Window Shopping*

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Abstract

"window shopping" and "showrooming" refer to the activity in which potential buyers visit a brick-and-mortar store to examine a product but end up either not buying it or buying the product from an online retailer. This paper analyzes potential buyers who differ in their preference for after-sale service that is not offered by online retailers. Making a trip to the brick-and-mortar store is costly; however, it has the advantage of mitigating the uncertainty as to whether the product will suit the buyer's needs. Windows shopping enhances the walk-in store's profit and lowers aggregate consumer surplus and total welfare.

Keywords: Window shopping, showrooming, brick-and-mortar stores, online shopping, online retailers, virtual stores, bricks and clicks.

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Note: This paper uses hyperlinks for easier navigation. If you read this article on a Windows PC, type *ALT-left arrow*, and on a Mac, type *Command-left arrow* or *Command-[*, to go back to the referring page after clicking on any hyperlink.

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1 Introduction

The magazine *Consumer Reports* recently surveyed over 10,000 readers and found that 18 percent of them bought electronic products online after they had examined the products in a brick-and-mortar store. More than half of this group eventually bought from Amazon.com.[1] The practice of inspecting products at a walk-in retailer before buying them online will be referred to in this paper as *window shopping*, or *showrooming*.[2] Note that this practice is observed not only in stores selling electric appliances, but also in stores selling other types of durable goods. For example, worried shopkeepers are increasingly frustrated by people they dub "fit-lifters" who use stores to find the best-fitting shoes before buying them online at a lower price.[3]

Online shopping in the United States accounted for 7 percent of all retail sales in 2011 and 2012. However, according to a Forrester Research Inc. report "U.S. Online Retail Forecast, 2012 To 2017," online retail in 2013 will reach $262 billion—a rise of 13 percent over 2012's $231 billion in online sales and representing 8 percent of the total retail market. This report also expects e-commerce to grow at a compound annual growth rate of 9 percent between 2012 and 2017.[4]

The purpose of this article is to investigate the effects of window shopping on profits and market shares of walk-in and online retailers, as well as on aggregate consumer surplus and total welfare. To pursue this goal, I construct a model of potential buyers who differ in their preference for after-sale services that are not offered by online sellers. Technically speaking, the walk-in retailer and the online seller are assumed to be vertically differentiated, which implies that, in the absence of the transportation costs incurred from going to the store, all buyers would prefer buying at the brick-and-mortar store if its price did not exceed the online price.

While making a trip to the store is costly for buyers, it has the informational advantage of mitigating the uncertainty as to whether the product will suit the buyer's needs. The analysis concentrates on a duopoly market structure where an online seller and a walk-in retailer compete

[1] See, "Get the best deal," *Consumer Reports*, December 2012, p. 24.

[2] Window shoppers also includes recreational shoppers (not analyzed in this paper) who simply spend time in shopping malls browsing and visiting stores. The attitudes of this type of consumers are described in Jarboe and McDaniel (1987) and Cox, Cox, and Anderson (2005).

[3] Quoted from a *Financial Times* article entitled "Shoe stores sock it to online buyers" by Barney Jopson, May 5, 2013.

[4] See, http://www.forrester.com/US+Online+Retail+Forecast+2012+To+2017/fulltext/-/E-RES93281.

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to attract potential buyers.

The main conclusion from the analysis in this paper is that the walk-in store earns a higher profit if consumers can exercise “window shopping” at the store. At first glance, this result seems counterintuitive because under windows shopping a fraction of consumers who visit the walk-in store leave the store after inspecting the product and then buy it online if they find the product suitable for their needs. However, this thinking neglects a very important advantage to the walk-in store from window shopping which is that window shopping attracts consumers to visit the store. That is, once a consumer visits the store, the consumer views the transportation cost as sunk and the decision as to whether to buy at the store or exit the store and buy online depends only on relative prices and on the individual consumer’s valuation of after-sale service. In other words, once a consumer visits the store, the transportation cost becomes irrelevant to the decision whether to buy at the store or whether to purchase online. In contrast, in the absence of window shopping, any potential buyer weighs in a third factor which is the transportation cost of traveling to the store before making a decision on which outlet to purchase the product.

The sequential decision making modeled in this article shows that the decision where to buy after visiting the walk-in store is different from the decision where to buy before visiting the store. The walk-in store is initially at a disadvantage because of the transportation cost consumers must bear to visit the store. However, after the consumer visits the store, transportation cost becomes irrelevant to the purchase decision which increases the market power of the walk-in store relative to the online retailer.

The analysis in this paper applies to products that potential buyers can benefit from inspecting prior to purchase. It is assumed that after physically inspecting the product and discussing the pros and cons with a live salesperson who demonstrates the product, the potential buyer can decide whether the product is suitable for his needs. Appliances are good examples of such products. Therefore, the main economic tradeoff modeled here is the consumer’s tradeoff between incurring the transportation costs associated with traveling to a brick-and-mortar store to inspect the product and forgoing the benefits derived from mitigating uncertainty as to whether the product suits the buyers’ needs.

The model developed in this paper draws heavily on Shin (2007). Both papers model consumers who are uncertain as to whether the product suits their needs and therefore would benefit from expert, in-store advice on this matter. In addition, in both models, a retailer that does not provide pre-sale service may be able to free ride on a pre-sale service provided by the rival vendor. However, a closer look at both models reveals some substantial differences. (a) In Shin's model, the two retailers are identical in all respects (including buyers' transportation costs) and both are capable of providing identical pre-sale services. In the present model, the online and the walk-in sellers differ in their ability to provide pre- and post-sale services. In addition, buyers' transportation and shopping time costs depend on whether they shop online or at the walk-in store. Consequently, (b) in Shin's model, if the two retailers charge identical prices, all potential buyers (informed and uninformed) would patronize the retailer that offers the pre-sale service. In contrast, in this model, under equal prices each seller will face some positive demand.

