and the decline in prices seem to occur afterwards. However, although the pattern depicted in the figure may suggest that prices have fallen after prices became transparent, additional factors (other than transparency) might have also contributed to these patterns.

Our research design allows us to address such concerns. First, we use price data on more than 100 food items sold in nearly 100 stores throughout Israel. The price data were collected multiple times both in the year that preceded the transparency regulation as well as in the following year. Such a large set of items and stores mitigate concerns that the observed price changes are driven by unobserved local trends or changes which are relevant to specific food items. Second, and more importantly, we identify a group of "treatment" items that became transparent after the regulation, and compare the price changes in this group against price changes in four distinct control groups. Notably, the four control groups that we use offer a different reference group vis-a-vis the treatment group. The first control group consists of prices of the same items as in the treatment group but that are sold online, through the online channel of the same supermarket chain. These prices constitute a useful control group because prices of items which are sold online remained transparent before and after the transparency regulation became effective. Second, we use prices of items that were collected since March 2013 on a bi-monthly basis by the Israeli Consumer Council (ICC). The products collected by the ICC form a representative basket of items which were often cited in the media and frequently mentioned in chains' ad campaigns as a reliable source of price data. Accordingly, we treat these items as another set of items whose price was transparent before and after the transparency regulation came into effect. Third, we use prices of items sold in stores

of SuperPharm, the largest drugstore chain in Israel, as another control group. Since drugstores were exempted from the Food Act we can use their prices as a comparison group to prices in supermarkets that were subject to the Act. Finally, we use prices of items that were collected by the Central Bureau of Statistics in grocery stores. These grocery stores are also helpful for our purpose because grocery stores were also exempted from the transparency regulation.

In the empirical specifications, we also include a rich set of fixed effects, such as store, item and date. Accordingly, when using the online channel as a control group, our identification of the effect of transparency comes from comparing over time the change in prices of the same item, sold by the same chain but through a different channel. When using the ICC basket as control, our identification comes from comparing changes over time in prices of different items sold in the same physical store. Finally, when using the prices in drugstores and in groceries as control, our identification comes from comparing the change in prices of the same items before and after the regulation, sold in the same time period but in stores that were either subject or not subject to the regulation. Although each of the control groups might be subject to a critique, the fact that we use several control groups and obtain similar results, alleviate such concerns and gives us confidence that we actually identify the impact of transparency on prices.

Our first finding indicates that shortly after prices became transparent, the average number of distinct prices that a given item was sold for significantly fell. Before prices became transparent there were 16 distinct prices, on average, in 61 brick-and-mortar stores selling a given item. After prices became transparent, the average number of distinct prices fell to about 5, resulting in a much more uniform distribution of prices for each item. Figure 2 illustrates the fall in the number of distinct prices by presenting a time series of the average number of distinct prices for the items in the treatment group and in both the ICC control group and for items that were sold through chains' online channel. As can also been seen in the Figure 2, the average number of distinct prices in the two control groups was smaller already before prices in the treatment group became transparent. This finding is consistent with our view that the prices of products in these two control groups, and especially for prices of products that are sold online, were transparent already before the regulation. Quickly after prices became transparent, the difference between the treatment and the control groups diminished. Similar patterns are observed when we separately examine the number of unique distinct prices in different supermarket chains. We find that price dispersion has substantially declined also when we use conventional measures of price dispersion, such as the coefficient of variation or the percentage price range.

After demonstrating the change in price dispersion, we turn to analyzing the impact on price levels. Our estimation results indicate that prices of items in the treatment group have fallen by 4 to 5 percents compared to the items in the control group. Importantly, the estimates are quite

similar across the control groups and do not significantly change in different specifications (e.g., when using price promotions). We further examine how the effect on prices varies across different chains and how it depends on the level of local competition. With regards to chains, we find that prices have primarily dropped among the chains that are generally considered more expensive. In contrast, the impact of the regulation on heavy-discount chains is largely insignificant. In the specification that focuses on the role of local competition, we find that prices have declined more in supermarkets that faced weaker competition in the pre-transparency period. Arguably, these supermarkets had higher markups and therefore transparency resulted in lower prices and lower margins at these stores. The magnitude of our estimates is not trivial for both consumers and firms. Using the 5% price reduction estimate, we can use back-of-the envelope calculations for consumers' saving and firms' revenue losses from the increased transparency. In particular, we find that consumer saved about $27 per month and firms‘ lost revenues are about 375 million dollars each month.

After establishing the decline in both price dispersion and in price levels, we show that the change in price dispersion occurred immediately after the regulation became effective while the change in price levels materialized several months afterwards, at the beginning of 2016. We take advantage of this finding on price levels, and perform our next set of analyses focusing only on the period that chains were required to post their prices. This is useful because since August 2015 we have access to a significantly larger number of products and a much wider set of stores. Therefore we can better explore and characterize which products experienced a greater drop in prices at the beginning of 2016. In particular, our empirical analysis suggests that the prices of more expensive and less popular products goods fell more. In addition, we find evidence that the price of branded products have fallen more than the prices of "similar"' private label products. This latter finding is consistent with the competitive role of transparency, given that transparency was especially helpful for products that can be compared across retailers. We also show that the prices of goods that meet the most stringent level of kosher have fallen less than "similar" kosher items. Arguably, these findings suggest that the transparency had a smaller effect on products that are characterized by a higher level of consumer search already in the pre-transparency period.

What drives the findings that we document? We highlight two main channels that we think are important. First, we show that the reduction in prices is negatively associated with the usage of websites that offer price comparison services. We use monthly data on the total number of pages viewed in the three main price comparison platforms, and find a negative relationship between usage and prices. In particular, we observe an increase in usage of the three websites in the beginning of 2016. From one of these platforms, we also obtained information on the number of users at the city level. We use this information to show a negative association between the

number of per-capita users in that city and the price reduction in that city over the relevant time period. Second, we highlight the potential role of the media in disciplining retailers' pricing decisions. In particular, we argue that the media uses the available price information and act as an intermediary in disseminating that information to the market. Another channel that may be at play with regards to the media emphasizes the value that supermarkets chains and chains' managers obtain from getting positive media exposure. Thus, we claim that, at least some, retailers are interested in getting positive media coverage regarding the prices that they charge, and this also creates disincentive to raise prices.

The remainder of the paper is organized as follows. In the next section we review the relevant literature. In Section 3 we provide the necessary background on the regulation and the Israeli retail food sector. In section 4 we describe the research design and the data and in Section 5 the estimation results. We discuss our findings and the potential mechanisms in Section 6. In Section 7 we conclude.

2 Related Literature

Economic theory provides conflicting predictions regarding the consequences of mandatory disclosure of prices. On the one hand, as search costs decline and consumers become more informed about prices, both price levels and price dispersion are expected to decrease (e.g., Salop and Stiglitz (1977); Stahl (1989); Stigler (1961)). Indeed, if consumers were to know every firm's prices, everyone (assuming zero transportation costs) would buy from the firm offering the lowest price; thus, all firms would offer the same price. Theoretical search models also emphasize that not all consumers need to actively search for cheap prices. In particular, it is sufficient that only a fraction of consumers are informed about prices to show that prices may decrease. On the other hand, theoretical models in industrial organization (e.g., Green and Porter (1984), Rotemberg and Saloner (1986), Campbell and Muhanna (2005)) have shown that better access to price information can help retailers monitor their rivals' prices and adjust their own accordingly, thereby possibly facilitating tacit collusion. In this case, we might expect prices to increase and price dispersion to fall. Somewhat surprisingly, only few empirical studies have examined the consequences of mandatory disclosure of prices. Furthermore, such studies typically examine the impact of disclosing historical prices or wages. For instance, Mas (forthcoming) examine the impact of pay transparency regulations in which the wages of public officials were disclosed online. Cullen and Pakzad-Hurson (2017) study the equilibrium effects of pay transparency in an online labor market. Other related studies examine how firms change their pricing behavior during the post-transparency period. Byrne and Roos (2016) use 15 years of gasoline price data to document how tacit collusion was initiated and

formed during the post-transparency period. Albek et al. (1997) also use post-transparency data to show that the price of ready-mixed concrete in Denmark significantly increased after firms were required to disclose prices. Luco and Lemus (2017) show that gasoline stations in Chile misreport gasoline prices in areas where consumers were more likely to search for low prices. More closely related to our paper is Luco (2017) who study the impact of mandatory disclosure of gasoline prices in Chile. Luco (2017) find that prices have increased after the transparency regulation, while the results regarding price dispersion are inconclusive. Our paper is different from these studies for several reasons. First, we focus on the food retail market in which consumers purchase a bundle of goods rather than one product. As shown in Section 5.4, we exploit this difference to examine across various dimensions why different products experienced different price changes. Second, our data and research design enables us to use both pre and post transparency price data and examine how the effect of the regulation depends on the pre-transparency market conditions. Finally, our qualitative results significantly differ from the results documented in previous studies.

In contrast to the dearth of evidence on the impact of mandatory disclosure, several strands of the literature study the role of voluntary price disclosure. First, early studies in the advertising literature have explored how shifts in advertising affects prices and other performance measures. For instance, Milyo and Waldfoegel (1999) investigate how removing the ban on advertising prices of alcohol items affected firms' decisions which alcohol products to advertise and how these decisions affected prices (See Bagwell (2007) for a survey of the literature). Second, several studies examine how online markets are formed, and how prices in these markets are determined (e.g.,Brynjolfsson and Smith (2000), Ellison and Fisher (2009)). These studies are typically concerned with industries in which actual transactions are conducted online, and had to assume away selection issues with regards to the types of retailers who begin or expand their online operations. Another important related study is Brown and Goolsbee (2002) which shows how firms' decisions to post their prices online affect prices in traditional markets. They find that prices have fallen and that price dispersion has initially increased and then dropped. Brown and Goolsbee focus on a single product and have not examined how local market conditions affect firms' pricing decisions, and which firms choose to go online.

Our study is also related to the literature that studies the retail industry in general (Basker (2016)) and in particular the supermarket industry (e.g., (Masta, 2011; Matsa, 2011), Pozzi (2013) Dubois and Perrone (2015)). Among these, few studies examine the Israeli supermarket industry. Hendel et al. (Forthcoming) study Israeli consumers' boycott of the cottage cheese in the summer of 2011. Eizenberg et al. (2017) study the period 2005 to 2007 in the Israel supermarket industry, Ater and Gerlitz (2017) use retail food prices to study a ban on non-zero price endings, and finally Heffetz et al. (2016) also study the impact of the Israeli Food Act. Finally, our study is related

to the literature that emphasized the relationship between press coverage and politicians' actions and policies (Snyder and Strömberg (2010)).

