# Why is Price Dispersion Higher Online than Offline? The Impact of Retailer Type and Shopping Risk on Price Dispersion 

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#### Abstract

When physically similar products, of similar quality, are offered by retailers both online and offline, we often observe that the dispersion in prices of these products online is greater than the price dispersion offline. This observation runs counter to early theories that suggested price dispersion online would be smaller than that offline due to the ease of search and information availability online. This paper investigates and provides an explanation for this puzzling phenomenon by examining the impact of two important drivers of price dispersion: retailer type and consumers' shopping risk. Retailer type refers to whether a retailer is a pure offline, pure online, or dual channel retailer. Shopping risk is defined as the product of consumers' perceived risk of shopping and the transaction uncertainty related to shopping at different types of retailers. A game-theoretic approach is adopted to model consumers' price search and product purchase, as well as price competition within and across retailer types in online and offline markets. Equilibrium pricing strategies are derived for different retailer types competing for different consumer segments with different levels of perceived shopping risk. The impact of retailer type and shopping risk on online versus offline price dispersion are quantified, and conditions when price dispersion is greater online than offline are identified. Results indicate that price dispersion is greater online when the number of pure online retailers is sufficiently large and is increasing in the number of pure online retailers. In addition, a reduction in online shopping risk may actually increase online price dispersion. Results further suggest that even without any online sales, dual channel retailers should maintain their online presence for the purpose of information dissemination, which justifies the importance for pure offline retailer to incorporate webrooming strategies, where consumers can search for prices online but purchase offline.


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## Introduction

Price dispersion refers to the difference in prices set by different sellers of the same product in a given market (Hopkins 2008). Studying the factors influencing price dispersion is of great importance to retailers, as it affects their ability to charge different prices from their competitors. The recent trends towards multi and omni-channel retailing have increased the importance of studying price dispersion and comparing price dispersion between online and offline markets.

[^0]Generally, price dispersion is believed to be caused by imperfect information as consumers do not know which seller charges the lowest prices. Therefore, the increased ability to search for price information online was expected to reduce price dispersion among online retailers (Bakos 1997; Smith and Brynjolfsson 2001). However, contrary to expectation some studies reported that significant online price dispersion remains (Brynjolfsson and Smith 2000; Pan, Ratchford, and Shankar 2004), and in some cases price dispersion is even higher online than offline (Clay, Krishnan, and Wolff 2001; Degeratu, Rangaswamy, and Wu 2000). This paper aims to investigate and explain this puzzling phenomenon. In particular, we examine the impact of two important drivers of price dispersion: retailer type and consumers' shopping risk. Retailer type refers to whether a retailer is a pure offline, pure online, or dual channel retailer. Shopping

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risk is defined as the product of consumers' perceived risk of shopping and the transaction uncertainty related to shopping at different types of retailers.

To further motivate the research question, we provide additional and more recent evidence that price dispersion persists and is greater online than offline for a variety of product categories. We collected data over a period of 3 months for several product categories, including batteries, flash drives, Espresso makers, toys, televisions and vacuum cleaners and found that price dispersion was consistently higher online than offline (for identical products, offered by retailers both online and offline). Details about the data and the procedures used to collect and analyze it are provided in Table A1. Further analysis of this data also suggests that price dispersion is different across retailer types.

We adopted a game-theoretic approach to model consumers' price search and product purchase, and price competition within and across retailer types in both online and offline markets. We derive equilibrium pricing strategies for different retailer types competing for different consumer segments with different levels of perceived shopping risk. Equilibrium pricing strategies of different retailer types in online and offline markets are used to derive market level price distributions and compare online versus offline price dispersion. We focus on quantifying the impact of retailer type and shopping risk on online versus offline price dispersion. Price dispersion across retailers of the same type may also exist due to different strategies used (e.g., differentiation based on product quality or service level), though, this is outside the scope of the current research.

