



Optimal strategy of multi-product retailers with relative thinking and reference prices[☆]



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ABSTRACT

Experimental evidence suggests that consumers are affected by reference prices and by relative price differences ("relative thinking"). A linear-city model of two retailers that sell two goods suggests how this consumer behavior affects firm strategy and market outcomes. A simple model analyzes the case in which all consumers want to buy both goods. An extended version adds consumers who want only one good. Relative thinking leads firms to increase the markup on the good with the higher reference price and decrease the markup on the other good, possibly to a negative markup. Stronger relative thinking increases the firms' profits.

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1. Introduction

Experimental evidence suggests that people are affected by relative price differences even when only absolute price differences should matter. The seminal experiment on this issue was conducted by [Tversky and Kahneman \(1981\)](#), who asked people to answer one of two versions of the following question:

Imagine that you are about to purchase a jacket for (\$125) [\$15], and a calculator for (\$15) [\$125]. The calculator salesman informs you that the calculator you wish to buy is on sale for (\$10) [\$120] at the other branch of the store, located 20 minutes drive away. Would you make the trip to the other store?

The responses in the two treatments were significantly different: 68% of the respondents were willing to make the trip to save \$5 on a

\$15 calculator, but only 29% were willing to exert the same effort for the same savings when the calculator's price was \$125. Notice that this not only implies that the respondents considered the relative savings, but also that they compared the savings to the price of the good on which the discount is given and not to the bundle's price.¹

Later, similar results were obtained also by others. [Mowen and Mowen \(1986\)](#) show that the effect holds similarly for students and for business managers. [Frisch \(1993\)](#) suggests that the effect holds also when only a calculator is being purchased, and [Ranyard and Abdel-Nabi \(1993\)](#) vary the price of the other good (the jacket) and get similar results. [Darke and Freedman \(1993\)](#) find that both the amount of money and the percentage of the base price that can be saved affect consumers' decisions.

[Grewal and Marmorstein \(1994\)](#) examine possible reasons why consumers' willingness to search for lower prices does not increase with price dispersion. One possible explanation, which the data eventually did not support, was that consumers underestimate the market price dispersion. The other explanation, supported by the data, is based on Weber's law of psychophysics and Thaler's transaction utility

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¹ The bundle's price remains the same (\$140) in both treatments, and therefore considering the savings relative to the bundle's price should not trigger different behaviors in the two treatments.

theory. Grewal and Marmorstein conclude that the psychological utility consumers derive from saving a certain amount is inversely related to the good's price. This means that consumers care about the percentage saved and not only the absolute amount. Azar (2004) showed, in an experiment with nine different price treatments, that when subjects can purchase a certain good either in a store they currently visit or in a remote store, the minimal price difference for which they are willing to travel to the remote store is an increasing function of the good's price.

Bartels (2006) uses scenarios with a tradeoff between relative and absolute savings, such as saving more lives vs. saving a larger proportion of a population. Choices were driven by both the absolute and relative savings. Maximizing relative savings at the expense of absolute savings is non-normative, and most participants agreed with this argument upon reflection. Svenson (2008) finds that people consider irrelevant ratios in decisions about which option can save more time (e.g., in saving doctors' time in reorganizing clinics or saving traveling time in road traffic).

Azar (2011a, 2011b) showed that thinking about irrelevant relative price differences exists also in choices between substitute goods that differ in quality. For example, people were willing to add more to a flight's price to get a flight with a more convenient departure time and avoid having to wake up at 4 AM, when the flight's price was higher. When choosing between a hotel room with and without a nice view, the willingness to add money for the nice view was higher when the room's price was higher. In other examples, the willingness to add to get a higher quality was documented in additional contexts, such as slow vs. fast shipping of a book from an online retailer; large vs. small laptop screen size; grocery shopping in a pleasant vs. an unpleasant store; bike with 5 vs. 15 speeds; and a direct flight vs. one with a connection stop. In all these cases the scenario was designed in such a way that the value of the quality difference should be unrelated to the good's price. Therefore the amount consumers are willing to add to get the higher quality should be similar irrespective of which good's price they are given in the scenario. However, in the experiments the subjects who were given the higher base price were willing to add more to it to get the better quality. A base price being multiplied by three, for example, led to the willingness to add for the better quality (which should remain constant) to be three times higher in several of the scenarios. This suggests that when people evaluate the value of quality differences between goods, the good's price affects their decision even when it should not. In other words, the percentage price difference is considered, at least partially, even when it should be irrelevant.

The phenomenon that people are affected by relative price differences even when these should be irrelevant was sometimes described as "mental accounting", but more recently the term "relative thinking" was offered instead (Azar, 2004), and here I use the latter. Relative thinking has important implications for firm strategy, one of which is pricing by multi-product firms.