3 Institutional Background

The average expenditure on food items in Israel accounts for 16% of disposable income. The Israeli retail food market is considered quite concentrated and was ranked 7th among OECD countries according to the CR3 criterion, and 5th according to the CR2 criterion (OECD2013). Shufersal, having 283 stores at the end of 2014, is the largest supermarket chain and Mega, the second largest chain, operated 197 stores at the end of 2014. The two large chains operate in many localities throughout Israel and each has several sub-formats. Other chains in our data had fewer stores at the end of 2014: Rami Levy, a heavy discount chain, operated 27 stores, Victory 28 stores and Yeinot Bitan 67 stores. Online grocery sales in Israel are growing but still account for only few percents from total food sales. Likewise, private label is growing but still account for a relatively small fraction of total grocery sales in the Israeli food market. Our study focuses on the above mentioned large supermarket chains given their significant market shares, 73% in 2014, and because each of these chains also offers an online grocery service (prices in the online segment are one of the control groups that we use).

The cumulative annual growth rate of food prices in Israel between September 2005 and June 2011 was 5%, compared with 2.1% for the period January 2000 to September 2005, and compared with 3.2% in the OECD countries for the 2005-2011 period.[3] This steep rise of food prices was a main driver behind the social protests that took place in Israel in the summer of 2011. Following the social protests, it is often said that Israeli consumers became more price-conscious and more likely to engage in search for low-priced items. One measure that captures the change in the competitive landscape before and after the social protests is the gross profits of the two largest supermarket chains, Shufersal and Mega. In the second quarter of 2011, before the summer protests, the gross profit percentage of Shufersal and Mega were 26.6 and 27.5 percents, respectively. In contrast, in the second quarter of 2014, the gross profit percentage of Shufersal and Mega fell to 23 and 24.9 percent, respectively. Somewhat in contrast to the downward trend among the large supermarket chains, the heavy discount chains were able to increase their market share over the same time period. Following the change in the competitive landscape and other managerial issues, Mega, the second largest chain, faced increasingly large financial difficulties and went bankrupt in early 2016. In June 2016, the Israeli antitrust authority allowed Yeinot Bitan, another large chain, to purchase Mega.

[3]See the Kedmi Committee report, 2012, page 8 - http://economy.gov.il/publications/publications/documents/kedmireport2012.pdf.

A direct consequence of the social protests in the summer of 2011, was the formation of a special committee on food prices (the Kedmi Committee). Following the recommendations of the committee and a long legislation process, in March 2014 the Israeli parliament passed the "Food Act". A primary component of the new legislation is the transparency chapter requiring retailers to upload real-time price information on all products sold in all stores into a publicly available data warehouse. Both chains' managers, politicians and academics have raised concerns regarding the effectiveness of the new regulation. The head of the economic committee in the Israeli parliament, MP Professor Avishay Braverman remarked "I am not convinced that transparency will result in good news. I hope that prices will go down in the process, though I doubt it and hope to be wrong."[4] Eyal Ravid, CEO of Victory, a large food retailer, argued that "what is transparency in the Internet? It is price coordination under the law." Likewise, Itzik Aberkohen, the CEO of Shufersal noted that "there is a concern that transparent prices will be used as a platform to coordinate prices under the law". Finally, Prof. Yossi Spiegel in an op-ed called the government "to reconsider the mass experiment that consumers are subject to". [5]

During May 2015 retailers began uploading price data to dedicated websites. Given that the raw price data uploaded by each chain were not easy to use, independent websites began making the data more accessible to consumers. During July and August 2015, websites began providing "beta" versions for price comparison services for food items sold in brick-and-mortar retail food stores across Israel. Information from personal communications indicates that food retailers and suppliers also obtained data from these websites. As of 2016, at least three websites offer food price comparison services: MySupermarket.co.il, Pricez.co.il and Zapmarket.co.il. We obtain the price data in the transparency period from one of these websites. Other parts of the Food Act came into effect in January 2015 and hence allow us to examine the impact of the regulation irrespective of the impact of these parts of the Act.

4 Methodology and Data

Identifying causal effects of transparency on prices is a challenging task for several reasons. First, such an endeavor requires an exogenous shock to the level of available information. In the absence of variation in the level of transparency it will be difficult to attribute any observed price differences to transparency. Furthermore, if price transparency is endogenously determined by the firms then selection is another valid concern. That is, the firms that will choose to advertise their products or the advertised products will not be representative of all firms or all products. Accordingly, the analysis of the effect of such a change in transparency might result in biased estimates. Second,

[4] See http://www.globes.co.il/news/article.aspx?did=1000921890. Interestingly, in his academic career, Braverman published an important work on consumer search (Braverman (1980)).

[5] See http://www.themarker.com/opinion/1.2506245.

identifying the impact of transparency requires data from both before and after the regulation. While, post-transparency regulation are likely to be available this is not the case for the pre-transparency period. Third, pricing decisions taking into account various factors, such as cost, local competition and seasonality. These factors may very well change alongside the change in transparency. Thus, to identify the impact of transparency on prices one needs to account for these additional determinants of pricing decisions and for changes in them. Finally, studying pricing decisions of supermarkets poses another challenge as thousands of items are sold in supermarkets. Accordingly, to obtain a reasonable estimate of the impact of transparency on prices, one should investigate a large sample of items. Our differences-in-differences research design offers a unique opportunity to address these issues. Below we describe our data and the research design that allows us to address these empirical challenges. Generally, we use price data collected in the year before the regulation and in the year following the regulation, We also compare price changes in items that belong to a treatment group against price changes in four distinct control groups: two control groups include prices of food items that were not transparent before as well as after the regulation, and the two other control groups consist of price of items that were transparent both before and after the regulation.

4.1 Data and descriptive statistics

Our price data come from several sources. For the pre-transparency period, we collected the prices of 69 products sold in 61 supermarket stores via a market survey firm. For the time period after prices became transparent we obtained the prices of these items from MySupermarket, one of the platforms that offers a price comparison service for food items sold in supermarkets in Israel. The selected products, which belong to several product categories (e.g., dairy products, drinks, ready meals, household cleaning, health and beauty) and different price ranges, comprise the treatment group in our analysis. The market survey firm collected prices in the pre-treatment period in the last week of the following 8 months: July, August, September and October and December 2014, and February, March and April 2015. Figure 1 presents a time series of the treatment basket average price for each of the five chains. As can be observed in the Figure, there is a declining trend in prices. In addition, there is convergence across chains' average prices, particularly shortly after prices became transparent. Yet, these patterns might be driven by other factors besides price transparency. The figure can also be used to rank the five chains according to the basket price. In fact, the price of the basket at the large chains: Mega and Shufersal is higher than in the other chains, and in particular, the basket price at Rami Levy, the heavy discount chain is the cheapest.

To take into account alternative factors that potentially affect prices, we collected the prices of products that belong to four control groups. First, since July 2014 we have been collecting

on a weekly basis the prices of all the items included in the treatment group but sold online through the websites of each of the five grocery chains. These prices are a useful comparison group because online prices were transparent both before and after the transparency regulation that we study. Unlike prices at traditional stores which are often determined locally and vary across stores, prices of items sold online by a given chain are similar regardless of the location of the store or the delivery address of an online customer. For the second control group we obtained monthly reports of product prices collected by the Israeli Consumer Council (ICC), the largest consumer organization in Israel. These monthly reports, beginning in March 2013, include price data of 48 items sold in hundreds of stores throughout Israel. Importantly, the 61 treatment group supermarkets is a subset of the ICC set of stores. The prices of these products, which are different from the items in the treatment group, were frequently cited in the media when reporting where consumers could find low-priced food items. For instance, a weekly update was dedicated to the ICC pricing initiative at "Saving Plan", one of the top-rating TV programs broadcasted in Israel. In addition to the media reports, supermarket chains often mentioned the ICC reports in their ad campaigns as a credible reference for cheap prices. Mega, the second largest supermarket chain dedicated about 40% of its advertising budget in 2014 to ads mentioning the ICC pricing initiative. Because chains and consumers are well aware of the items collected by the ICC, we consider the price of items collected by the ICC as transparent also before the regulation and use them as a second control group. The third control group is based on prices of 28 items sold at 32 stores affiliated with Super-Pharm, the largest drugstore chain in Israel. These prices provide a useful control group since drugstore chains were exempted from the Food Act.[6] The prices at Super-Pharm stores were collected before and after the transparency regulation law came into effect: in October 2014, April and October 2015 and April 2016. Given that drugstores do not sell the full array of products sold in supermarkets, we do not have a full overlap between items in the treatment group and the items in the Super-Pharm control group. Finally, a fourth control group includes the prices of 8 (treatment group) items collected by the Central Bureau of Statistics from grocery stores across Israel. Prices in grocery stores also form a control group because grocery stores were not subject to the regulation. We use these prices as an additional control group. Given the small number of items in the latter group, and because due to confidentially concerns, we cannot perform some of the analyses for this control group, we present the results using this control group only in the robustness section.

Following the regulation, the price collection effort is less cumbersome in the post-regulation period. Thus, for the post-transparency regulation period, we obtain weekly reports on the prices

[6]Starting on July 2017, drugstore chains are also subject to the transparency regulation. In the Online Appendix we present preliminary results that show that prices at Super-Pharm have declined by .. after its prices became transparent.

of nearly 355 items sold in 589 stores including the online stores of the five chains. The 355 items include the treatment group items; items collected by the ICC as well as other items, such as private label goods. In addition to an item's price at each store, these weekly reports also include information on price promotions associated with each item in each store. Throughout most of the paper, we use only the prices of items that belong to the above mentioned treatment or control groups. Table 1 present summary statistics for these prices and products separated by the different channel. In Section 5.4, in which we try to explain the differential price changes across different products and categories, we extend the sample of products and use the prices of nearly 300 products in the post-transparency period.

