End of 9-endings, price recall, and price perceptions☆

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HIGHLIGHTS

- A regulatory ban on non 0-ending prices is studied.
- One-year after the ban, 90-ending prices have replaced 9-ending prices.
- After the ban, 90-endings play a role similar to that of 9-endings before the ban.
- 90-endings have replaced 9-endings as the new psychological price point.
- Market's response has partially eliminated the regulation's intended effect.

ARTICLE INFO

ABSTRACT

Prices that end with 9, also known as psychological price points, are common, comprising about 70% of the retail prices. They are also more rigid than other prices. We take advantage of a natural experiment to document an emergence of a new price ending that has the same effects as 9-endings. In January 2014, the Israeli government passed a new regulation prohibiting the use of non 0-ending prices, bringing an end to 9-ending prices. We find that seven months after 9-ending prices have disappeared, 90-ending prices acquired the same status as 9-ending prices had before the new regulation was adopted. Thus, 90-ending prices became the new psychological price points, partially eliminating the regulation's intended effect.

1. Introduction

9-ending prices are common, comprising about 70% of the retail prices. They are also more rigid than other prices (Kashyap, 1995; Blinder et al., 1998; Chen et al., 2008; Levy et al., 2011; Knotek, 2010; Anderson et al., 2015; McShane et al., 2015). Their ubiquity and rigidity are explained by 9-endings' positive effect on revenues (Anderson and Simester, 2003), which is attributed to 9-endings being *psychological price points*, implying

that they affect shoppers' price perceptions.[1] Two leading explanations for this effect are *level-effect* and *image-effect*.[2]

According to the level-effect, consumers have bounded rationality and, therefore, they round prices down or process price information L-to-R, and sometimes ignore the rightmost digit (Schindler and Kirby, 1997; Stiving and Winer, 1997; Thomas and Morwitz, 2005). According to the image-effect, 9-endings signal low prices and so, consumers are drawn to goods with 9-ending prices even when other goods have lower prices (Anderson and Simester, 2003; Stiving, 2000).

In January 2014, the Israeli government adopted a new regulation prohibiting the use of non 0-ending prices. We take advantage of this natural experiment to study the effects of eliminating 9-ending prices on consumers' price recall and price perceptions. We combine in-store posted price data from supermarkets with three consumer survey data, collected before, immediately after, and 12-months after the regulatory change. In the surveys, shoppers were asked to recall the prices they have paid, and indicate any price change they have noticed.

We find that before the regulation, (1) the most common price-ending was 9, and (2) shoppers made larger errors in recalling 9-ending prices in comparison to other prices. In addition, Levy et al. (2016) report that (3) the likelihood of noticing a price change was smaller for 9-ending prices than for other prices. Immediately after the regulation, shoppers' price recall accuracy improved relative to the period prior to the change. Further, although 90 became the most common price ending immediately after the change, they had no negative effect on price recall accuracy.

One year after the regulation, however, we find that (1) 90 is the most common price ending, (2) shoppers make larger errors in recalling 90-ending prices than other prices, and (3) the likelihood of noticing a price change is smaller for 90-ending prices in comparison to other prices. Thus, after the regulation, 90-ending prices seem to have influence similar to the influence 9-ending prices had before the change; 90-ending prices are the new psychological price points. We further find that the effect of 90-endings is consistent with the image-effect.

Ater and Gerlitz (2016) also use this particular episode of regulatory change in Israel. They, however, study a theory of price rigidity, while we study shoppers' price recall and price perceptions.[3,4] A second related study is Aalto-Setala (2005), who studies another natural experiment, the Euro changeover (Ehrmann, 2010). He looks at the dynamic adjustment of retail price endings in Finland during and following the 2002 Euro transition. There are important differences between the Israeli and Finish episodes, since the Euro changeover involved a currency conversion. Despite

this, we find interesting similarities between the two episodes, as discussed below.

In Section 2, we discuss the regulatory change. In Section 3, we describe the data. In Section 4, we discuss the estimation results. We conclude in Section 5.

2. Abolition of non 0-ending prices: a natural experiment

The 0.01 New Israeli Shekel (1-agora) and the NIS 0.05 (5-agora) coins were eliminated in 1991 and 2008, respectively. They are not in use since, but until January 2014, the retailers were free to set any price ending.[5] In credit-card transactions, shoppers paid the exact amount. In cash transactions, however, the total bill was rounded to the nearest 10-agora. For example, if the total bill was between NIS 7.45 and NIS 7.54, the actual amount paid was NIS 7.50.