Our research makes several contributions to the literature. We address the puzzle of why online price dispersion may be higher than offline price dispersion, even for homogeneous products (physically similar products, of similar quality). In particular, we study the impact of retailer type and consumers' shopping risk on online versus offline price dispersion. This is in contrast to previous analytical models that limited the analysis of price dispersion to a single market (online or offline) or just to two retailer types (pure online and pure offline retailers). Previous research has largely ignored the influence of retailers selling through multiple channels, an important limitation given the recent trends towards multi-channel and omni-channel retailing (Ailawadi and Farris 2017; Cao and Li 2015; Herhausen et al. 2015; Verhoef, Kannan, and Inman 2015; Yurova et al. 2017). These trends have important implications for competitive pricing strategies within and across different retailer types, and as such, on online versus offline price dispersion.

In addition, we focus on the impact of shopping risk on online versus offline price dispersion. Shopping risk plays an important role in consumers' decisions to shop online or offline (Kiang et al. 2011; Shankar, Urban, and Sultan 2002). In particular, concerns about fraud and information privacy are major worries to online consumers (Dai, Forsythe, and Kwon 2014; Nepomuceno, Laroche, and Richard 2014; Zhang et al. 2010). Shopping risk therefore influences retailer pricing, due to consumers' willing to pay for making purchases at more secure retailer types (Al-Matarneh 2016; Dai, Forsythe, and Kwon 2014; Gupta, Su, and Walter 2004). This influence of shopping risk is directly related to the different types of retailers.

Buying from pure online retailers is generally perceived to be riskier than purchasing from pure offline retailers. Adding to the previous literature, this paper makes a unique contribution by modeling shopping risk (as a product of transaction uncertainty related to shopping at different retailer types and consumers' heterogeneous risk sensitivities) and analyzing its impact on price dispersion in the online versus offline markets.

Finally, we show that our main results, of market conditions with greater online than offline price dispersion, are robust for list and transaction prices, for asymmetrical marginal costs (for retailers of the same type), under conditions of channel-based price differentiation, for different measures of price dispersion (range and variance), and for geographic-based search costs.

Results from our analytical model indicate that retailer type and shopping risk directly influence competing retailers' equilibrium pricing strategies. Shopping risk influences where different consumer segments shop and the price and price premium that different retailer types can charge for a more secure shopping environment. Pure online retailers set the most competitive prices. Their prices are the lowest because they compete for consumers who perceive shopping risk to be low online (i.e., who are not willing to pay a premium for the security of an offline store), and due to reduced search cost in the online market, allowing them to search without cost for the lowest price. Pure offline retailers set the highest prices. They compete for consumers who perceive shopping risk to be high online, and who are willing to pay a risk premium for the added security of an offline store. Consumers who purchase offline incur nonnegligible search cost to visit different retailers, searching for lower prices. In equilibrium pure offline retailers set prices at the level where consumers in the offline market feel indifferent between purchasing at the current retailer or continuing to search for better prices. Dual channel retailers set prices in between pure online and pure offline retailers. They set prices higher than pure online retailers since they can charge a risk premium to mixed consumers who value the convenience of shopping online yet prefer the safety of the offline presence of dual channel retailers. However, dual channel retailers set prices below those of pure offline retailers since not doing so would result in a loss of sales from both the mixed and offline consumer segments.

We find that these pricing strategies and the number of retailers of each type drive the difference in price dispersion between online and offline markets in our model. We show general market conditions under which price dispersion is greater online than offline. In particular, price dispersion is greater online when the number of pure online retailers is sufficiently large (relative to the number of pure offline or dual channel retailers), and online price dispersion further increases as the number of pure online retailers increases. This finding suggests that contrary to conventional beliefs, retailers may have greater ability to charge different prices in online markets. Our findings further indicate that even without any online sales, dual channel retailers should maintain their online presence for the purpose of information dissemination. This finding also points to the importance of adopting webrooming strategies by pure offline retailer. Webrooming, where consumers can search for prices online but purchase offline where shopping risk is lower, are

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