Figures 3 and 4 present a time series of the total price of a basket of items sold in the sampled stores starting in July 2014 and ending in July 2016. In both figures, we distinguish between the treatment and the control groups. In Figure 3 the control and the treatment group baskets consist of the same set of items, sold either through the online channel of through the traditional channel, whereas in Figure 4 the control group basket consists of items collected by the ICC. Since the items in the ICC control group differs from the items in the treatment group, we normalize the basket price of the control and the treatment baskets to 100 in April 2015 (the month before the regulation became effective). In figure 5 we focus on a subset of comparable items from the treatment and the ICC control group. That is, instead of using the entire ICC basket we restrict attention to items that appear in our treatment group and in the ICC control group and that can be considered substitutes. For instance, one of the items in the ICC group is 200 gram Nescafe Tasters' choice. Accordingly, in this exercise we include in the treatment group the price of another quality brand of coffee: 200 gram Jacobs Kronung Coffee. Likewise, we take from the ICC control group the prices of a 700 ml Hawaii shampoo bottle and from the treatment group items we use the prices of a 700ml Crema Nourishing cream wash bottle. Overall, in this exercise we have 20 items, 10 items from the treatment group and 10 items from the ICC control group. As can be seen in these figures, over the relevant time period the aggregate price of the treatment basket significantly fell compared to the aggregate basket price of the control group. Figure 3 also reveals that prices of items that are sold online were throughout cheaper than the prices of the same items sold in brick-and-mortar stores. One potential reason for this difference is that online prices were transparent in the pre-regulation period and this transparency led to fiercer competition in the online channel. More importantly, we also see that the gap between online and traditional stores has declined after prices in traditional stores became transparent. That is, prices in the online channel increase while the prices in traditional stores decline. A similar decreasing difference pattern is observed in Figures 4 and 5. In particular, when using the comparable basket of items, the patterns in the pre-transparency period of products in the ICC and in the treatment look quite similar. After

prices became transparent, we observe that prices of items in the treatment group decline relative to the items in the ICC group. While the graphical illustration is encouraging, the figures do not account for time and item specific changes that may have occurred over the relevant time period. In the regression analysis we take these factors into account. In addition to the price data we also construct measures of local competition. These measures are based on the number of supermarkets operated by rival chains within a certain distance of a given store. Finally, in Section 6 we also use data on the usage of the price comparison websites, some of it at the municipality level. We use these data to examine the relationship between the use of the price comparison websites and the observed price changes.

4.2 Identification and research design

To identify the impact of the transparency regulation, we compare price changes of items that belong to the treatment group with price changes of items that belong to the control groups. If the transparency resulted in increased competition among food retailers then we would expect that the prices of items in the treatment group would fall relative to items that belong to the control group. If, however, transparency helped food retailers to tacitly collude then we would expect that the prices in the treatment group would rise relative to the prices of items that belong to the control groups.

Importantly, each of the control groups helps to mitigate concerns about the validity of the causal interpretation of the estimation. For instance, using the online prices as a control group is important because it helps addressing concerns that the estimated effect in the ICC specification is driven by changes in the marginal costs of items in the treatment group, rather than by changes in transparency. In other words, as long as chains purchase the food items sold in traditional stores and in the online segment for the same price then changes in the marginal costs cannot constitute an alternative explanation for the estimates we provide. Likewise, using the items collected by the ICC as a control group is important because it mitigates concerns that the estimates when the online prices is used as a control group are driven by changes in the online segment that also could have led to higher prices in the online segment compared to the traditional segment. More generally, obtaining similar estimates for the impact of transparency when using the different control groups gives us more confidence that our estimates are indeed driven by the transparency regulation rather than by other changes in the market.

Our first specification focuses on the relationship between transparency and price dispersion. In the regression analysis, we use three measures of price dispersion: the number of distinct prices that a given item is sold for in a given period, the coefficient of variation of a given item in a given time period and the percentage price range of an item in a given time period. Since the dispersion

of prices depends on the number of observations per item-date, we include this measure in the price dispersion specification. The identification of the change in price dispersion comes from the comparison between the treatment and control groups, and exploiting the temporal variation in the implementation of the law. To capture changes in price dispersion we aggregate the price-store-date data to the item-date level. Formally, we estimate the following equation:

$$y_{ict} = \mu_i + \gamma_t + \alpha \times Num\_obs_{it} + \beta \times After_t \times Treatment_{is} + \epsilon_{ict} \quad (1)$$

where the dependent variable is one of three measures of price dispersion. The $After$ indicator equals one for items whose prices were collected after the transparency regulation came into effect in May 2015, and zero otherwise. The $Treatment$ indicator gets the value 1 for products in the treatment group of items. Num_obs is the number of observation the price dispersion measure is based on. The equation also includes fixed effects for the item and the time period in which the prices were collected. The item fixed effects capture time-invariant characteristics of each item, such as its mean cost of production. We also acknowledge the possibility of pricing trends that may vary across items by incorporating linear item-specific time trends. The week fixed effects capture the impact of seasonality on pricing and other regulatory changes that might have affected chains' costs and pricing decisions. Standard errors are clustered at the item level. The coefficient of interest, β captures the change in price dispersion in the treatment group of items after prices became transparent relative to the change in dispersion in the control group.

To identify the impact of transparency on price levels we use the following difference-in-differences specification:

$$log(p_{isct}) = \mu_i + \eta_s + \gamma_t + \beta \times After_t \times Treatment_{is} + \epsilon_{isct} \quad (2)$$

In this specification an observation is an item-store-date tuple and the dependent variable is the log(price) of item i sold in store s affiliated with chain c in week t. To control for other factors that potentially affect prices we also include week (γ_t), store (η_s) and item (μ_i) fixed effects. The week fixed effects capture the impact of seasonality on pricing and other regulatory changes that might have affected chains' costs and pricing decisions. For instance, the minimum wage in Israel was increased in April 2016 and this should affect retail chains' pricing decisions. Yet, such an effect should be captured by the week fixed effects. The store fixed effects capture time-invariant local competition conditions and the socio-demographic characteristics of local customers. Finally, we cluster the standard errors at the store level.

The main parameter of interest is β which is the coefficient on the interaction between the $After$ and the $Treatment$ indicators. Like in the price dispersion equation, the $After$ indicator equals

one for items whose prices were collected after the transparency regulation came into effect in May 2015, and zero otherwise. The $Treatment$ indicator gets the value 1 for products that belong to the treatment group of items and that were collected by the market survey firm. The identifying assumption is that the only systematic difference between the control group products and the treatment group products is the amount of price-related information available to consumers before the law took effect. Per our discussion above regarding the use of the different control groups, and given that the treatment and control groups contain a substantial number of products in several categories, with overlapping manufacturers and different retailers, we believe that this is a reasonable assumption.

We also examine how the local market conditions affect retailers' response to transparency. To do so, we interact the the $After*Treatment$ variable in Eq. 2 with a measure of local competition that we constructed based on the number of other retailers that operate in the local market. We construct two such measures. One is a continuous measure and the other measure is a binary variable for high and low competitive environments. Notably, in this analysis we are exploring whether stores affiliated with the same supermarket chain but face different local competitive conditions respond differently to the transparency regulation. Because we are comparing pricing decisions by same-chain stores, we only use the ICC prices as a control group in this exercise.

In Section 5.4, where we use price data only from the post-transparency period, we estimate Equation 2 with three modifications. First, we only use online prices as a control group. This is because we can match each item with its counterpart online item sold by the same chain. Second, consistent with our findings in Section 5.3 regarding the time that prices have started to decline, we define the post-transparency period as starting in January 2016. In other words, in this analysis the pre-transparency lasts from August to December 2015, and the post-transparency period lasts from January to July 2017. Third, as we further explain in Section 5.4, we add to the specification interaction terms that enable us to examine the differential effect of transparency on different types of products.

5 Results

5.1 Price dispersion

The regression results of Equation 1 are shown in Table 2. The table includes the estimates for three measures of dispersion for the price charged for a product in a given week: the number of unique prices, the coefficient of variation and the percentage price range. Each three columns corresponds for a different measure of price dispersion and includes not only the point estimate of the parameter of interest but also the average value of the dependent variable. Although the

magnitude of the transparency effect varies across dispersion measures and control groups, the table demonstrates an economically and statistically significant decrease in price dispersion. For instance, in columns 1-3 we show that after prices became transparent the number of distinct prices charged for a product in a given week has fallen by 8 to 16 distinct prices, depending on the control group that we use. This decrease is fairly large given that the average number of distinct prices for a product prior to the mandatory transparency was between 16 to 19.[7]

5.2 Price levels

To explore the effect of mandatory disclosure of prices on the price level, we present in Table 3 the regression results of Equation 2. The point estimates of the main parameter of interest for the various control groups are roughly similar and indicate that after prices became transparent, the prices in traditional supermarkets fell by 4 to 5 percents relative to the prices in the control groups. We also estimate the same equation using a comparable basket of goods. That is, products in the treatment group for which we identify a comparable item in the ICC control group. We obtain similar qualitative results (presented in the Online Appendix), though with a larger magnitude. One interpretation for the larger magnitude obtained for this subset of products is that the transparency was more effective for products that have better substitutes among products that were already transparent.

Table 4 presents the point estimates from a version of Equation 2 that simultaneously estimates the transparency effect for each of the supermarket chains. The regression results illustrate that the reduction in prices attributed to the transparency change is mostly among the more expensive chains: Mega, Shufersal and also Victory. For the chains that set relatively cheaper prices: Yeinot Bitan and Rami Levi we do not find strong evidence that prices have fallen. A different heterogeneous effect analysis in presented in Table 5. This analysis accounts for the possibility that the effect of transparency on prices varies with the degree to which a store faces local competition. We estimate two specifications. In column 1 we present the results of a specification that allows the effect of transparency to differ between stores that operate in markets that are more (less) concentrated than the median degree of concentration. The second specification, whose results are presented in column 2, imposes a linear effect of local competition on the effect of transparency on prices. The regression results suggest that the change in prices is greater in stores that faced weaker competition. Overall, these findings suggest that prices have declined more when they set at a relatively high level before the transparency regulation.

[7] In Table 1 in the online Appendix we present the estimation results of a specification that estimates the effect on the number of unique prices for each of the chains. The table reveals significant effect for each of the chains, suggesting that no single chain is responsible for the results shown in Table 2.