The Israeli shoppers, however, felt that they were losing in cash transactions because the asymmetric rounding was tilted towards the retailers. More importantly, the public demanded to put an end to 9-ending prices because they perceived them as "unfair" and "manipulative". In response to these public demands, the Minister of Economic Affairs announced in October 2013 that beginning January 1, 2014, all retail prices must end with 0.[6]

Fig. 1 illustrates the dynamic effect of the regulation by showing the distribution of price endings at three points in time: before the regulation was announced, immediately after it went into effect, and 7-months after it went into effect. Panel (a) shows the distribution of price endings in July 2013–August 2013, two months before the regulation was announced, and half a year before non 0-ending prices were abolished. At that time, about 60% of the prices ended in 99 and 5% in 49. In total, in that period 72% of the prices were 9-ending. The share of 90-ending prices was only about 2.3%.

Panel (b) depicts the price endings' distribution in January 2014–February 2014, immediately after the regulation went into effect. As can be seen, the share of 00-ending prices increased from 4% before the regulation, to over 23% after the regulation. The share of 90 ending prices increased from 2.3% to over 47%. Thus, it seems that following the abolition of non 0-ending prices, many 99-ending prices were converted to 90-ending prices or were rounded up to 00-ending prices. Panel (c) shows that by July 2014–August 2014, the share of 90-ending prices has reached about 55%, while the share of 00-ending prices went down to 18%.

The figures reported by Aalto-Setala (2005) suggest that the Finish experience was similar but in the reverse direction. *Before the Euro changeover, the price level in Finland was similar to the*

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[1] According to Landsburg (2012), dollar-store owners in the late 19th century began using 99¢ pricing to make it harder for cashiers to steal, and thus inadvertently discovered the benefits of 9-ending prices as psychological price points.

[2] In the literature, level-effect and image-effect are sometimes described as left-digit effect and right-digit effect, respectively.

[3] Ater and Gerlitz (2016) test Blinder et al.'s (1991, 1998) theory, which argues that 9-endings form barriers to price changes, and therefore 9-ending prices will be more rigid than other prices. They compare the probability of prices to adjust before and after the regulation banning 9-endings. Before the regulation, they find that 0-ending prices were more likely to change, in comparison to non 0-ending prices. After the regulation, these differences disappeared. These findings, they conclude, support the price point theory.

[4] In addition, they use different data and different methodology. They use two large datasets: (1) Israeli Consumer Council's bimonthly price data, and (2) internet price data collected from supermarket websites. We use two small datasets: (1) hand-collected, in-store, posted price data, and (2) three survey datasets which we collected by surveying supermarket shoppers, where they were asked to recall the prices they paid and indicate whether they noticed any price change (upward, downward, or no-change).

[5] The coins were eliminated because of their increased cost of production. For example, by 2008 the cost of minting a 5-agora coin was 16-agorot. In addition, the public was reluctant to accept them as a change, and vending machines, parking meters, and other coin-operated devices stopped accepting them. As of January 2014, only 0-ending prices (i.e., prices that end with 0.10, 0.20, . . . , 0.90) are allowed. See: www.boi.org.il/en/NewsAndPublications/PressReleases/Pages/070716e.aspx, and www.boi.org.il/press/eng/100815/100815d.htm (both accessed February 19, 2017).

[6] See: www.jpost.com/National-News/Farewell-to-the-agora-and-the-phenomenon-of-prices-that-cant-be-paid-336741 (accessed March 1, 2017). The asymmetry was caused by the rounding rule that was adopted by the Bank of Israel for the non 0-ending prices. If a total bill ended with 1, 2, 3 or 4 agorot, the price was rounded down, and if it ended with 5, 6, 7, 8, or 9 agorot, then it was rounded up. Thus, in four cases, the price was rounded down and in five cases, it was rounded up. In a survey conducted by the Israel Consumer Council as part of its project of constructing a fairness index for the retail industry, Israeli consumers ranked 9-ending prices as the most unfair practice of the food retailers, well above price mistakes, misleading promotional campaigns, lack of transparency, etc. Source: www.consumers.org.il/item/fairness_index (in Hebrew), and www.consumers.org.il/?catid=%7B36654ED8-AA18-4882-A471-BCB94C7F103B%7D (both accessed February 18, 2017).