Relative thinking is not the only psychological aspect that should affect pricing, however. Another important consideration of consumers when making purchase decisions is the perceived fairness of prices, which in turn depends on a comparison between the firm's prices and some reference prices (Kahneman et al., 1986a).² A rich literature, mostly in marketing, studies price fairness perceptions and reference prices, and how these are determined (see for example Thaler, 1985; Kahneman et al., 1986b; Urbany et al., 1988; Bolton et al., 2003).³ The importance of reference prices is emphasized by Rajendran and Tellis (1994), who write that "An emerging consensus in marketing is that consumers respond to price relative to some standard or reference

price." Similarly, Koszegi and Rabin (2006) suggest that "How a person assesses the outcome of a choice is often determined as much by its contrast with a reference point as by intrinsic taste for the outcome itself."

Dodonova and Khoroshilov (2004), who examine empirical data from the auction website Bidz.com, provide additional evidence for the importance of reference prices. They find that people bid more for the same item when its posted "buy now" price is higher, suggesting that the reference "buy now" price affects buyers' valuation of a good. Other studies (e.g., Heidhues and Koszegi, 2008; Koszegi and Rabin, 2006) offer analysis of reference prices and how they affect pricing by firms when consumers are loss averse, i.e., attach a greater weight to losses than to gains (relative to some reference point). Additional related theoretical work includes Bordalo et al. (2013a), who present a theory of context-dependent choice where a consumer's attention is drawn to salient attributes (e.g., quality or price) of goods. An attribute is salient when it stands out among the good's attributes relative to that attribute's average level in the choice context (an idea that resembles the notion of comparing a price to reference prices). Consumers then attach particularly high weight to salient attributes and consumer choices are tilted toward goods with higher quality/price ratios. Consumers display higher price sensitivity (a steeper tradeoff between quality and price) at low price levels. Cunningham (2013) presents another theoretical model that deals with comparison effects, in which being exposed to a larger value along a certain dimension makes the decision maker less sensitive to differences along that dimension.

Another psychological aspect that has implications for pricing is the utility that consumers may derive from finding a good bargain, beyond the utility that can be obtained from using the money saved for additional consumption. Darke and Freedman (1995), for example, find that subjects enjoyed bargains regardless of any financial gain, implying that non-financial motives might also be involved. In addition, they report that bargains acquired through skill were not enjoyed more than bargains achieved because of luck, suggesting that achievement motives could not explain why subjects enjoyed bargains when there was no associated financial gain.

The psychological evidence mentioned above has important implications for optimal pricing strategy in general, and in particular for pricing of multi-product firms. However, models of multi-product firms' pricing (e.g., DeGraba, 2006; Doraszelski and Draganska, 2006) have not yet considered these implications. The purpose of this article is to model how incorporating reference prices and relative thinking affects optimal pricing in the presence of multiple goods, thus contributing to the literature on pricing of multi-product firms. The article also contributes to the growing literature that addresses the effects of psychological biases on industrial organization and firm strategy.⁴

The article presents a duopoly model of retailers that are located at the endpoints of a linear city and sell two goods, L and H, with H being the good with the higher reference price.⁵ The firms take into account that consumers exhibit relative thinking and are affected by reference prices. This is captured in the model by assuming that consumers minimize not only the usual total costs (the goods' prices plus the transportation costs), but rather a combination of these total costs and an expression that involves the ratio of the prices to some reference prices.⁶

⁴ For theoretical models in this area, see DellaVigna and Malmendier (2004), Gabaix and Laibson (2006), and Ho et al. (2006). DellaVigna and Malmendier (2006) analyze empirically the case of gym pricing. For literature reviews, see Ellison (2006) and Camerer and Malmendier (2007).

⁵ See Hotelling (1929) for the original model that used the linear city framework.

⁶ In what follows, for the sake of brevity and to avoid too many cumbersome sentences, I sometimes use "relative thinking" to describe this consumer behavior of considering the ratio between the prices and the reference prices. This behavior captures both the idea that consumers pay attention to relative price differences (and not only to absolute differences) and the idea that they are affected by reference prices. When I mention stronger relative thinking, this means more emphasis of consumers on the expression that involves the ratio of the prices to the reference prices.

² Kahneman et al. (1986a, p. 729–730) write, "A central concept in analyzing the fairness of actions in which a firm sets the terms of future exchanges is the *reference transaction*, a relevant precedent that is characterized by a reference price or wage..."

³ Reviewing this literature in detail is beyond the scope of this article. The interested reader is referred to Xia et al. (2004) for a review and conceptual framework of price fairness perceptions, and Mazumdar et al. (2005) for a literature review on reference price research.

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