5.3 How quickly do prices adjust?

Given the effects on price dispersion and on the price level presented in Tables 2 and 3, it is natural to examine the pace at which these effects took place and their relative order. To examine this, we conducted an analysis estimating monthly effect of price transparency for each month included in our sample. This type of analysis is also useful for examining the degree to which the outcome variables responded *prior* to the date in which price transparency became mandatory. We estimate the monthly-specific effects using flexible versions of Equations 1 and 2 and present the monthly effects on the number of distinct prices (as a measure for price dispersion) and on the (log) price levels in Figure 6. The figure demonstrates that the effect on price dispersion was quite immediate, whereas the effect on prices was essentially indistinguishable from zero until the beginning of 2016, and only then the effect became negative and statistically significant. This suggests that supermarket chains responded to the mandatory disclosure of prices in two phases: First, they reduced the number of distinct prices for each item while maintaining the average price unaffected, and only later they decreased the level of prices that they charge.

5.4 Differences across products

Above we showed that the decline in prices materialized several months after the transparency regulation became effective only in the beginning of 2016. We now exploit this fact and repeat the differences-in-differences analysis for the post-transparency period using panel price data on 355 products, which are available to us since August 2015. In our first analysis that relies only on data from the post-transparency period we obtain similar results to the ones reported in Table 3. That is, the price difference in traditional stores between the January-August, 2016 period and the August-December, 2015 period compared to the corresponding price difference of the same items sold through the online channel is 5%. This finding, shown in column 1 in Table 8, suggests that our initial sample of products is largely representative of the products sold in supermarkets. Next, we use a regression framework to characterize which products experienced a greater drop in prices after December 2015. First, we divide the 355 products to 10 price deciles based on the mean price and estimate a specific treatment effect for the set of products within each of the mean price deciles. As shown in Figure 7 we find a strong negative relationship between the price level and the corresponding decline in price. Next, we examine how the observed price reductions are correlated with the popularity of each product. For this matter, we classify a product popularity based on a list of the top 500 selling items at Mysupermarket.co.il.[8] We then interact this measure of popularity with a post-transparency indicator and add it to the estimated specification . The

[8]Because more than half of the products in our sample are not included in the top 500 products, we cannot directly match the list with each product. Instead we use a more coarse classification for popularity. The results are robust to different classifications.

regression results are shown in column 2 of Table 8. As can be seen in the table, the results suggest that the prices of more popular products have declined less than the prices of less-frequently bought items. One potential explanation for this finding is that in the pre-transparency period consumers paid closer attention to products that are more frequently bought. As a result, prices for these products were relatively low, and the impact of the transparency regulation on prices was greater for less popular goods. We now turn to comparing price changes among private label products and branded products in the same category. To capture this difference, we estimate an equation similar to Equation 2 and also include two interaction terms. One interaction term is the indicator for the post-treatment period interacted with an indicator for a private label product, and a second interaction term is a post January, 2016 period indicator interacted with a branded-product dummy. We present these regression results in columns 3 and 4. As shown in the table, we find that the prices of branded products dropped more than the prices of private label products. For column 3, the sample of products consists only the 12 categories that contain private label products, while in column 4 we include all 91 categories, including those with no private label products. In both cases, we find that the prices of branded products fell more than the price of private label products and that the differences are statistically significant. These findings may suggest that following the transparency regulation, consumers find it easier to compare the prices of branded products relative to the prices of private label products which differs across chains, even within a category. Finally, we also examine the prices of products that can be characterized by a high degree of consumer search, even prior to the transparency regulation. We expect that likely-to-be-searched products to exhibit a smaller price reduction following the transparency regulation compared to similar, less "searchable" products. In particular, we compare price changes of products in the same category that either offer the most stringent kosher requirement ("Kosher Le'mehadrin") to products carrying the regular kosher label only. Ceteris paribus, a typical consumer will be indifferent between the two kosher options. Yet, for a group of religious Jews consumers only the more stringent kosher requirement is relevant. Thus, for instance, in the kosher mehadrin group we have Osem bamba peanut snack 25 grams while in the regular kosher group we have Osem bamba peanut snack 100 grams. The results, presented in column 5 imply that the prices of the more stringent kosher goods have fallen less relative to the regular kosher products. Like before, the price differences are statistically significant. Qualitatively similar results hold when we add products from other categories (column 6). Overall, these results may suggest that the prices of products that can be characterized by a high degree of search before the transparency regulation fell less than other products.

5.5 Research Design Validation

5.5.1 Grocery stores as an additional control group

Our regression analysis indicates that following the transparency regulation prices of items in the treatment group fell by 4-5 percents compared to the prices of items in the different control groups. A potential concern with our results is that they are driven not only by the transparency regulation, but rather by the change in the source of data which is being used for the analysis. For example, the source of data for the treatment group in the pre-transparency period is a market survey firm, whereas after the regulation the treatment group data come from a price comparison website. Thus, if there are systematic measurement errors associated with one of these methodologies then our results are potentially biased. In particular, if (due to the collection method) the prices recorded in the treatment group during the pre-regulation period were systematically higher than the actual prices, then our results are potentially biased upward (in absolute values). To alleviate this concern, we obtained data collected by the Israeli Central Bureau of Statistics ("CBS") for the same time period as our main analysis. The prices of the eight items that we obtained are regularly collected by the CBS to construct the Israeli CPI. Importantly, the methodology to collect the prices of these items has not changed over the relevant time period. The CBS data include an item identifier, price, store identifier, city name, the month in which the price was collected and an indication whether the store belongs to a supermarket chain or is it a grocery store. Overall, the CBS data include nearly 9,500 observations from 110 supermarkets and 73 grocery stores. For confidentiality, these data do not include a specific address, chain affiliation or exact date. Thus, we cannot directly compare it with the other sources of data that we use. Nevertheless, we can use the CBS data to examine how the regulation affected prices in supermarkets (which were subject to the regulation) relative to changes in prices of the same items but sold in grocery stores (which were not subject to the regulation).

More specifically, we estimated Equations 1 and 2 using the price data on the 8 items collected by the CBS. The results of these analyses, which are presented in Table 6 indicate that both the price dispersion and the price level have fallen after the transparency regulation. The magnitude of the price reduction is 2.2% compared to 4% or 5% change in our analysis presented in section 5.2. Given that the sample of items in this analysis is considerably smaller than the sample of products that we use in the main analysis, we consider these results as providing additional support for the findings presented in the main analysis. Using the prices in grocery stores as a control group is also useful because, as we we further discuss in section 5.5.4, it is difficult to see how the results based on the grocery stores are driven by a strategic response of these independent small grocery stores.

5.5.2 Parallel time trends

The key requirement for the differences-in-differences research design to be valid is that both control and treatment groups share the same time trend. Given the multiplicity of control groups used here, we find it useful to demonstrate that each of the control groups share a similar time trend with the treatment group. For this, we estimated specifications using log(price) and the number of distinct prices as the dependent variables that incorporates group (treatment/control) by month specific effects and graph these effects in Figure 8. The figure demonstrates that for each control group and outcome variable, the treatment group time trend is nearly parallel to the corresponding control group time trend. This observation validates the ability of the research design to identify the regulation treatment effect.

5.5.3 Placebo tests

A potential threat to identification when using a differences-in-differences research design is that the estimated effects are not driven by the treatment, but rather by other unobserved factor. For this, we conducted a placebo test by considering a sample that started on July 2014 and ends of July 2015, just before the full implementation of the regulation. We then re-estimated the price regression (Equation 2), defining a fictitious date for the transparency regulation implementation. Since the treatment group was sampled eight times in the pre-regulation period, and given that we want the placebo pre-regulation period and the placebo post-regulation period to incorporate at least two data pulls each, we are left with at most five possible points in time to set the fictitious regulation dates. We conducted the test for both the online and the ICC control groups. The results, which show no significance effect of the fictitious regulation, are presented in Table 2 of the Online Appendix. These results mitigate the concern that another event that occurred prior to the regulation implementation explains our findings.

5.5.4 Strategic response by Super-Pharm

Another potential concern with the interpretation of our findings is that prices of items in the control groups may react to the increased transparency, and potentially increase. If this is the case then our results are potentially not driven by lower prices in the treatment group but rather by higher prices in the control group. In particular, if following the transparency regulation, Super-Pharm decided to target insensitive price consumers by raising its prices then our results may overstate the impact of the regulation. While we believe that it is unlikely that Super-Pharm prices will rise once consumers can observe that prices in supermarkets are cheaper, this is not theoretically impossible. To address this concern, we classify Super-Pharm stores in our sample as ‘close‘ or ‘far‘ based on their proximity to a supermarket store. We then check if the price changes

in 'close' Super-Pharm stores differ from the price changes in stores defined as far. Arguably, if the above concern holds, we should expect that prices in close stores rise compared to stores defined as far. We do not find such a relationship. Second, as mentioned in Section 5.5.1 we use prices of items sold in individual grocery stores as an additional control group and find qualitatively similar results. This analysis further suggests that our main results are not driven by a strategic response by Super-Pharm.

6 Potential channels

6.1 Usage of price comparison websites

The natural channel through which increased transparency resulted in lower prices is consumers' access to price information and its usage. To examine this channel, we obtained from Similarweb, a digital market intelligence company, data on the total number of pages viewed at each of the three websites that offer price comparison services (MySupermarket.co.il, Pricez.co.il and ZapMarket.co.il). These data, at the monthly level, cover the time period from June 2014 to November 2016. Overall, the number of visitors in these websites increased over the relevant time period.[9] Thus, the total monthly number of pages viewed at Pricez.co.il, the only website that relies on price comparison services in the traditional stores as its core business, increased from about 100k before the regulation to above 300k in September and October 2016. Also, the average number of pages viewed per visitor increased from about 2 pages per visit before the regulation to 8 pages per visit towards the end of the period. We then use the total number of pages viewed in each month to estimate a treatment intensity version of Equation 2, replacing the transparency indicator in the original specification with the number of total-pages-viewed in a given month. We perform the analysis using the three control groups and either use the total number of pages viewed in three websites combined or focus only on the information for Pricez.co.il.[10] The regression results, presented in Table 7, support our conjecture that increased access to price information leads to lower prices in traditional stores. This regression estimates are qualitatively similar across the three control groups and for the two intensity measures. Focusing on the results using only the visits at Pricez.co.il, the estimates suggest that a monthly increase of 100k pages viewed is likely to result in a price decrease of 2.9% in traditional stores compared to the online prices. In addition, the fact that we observe an increase in the usage of the different platforms in early 2016 is consistent

[9] The data on the number of visitors are available for MySupermarket and for Pricez also in the pre-transparency period. The reason for this is that MySupermarket's main business is in the online grocery segment, and Pricez offered a price comparison service based on consumer reports.

[10] Given that the main business of MySupermarket is to facilitate online shopping, we are unable to disentangle between customers who visit that website to shop online (e.g., at Shufersal Online) from visitors who want to obtain price information in traditional stores. ZapMarket, the third website began offering service only in November 2015.

with our results in Section 5.3 that prices have declined at the same time.[11]

While the latter analysis supports the argument that better access to price information leads to price reductions, we are quite hesitant to conclude that this is the only channel through which the transparency regulation affected prices. In particular, the overall number of visitors at the three websites is not large. Furthermore, from conversations with these websites the number of users who actively use the mobile applications of these websites is also not large. For that reason, we suspect that relying only on the number of customers who directly access the price information as the main mechanism does not provide a complete explanation for the reduction in prices. Instead, we believe that a related channel can, at least partially, also contribute to the reduction in prices. We refer to this channel in the next subsection.

6.2 The Media

The Israeli media, especially since the massive social protests in the summer of 2011, has been actively involved in supporting pro-market agendas, criticizing attempts to gain market power and denouncing price increases. Both traditional and online newspapers regularly report on consumers' issues, typically taking a pro-consumer point of view. The media coverage of consumer-related topics also involves price comparisons. However, while before the transparency regulation, reporters had to visit themselves the stores and wander across the aisles to find the prices of each product, after the regulation the costs of collecting and comparing prices significantly fell. For instance, on April 7th 2016, Ynet, the most popular Israeli website, reported on a comprehensive price comparison across dozens of retailers across Israel. The comparison, based on information from Pricez, included information from 18 geographic regions, where the names and addresses of the three stores that offered the cheapest basket in each region were reported. The number of items included in the basket compared varied across regions, where the minimum of items was 130 in one region and 210 items in another.[12] On January 12, 2016, channel 2 news, the most popular news program, had a 4.5 minutes item on a new price competition among supermarkets chain in the city of Modi'in.[13] To compare prices across supermarket chains, the reporter used the online application of Pricez. In December 2015, the Israeli Internet association, together with Google and the Israeli Fair Trade Authority, launched a competition for the development of the best food price comparison application. This competition received coverage by national coverage.[14]

The national media also compared the user interface of food price comparison websites, their

[11] In the Online appendix, we report additional analyses that exploits cross-sectional variation across cities in the usage of Pricez. We find a negative relationship between the per capita number of Pricez' users in a given city and the transparency effect on prices in that city.

[12] http://www.yediot.co.il/articles/0,7340,L-4788678,00.html.

[13] www.mako.co.il/news-channel2/Channel-2-Newscast-q1_2016/Article-996f23598873251004.htm.

[14] See http://www.globes.co.il/news/article.aspx?did=1001056276 and http://www.globes.co.il/news/article.aspx?did=1001074618.

accuracy and graphical design. In other cases, the media reported on price differences across stores or regions.[15] Another example of the role of the Media in using the price comparison services and in disciplining retailers' pricing decisions is the merger between two large supermarket chains: Mega and Yeinot Bitan in June 2016, towards the end of our sample. In this case, TheMarker, a leading business national newspaper, compared the price changes at the merged firm before and after the merger relative to price changes at another supermarket chain that did not take part in the merger. TheMarker used price data from one of the price comparison platforms and repeated this exercise a few weeks after the merger as well as a few months after the merger.[16] We also found reports at the local level on the new price comparison platforms. For instance, the local newspaper of Petach Tikva, the fifth largest city in Israel, used the price comparison platform to report on the supermarkets with the cheapest prices.[17]

We believe that the extensive coverage of consumers' issues by the media has two potential effects on supermarket prices. First, thanks to the media, the number of consumers who are exposed to price comparison services is significantly higher than the actual number of consumers who visit the price comparison website. Second, and at least as important, many food retailers value a positive press coverage. Thus, for instance, in 2012, Rami Levy, who owns and manages the heavy discount chain Rami Levy, was chosen by TheMarker as the most influential figure in Israel in that year! On Israel's independence day in 2015, Rami Levy received from the state of Israel, the most prestigious award for Israelis who made a difference for society. No doubt, that the media's praise and support were helpful in the widespread recognition of Rami Levy's achievements. This latter channel implies that regardless of whether consumers actually respond to lower prices set by retailers or not, retailers have an incentive to set low prices and to be regarded as offering consumers good value for the money.

7 Discussion and concluding remarks

Only since the beginning of 2017, several large retail chains, including Macyṣ, JC Penny, Sears and Payless Shoesource have announced the closing of hundreds of brick-and-mortar stores and the layoffs of many thousands of employees.[18]This dismal trend is often attributed to the highly competitive digital age and the strength of online giants such as Amazon. However, Amazon's decision to purchase Whole Foods $13.7 billion seems to suggest that Amazon acknowledges that

[15]See http://www.themarker.com/consumer/1.2824847 for food price applications comparison. For reports on price differences see http://www.globes.co.il/news/article.aspx?did=1001108062 and http://www.yediot.co.il/articles/0,7340,L-4858377,00.html.

[16]See http://www.themarker.com/advertising/1.3006498 and http://www.themarker.com/advertising/1.3116830

[17]See https://goo.gl/YsVT9a

[18]https://www.usatoday.com/story/money/2017/03/22/retailers-closing-stores-sears-kmart-jcpenney-macys-mcsports-ganderm 99492180/

there are great complementarities in having presence in traditional stores, at least in the grocery segment. One likely implication of mixing the online and the offline retail world, is displaying online the prices of products sold in traditional stores. In this paper we investigate what are the implications of price transparency?

Economists often stress that available price information is crucial for the efficient functioning of markets. Yet, others have stressed that more information can also be used by firms to better coordinate the actions in a manner that will reduce consumer surplus. Somewhat surprisingly, while the impact of mandatory disclosure of price information is at the core of IO, to our knowledge, only few studies have examined this issue empirically. These studies have focused on markets in which firms sell one or two products and have not examined how the effect varies with pre-regulation competition conditions.

We investigate the effects of the transparency regulation in the supermarket industry in Israel. Following this regulation, Israeli food retailers have began uploading food prices to the Internet and independent websites have developed price comparison services. We use this regulation to investigate how price transparency affected pricing decisions. First, we show that supermarket chains, shortly after the regulation became effective, reduced the number of distinct prices that they set for each item that they sell. This finding suggest that supermarket chains, anticipating that prices become transparent, changed their pricing strategy. Second, we show that prices have fallen and that the decline in prices is greater in stores that initially set high prices: either stores that are affiliated with more pricey chains or stores that face weaker competition in their local markets. These latter set of findings suggest that as price information became available to consumers, the media and food retailers, the competitive role of information prevailed and prices have declined.

The impact of transparency potentially affects other decisions made by the firms. For instance, how product availability is affected once consumers can observe it before reaching to the store? How often prices change in such an environment and whether firms adopt a different price promotion strategy? Another potential issue is how transparency affect firms' advertising decisions. While without transparency, loss-leader campaigns may be useful to attract consumers who do not have access to prices of other items in the store, this may not longer be the case when all prices become transparent. We leave these issues for future research.

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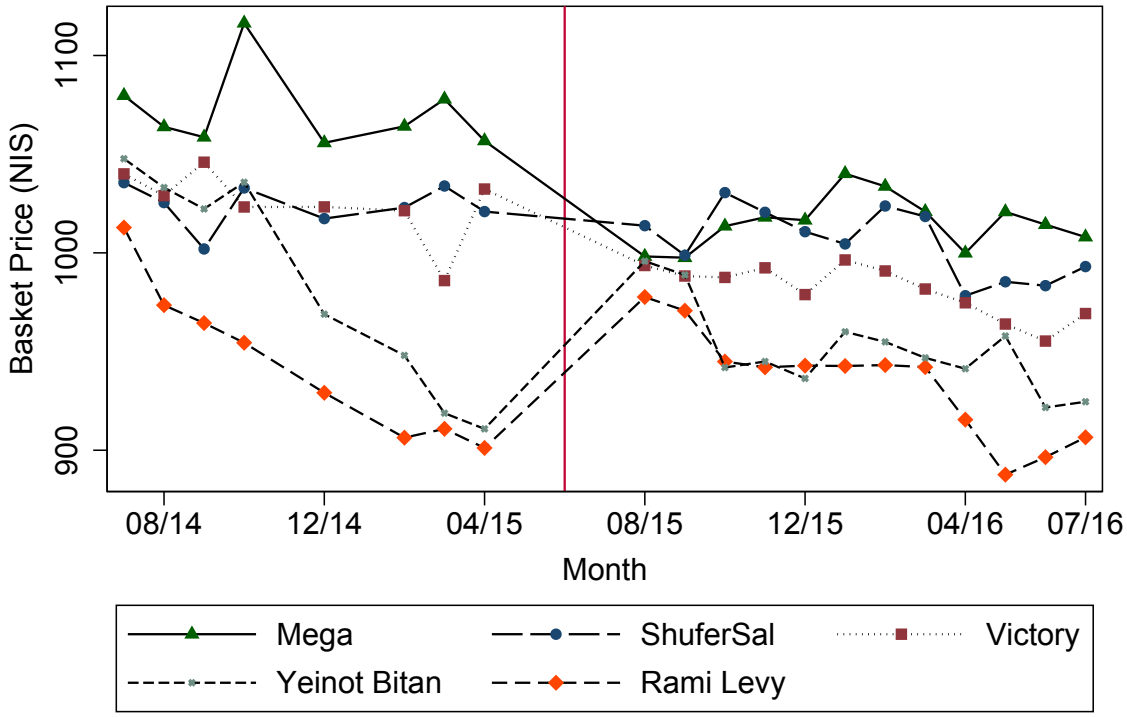
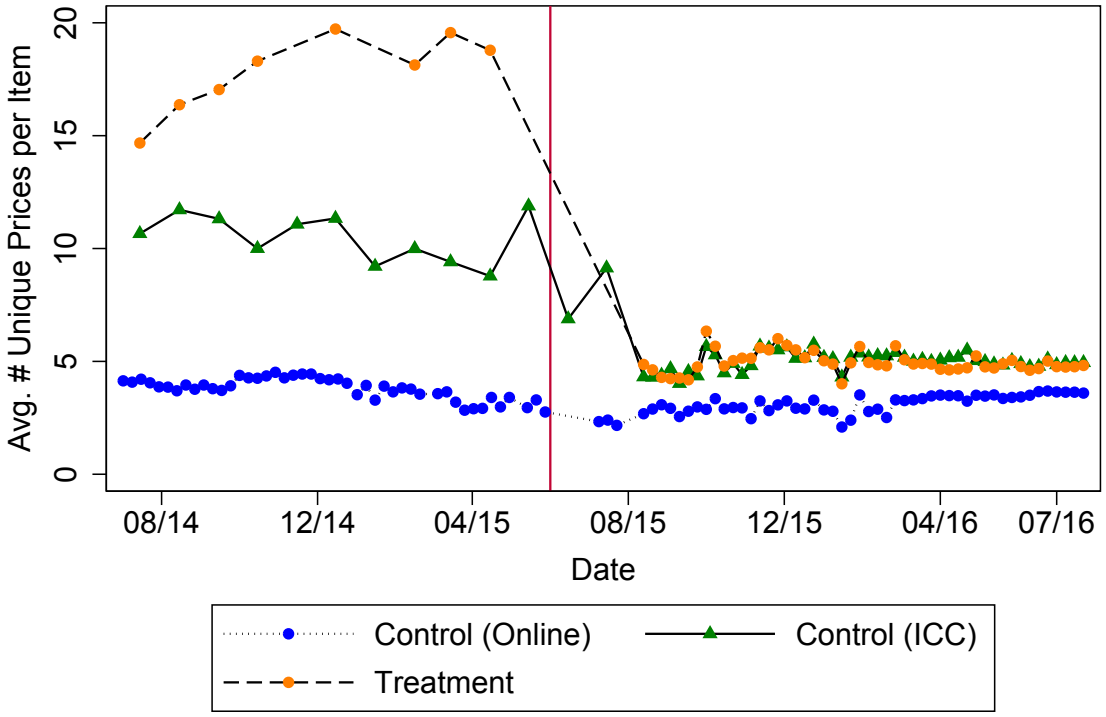
Figure 1: Retailer-Specific Basket Price



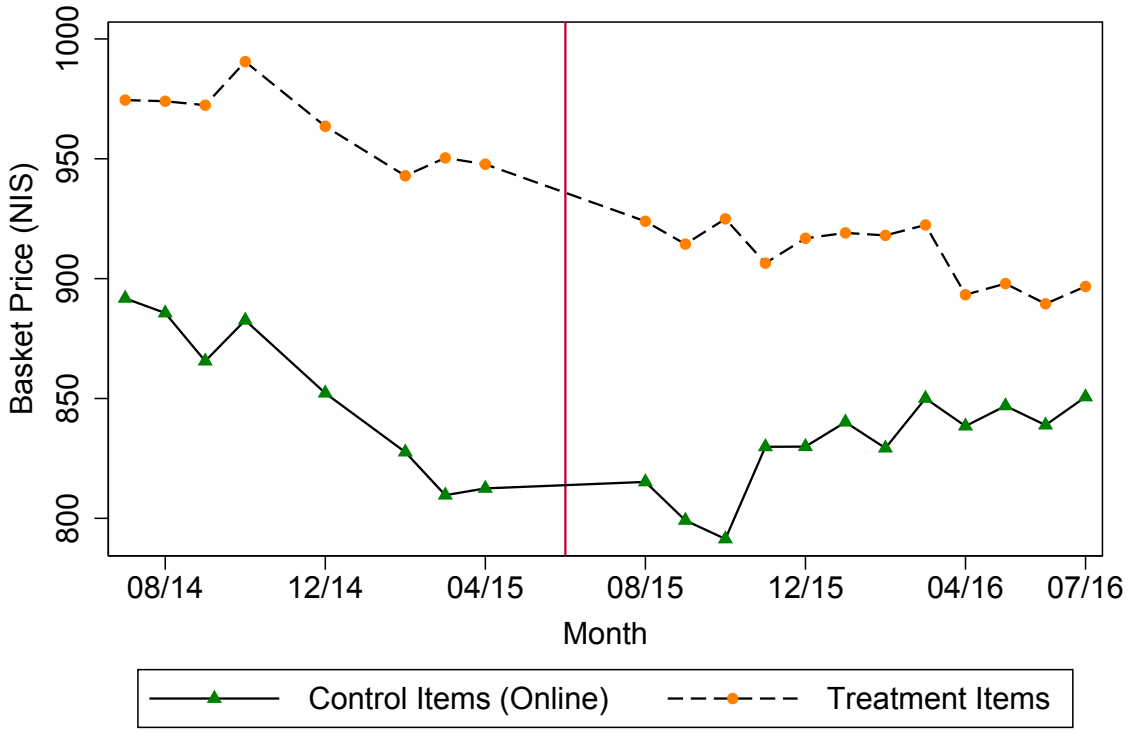
The figure shows a time series of the total basket price for each of the retailers. A basket consists of 58 items. Monthly basket price is the sum of items average price, where the average is taken over the retailers' stores. Missing price are imputed.

Figure 2: Number of Distinct Prices



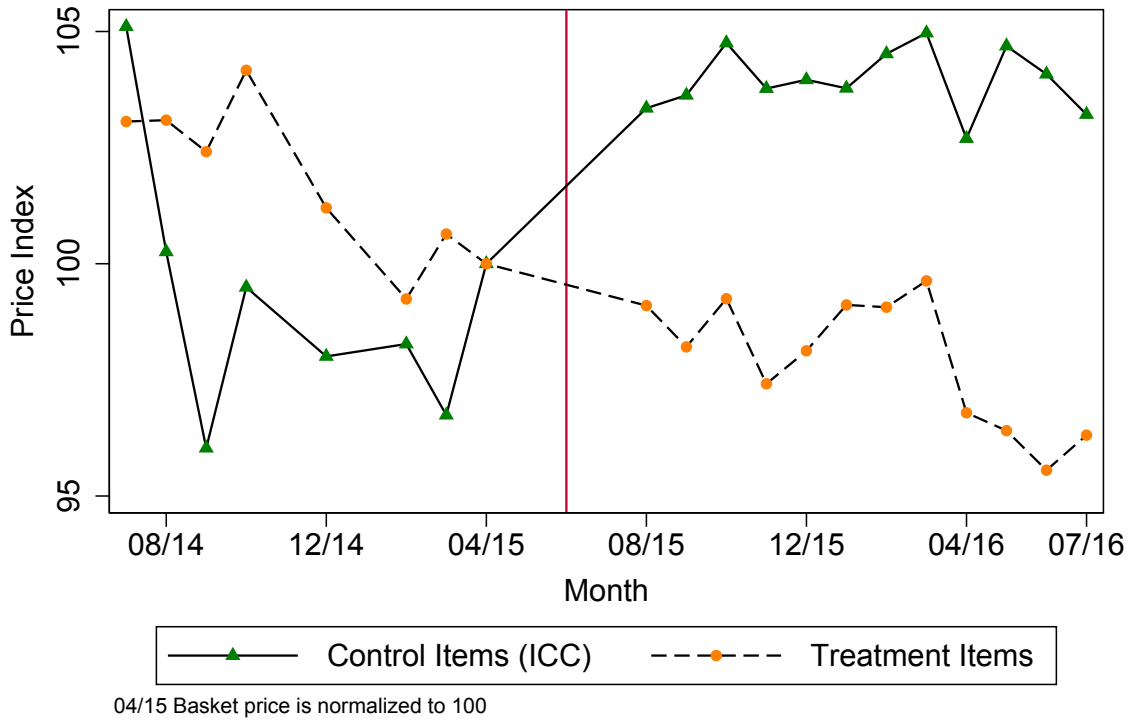
The figure shows a time series of the average number of distinct prices for the treatment group of items, the ICC control group and the online control group.

Figure 3: Basket Price in the Online Control and the Treatment Groups



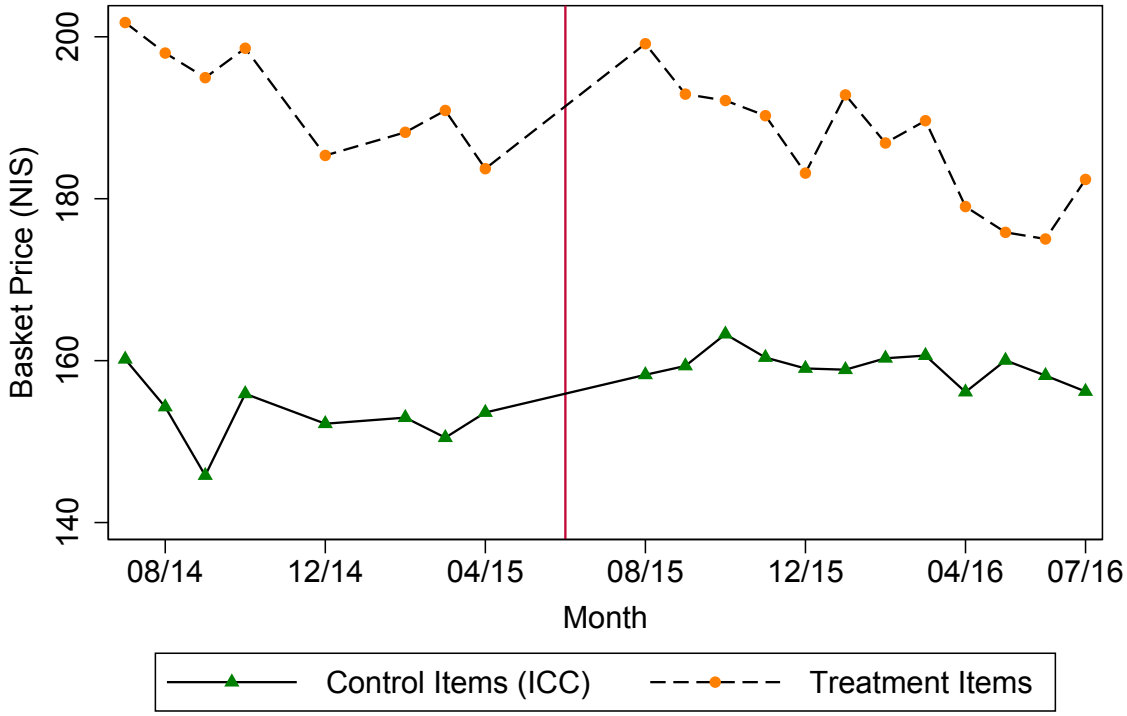
The figure shows a time series of the total basket price, divided into the online (control group) channel or traditional (treatment group) channel. In each channel, prices are averaged across stores and chains and missing prices are imputed. The figure shows that throughout the period the online basket is cheaper than the same basket purchased in the traditional channel. Yet, the difference between the two channels falls after the prices in traditional stores became transparent.

Figure 4: Basket Price Index in the ICC Control and the Treatment Groups



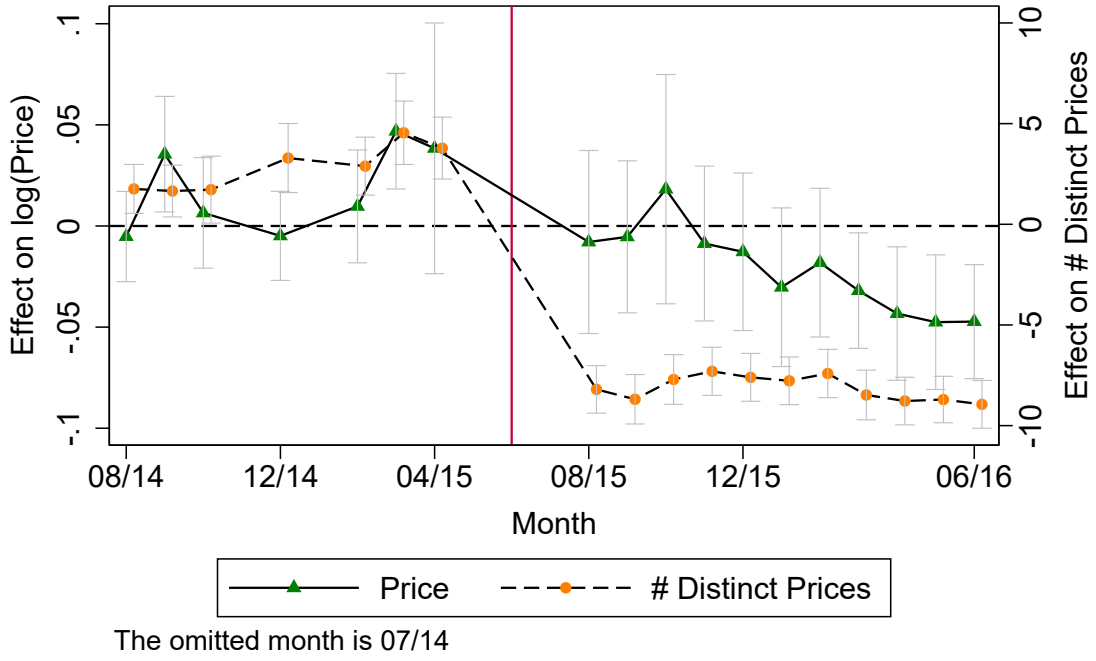
The figure shows a time series of the total basket price, divided into the ICC control basket and the treatment basket. In each group, prices are averaged across stores and missing prices are imputed. Since the two baskets contain different items, we normalize each basket price to 100 on April 2015, the last data point before price transparency became mandatory.

Figure 5: Comparable Basket Price



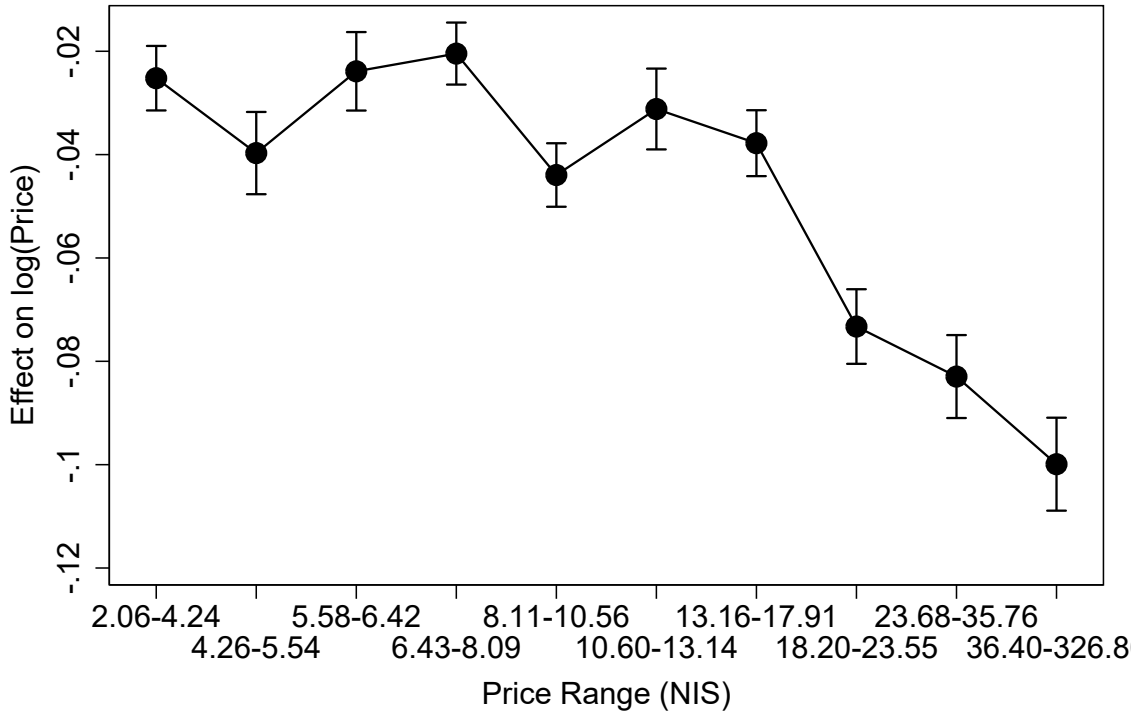
The figure shows a time series of the total basket price for two baskets. One basket consists from 10 ICC cotrol items (control group) and the other consists from 10 comparable items from the treatment group. The figure demonstrates that the two baskets exhibit similar patterns before prices in the treatment group became transparent.

Figure 6: Monthly Effect on Price Level and Price Dispersion



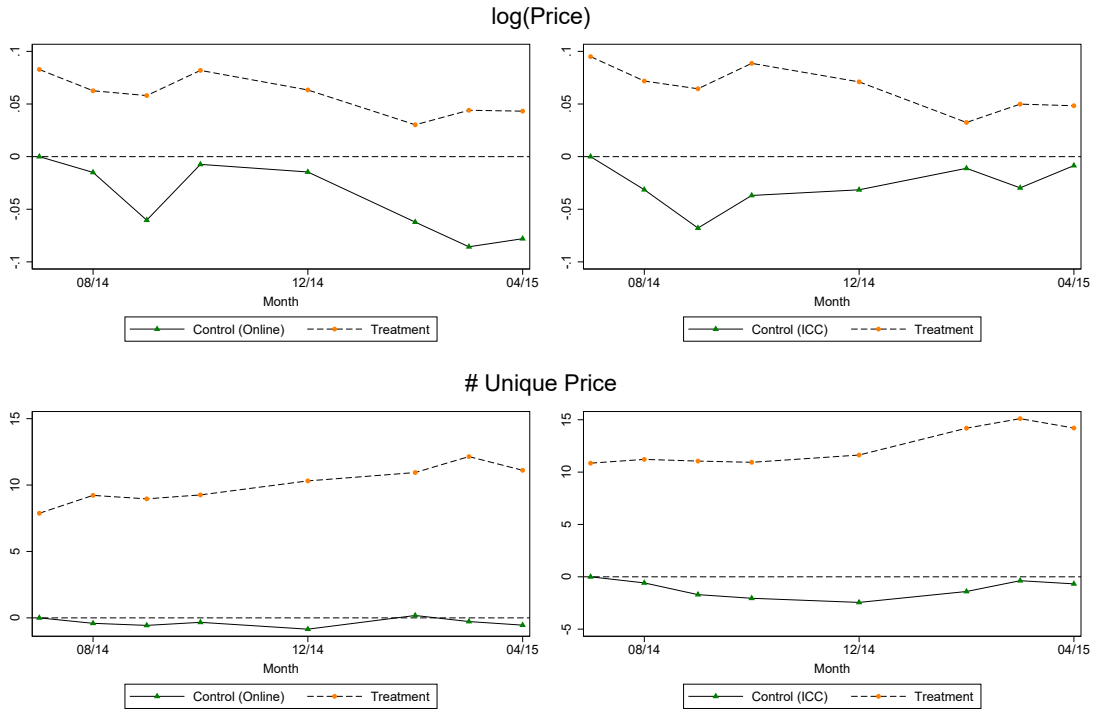
The figure shows the monthly F.E. from two variants of Equations 1 and 2 in which the effect is estimated for each and every month before and after the regulation. For each monthly estimate the 95% confidence interval is presented.

Figure 7: Post-transparency Analysis



The figure shows the relationship between the average price of a group of products and the reduction in prices of that group of products. In particualr, we use the post-transparency price data and divide the products into 10 deciles based on mean price. Each dot in the figure corresponds to one decile and as shown there is a clear negative relationship between the average price and the price reduction.

Figure 8: Validating the Parallel Time Trend Assumption - Monthly Effect on log(Price) by Groups Association



Each figure presents the pre-regulation period group specific monthly effects estimated in regressions using log(price) and number of distinct prices as the dependent variable. Figures are distinguished by the control group used in each of them.

Table 1: Descriptive Statistics

Data Source		# Stores	# Items	# Data Pulls	*N*
Supermarkets					
	Treatment group	61	69	58	159,214
	Online stores	5	69	99	30,865
	ICC	61	48	63	115,749
Drugstore		32	28	4	2,789

The table presents information on the number of stores, items and periods for which prices have been collected in the treatment and each of the control groups. For instance, the 115,749 prices of the 48 items in the ICC control group were collected in 61 stores at 63 different weeks.

Table 2: Mandatory Disclosure Effect on Price Dispersion

	# Unique Prices			Standard Deviation/Avg.			Percentage Range ($100 * \frac{P_{max}-P_{min}}{P_{max}}$)		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
After*Treatment	-15.920**	-10.881**	-8.103**	-0.083**	-0.101**	-0.053**	-32.962**	-27.396**	-12.481**
	(1.700)	(0.549)	(0.812)	(0.024)	(0.011)	(0.012)	(6.300)	(1.679)	(2.436)
Week F.E.	✓	✓	✓	✓	✓	✓	✓	✓	✓
Item F.E.	✓	✓	✓	✓	✓	✓	✓	✓	✓
Lin. Item Time Trend	✓	✓	✓	✓	✓	✓	✓	✓	✓
Control Group	Super Pharm	Online	ICC	Super Pharm	Online	ICC	Super Pharm	Online	ICC
Dep. Var. Average Value	19.097	16.265	17.317	0.209	55.006	0.211	57.742	55.006	55.642
R^2	0.833	0.785	0.804	0.471	0.392	0.627	0.635	0.488	0.736
N	1525	9636	6176	1510	9345	6120	1525	9636	6176

The unit of observation in columns 1, 2, 4, 5, 7 & 8 is item i in date t in treatment/control group

The unit of observation in columns 3, 6 & 9 is item i in date t

Time period covered 7/2014 - 6/2016

Errors are clustered by items

* $p < 0.05$, ** $p < 0.01$

The Table presents the regression results of Equation 1 using three different measures of price dispersion as the dependent variable, and each of the three control groups (drugstores, online and ICC). To get a sense of the magnitude of the change in price dispersion following the transparency regulation, in the table we also report the average value of the corresponding dependent variable. For all the measures of price dispersion measure and for each of the control groups, we find a significant reduction in price dispersion.

Table 3: Mandatory Disclosure Effect on Price

	(1) log(Price)	(2) log(Price)	(3) log(Price)
After*Treatment	-0.040**	-0.051**	-0.052**
	(0.014)	(0.008)	(0.005)
Store F.E.	✓	✓	✓
Date F.E.	✓	✓	✓
Item F.E.	✓	✓	✓
Linear Item Specific Time Trend	✓	✓	✓
Control Group	Super Pharm stores	Online stores	Moatza Items
R^2	0.909	0.937	0.961
N	58358	186810	278228

The unit of observation is item i in store j in date t

Time period covered 7/2014 - 6/2016

Errors are clustered by stores

* $p < 0.05$, ** $p < 0.01$

The table presents the regression results of Equation 2. Each column corresponds to a different control group. The results indicate that prices have declined by 4% - 5% after prices became transparent.

Table 4: Mandatory Disclosure Retailer-Specific Effect on Price

	(1) log(Price)	(2) log(Price)	(3) log(Price)
Mega: After*Treatment	-0.060**	-0.084**	-0.047**
	(0.014)	(0.008)	(0.005)
Shufersal: After*Treatment	-0.035*	-0.048**	-0.053**
	(0.015)	(0.008)	(0.006)
Victory: After*Treatment	-0.052	-0.062**	-0.044**
	(0.026)	(0.020)	(0.007)
Yeinot Bitan: After*Treatment	-0.006	-0.025	-0.048**
	(0.016)	(0.014)	(0.006)
Rami Levi: After*Treatment	0.021	-0.009	-0.002
	(0.015)	(0.008)	(0.006)
Store F.E.	✓	✓	✓
Date F.E.	✓	✓	✓
Item F.E.	✓	✓	✓
Linear Item Specific Time Trend	✓	✓	✓
Control Group	Super Pharm	Online stores	Moatza Items
R^2	0.911	0.937	0.962
N	57734	186810	274669

The unit of observation is item i in store j in date t

Time period covered 7/2014 - 6/2016

Errors are clustered by stores

* $p < 0.05$, ** $p < 0.01$

The Table presents the regression results of a version of Equation 2 in which the post-transparency indicator is interacted with each supermarket chain dummy. As shown in the table, the regression results, for each of the control groups, suggest that prices have significantly declined for the large, more upscale chains (i.e., Mega and Shufersal) and have only slightly changed for the heavy discount chains (i.e. Rami Levy).

Table 5: Mandatory Disclosure Effect on Price by Degree of Competition

	(1) log(Price)	(2) log(Price)
After*Treatment - Low Comp.	-0.057**	
	(0.006)	
After*Treatment - High Comp.:	-0.043**	
	(0.006)	
After*Treatment		-0.037**
		(0.008)
After*Treatment*Concentration		-0.043**
		(0.015)
Store F.E.	✓	✓
Date F.E.	✓	✓
Item F.E.	✓	✓
Linear Item Specific Time Trend	✓	✓
Control Group	ICC Items	ICC Items
R^2	0.962	0.962
N	238957	238957

Concentration ranges form 0 to 1, with 0 being perfect competition and 1 being monopoly

The $10^{th}, 50^{th}$ and 90^{th} percentiles of concentration are 0.13, 0.32 and 0.45, respectively

The unit of observation is item i in store j in date t

Time period covered 7/2014 - 6/2016

Errors are clustered by stores

* $p < 0.05$, ** $p < 0.01$

In this table we present the regression results of a version of Equation 2 in which we interact the post-transparency indicator with a measure of the local competition faced by the supermarket store. In column 1, the local competition measure is a binary variable for high or low competition and in column 2 we use a continuous measure of local competition. Because we want to compare price changes across stores that belong to the same chain but that face different local competition we do not use the online control group in which prices do not vary across locations. Instead, we use the ICC control group. The results suggest that prices in stores that faced weaker local competition have declined more than stores that faced stronger local competition.

Table 6: Mandatory Disclosure Effect on Price and price Dispersion using CBS Data

	(1) # Unique Price	(2) Standard Deviation/Avg.	(3) Percentage Range ($100 * \frac{P_{max}-P_{min}}{P_{max}}$)	(4) log(Price)
After*Treatment	-1.465**	-0.042**	-9.407**	-0.022**
	(0.288)	(0.004)	(0.726)	(0.007)
Date F.E.	✓	✓	✓	✓
Item F.E.	✓	✓	✓	✓
Linear Item Specific Time Trend	✓	✓	✓	✓
Control Group	Grocery Stores	Grocery Stores	Grocery Stores	Grocery Stores
Dep. Var. Average Value	9.856	0.164	38.853	
R^2	0.832	0.905	0.778	0.975
N	400	400	400	9472

The unit of observation in column 1 is item i in store j in month t

The unit of observation in columns 2-4 is item i in month t

Time period covered 7/2014 - 6/2016

Errors are clustered by store in coulmn 1 and by month in columns 2-4

* $p < 0.05$, ** $p < 0.01$

The table contains the regression results using price data obtained from the Israeli Central Bureau of Statistics. We consider the prices of items set at grocery stores as another control group and use city-level data (rather than store-level). we repeat the analysis featured in Tables 2 and 3 using the three measures of price dispersion (columns 1 -3) and the price level (column 4). The results indicate that both price dispersion and price levels have significantly declined.

Table 7: Mandatory Disclosure Effect on log(Price) using Web Site Page Views as Intensity Measure

	(1) log(Price)	(2) log(Price)	(3) log(Price)	(4) log(Price)	(5) log(Price)	(6) log(Price)
After*Treatment Inten.	-0.058***	-0.005***	-0.029***	-0.002**	-0.004*	-0.001**
	(0.013)	(0.002)	(0.006)	(0.001)	(0.002)	(0.000)
Store F.E.	✓	✓	✓	✓	✓	✓
Week F.E.	✓	✓	✓	✓	✓	✓
Item F.E.	✓	✓	✓	✓	✓	✓
Lin. Item Time Trend	✓	✓	✓	✓	✓	✓
Traffic Source	Pricez	All	Pricez	All	Pricez	All
Control Group	Super Pharm	Super Pharm	Online	Online	ICC	ICC
R^2	0.909	0.909	0.937	0.936	0.961	0.961
N	58358	58358	186810	186810	278228	278228

The unit of observation is item i in store j in date t

Time period covered 7/2014 - 6/2016

Treatment intensity is based on 100,000 page views and is measured monthly

Errors are clustered by stores

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

The Table presents the regression results in which we replace the post-transparency indicator with monthly usage measures of the price comparison websites. In odd columns we use information only from Pricez.co.il, a website that offers only price comparison services, and in even columns, we use aggregate usage data from the three price comparison websites. For the three control groups (drugstores, online and ICC) we find that prices have declined as more consumers used the price comparison websites.

Table 8: Mandatory Disclosure Effect on Price using Post Data - Heterogenuous Analysis

	Baseline Spec.	Popularity	Private Label		Mehadrin Kosher	
	(1)	(2)	(3)	(4)	(5)	(6)
After*Treatment	-0.050**					
	(0.003)					
After*Treatment (property turned off)		-0.061**	-0.051**	-0.051**	-0.051**	-0.051**
		(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
After*Treatment (property turned on)		-0.028**	-0.033**	-0.003	-0.033**	-0.002
		(0.004)	(0.003)	(0.003)	(0.008)	(0.008)
Store F.E.	✓	✓	✓	✓	✓	✓
Date F.E.	✓	✓	✓	✓	✓	✓
Item F.E.	✓	✓	✓	✓	✓	✓
Linear Item Specific Time Trend	✓	✓	✓	✓	✓	✓
# Categories	91	91	12	91	6	91
R^2	0.982	0.982	0.976	0.982	0.981	0.982
N	5173161	5173161	1040956	5173161	433158	5173161

The unit of observation is item i in store j in date t

Time period covered 8/2015 - 6/2016

Errors are clustered by stores

* $p < 0.05$, ** $p < 0.01$

The table presents regression results using only data from the post-transparency period, focusing on the changes in the prices of 355 items sold in 589 stores affiliated with the five supermarket chains used in the main analysis. In this analysis, the control group is the prices of the same items sold through the online channel of each the chains. The post-transparency period begins in January 2016. In column 1, we estimate Equation 1 and find results similar to the ones shown in Table 3. In column 2, we examine the change in prices of items that classified based on their popularity. In columns 3 and 4, we examine the change in prices of private label and branded products. While column 3 only includes categories with private label products, column 4 also includes categories with no private label products. In column 5 and 6, we examine the change in prices of items that either follow the more stringent kosher (Mehadrin Kosher) requirements or items that offer standard kosher items. While column 5 include only categories with Mehadrin Kosher products, column 6 include also categories with no Mehadrin Kosher products.