These differences imply that Shin's model is better suited to study competition between full-service and discount brick-and-mortar stores than to study online versus walk-in retailers. In contrast, the present model is probably better suited to study competition between independent online sellers and brick-and-mortar sellers, which are differentiated not only by their pre-sale service but also by their post-sale service, than to study competition between full-service and discount sellers. This is because the first-best allocation in Shin's model can be supported by a single retailer (if the price is maintained at the competitive level), whereas in the present model a first-best allocation may be supported by coexistence between the online and the walk-in stores. This may be the reason why Shin's paper does not include a welfare analysis.

Pre-sale service provision arises in Shin's model as a strategy of one retailer to differentiate itself from another retailer, in order to avoid intense price competition that would otherwise eliminate all profits. This theory shows that one retailer always benefits from bundling service with the sale of a product. (See Carbajo, De Meza, and Seidmann (1990), Horn and Shy (1996), and their references). In the absence of bundling, buyers view the products (brands) as homogeneous and choose the retailer with the lowest price. In that circumstance, price competition affecting all consumers reduces prices to marginal cost. This literature argues that a store offers more services than its competitors only for the sake of segmenting the buyers' market into two groups according to buyers' benefits from consuming these services. Market segmentation is needed to soften price competition.

Friberg, Ganslandt, and Sandström (2001) develop an analytical model of price competition between an online and a physical store in the absence of window shopping. Liu (2013) investigates the roles of price-matching guarantees as a response to showrooming. On the empirical side, Farag, Krizek, and Dijst (2006), Farag et al. (2007), Forman, Ghose, and Goldfarb (2009), Cao (2012), and Cao, Xu, and Douma (2012) investigate the effect of online shopping and online search on traditional shopping. Brynjolfsson and Smith (2000) find that online prices are 9 to 16 percent lower than prices in conventional retail outlets, depending on whether taxes, shipping, and shopping costs are included in the final price.

This study is organized as follows: Section 2 constructs a model of price competition between an online retailer and a walk-in store. Section 3 characterizes two separate equilibria, with and without window shopping, solves for the equilibrium prices, market shares, and profits of both types of sellers, and computes aggregate consumer surplus and total welfare for the two equilibria. Section 4 provides the main results showing the effects of window shopping on profits, consumer surplus, and total welfare. Section 5 concludes.

2 The Model

The market consists of two sellers: an *online* seller (denoted by O) and a walk-in (brick-and-mortar) retailer that sells only at a specific location (the *store* in what follows, and denoted by S). Both the online and the walk-in retailers sell the same product but may charge different prices denoted by p_O and p_S, respectively. All potential buyers are fully informed of these prices before they make any purchase decision.

The brick-and-mortar store offers an after-sale service that the online seller does not provide. After-sale service may include: (a) easy return for any reason or a replacement of a defective product, (b) help in the activation of related services and the installation of compatible software, and (c) assistance in learning how to operate the product.

2.1 Potential Buyers

All potential buyers are uniformly distributed on the interval $[0,1]$ according to increased preference for after-sale service, denoted by $s \in [0,1]$ ("s" stands for "service" benefits). Therefore, buyers indexed by s close to 1 derive a great deal of benefit from after-sale service, whereas buyers indexed by $s=0$ do not benefit at all from after-sale service. Figure 1 illustrates how potential buyers are distributed according to the value they place on the potential benefits of after-sale service.

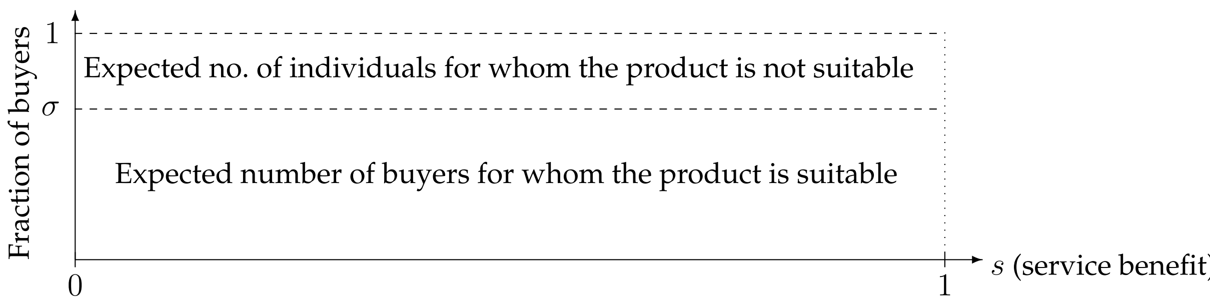

Figure 1: Heterogeneous potential buyers

The term *potential buyers* should be distinguished from *buyers* because not all individuals will find that the product suits their needs. In this case, we will say the product is *unsuitable*. Each buyer estimates that the product will fulfill her or his needs with probability σ (the Greek letter "sigma" stands for "suitable" here), and hence will be unsuitable with probability $1-\sigma$, where $0<\sigma<1$.

One advantage of going to a walk-in store rather than buying directly online is that the store allows potential buyers to examine the product and decide whether it suits their needs before making a purchase. However, traveling to the store is costly. Let $\tau \geq 0$ denote the transportation cost of traveling to the store.

Let v ($v>0$) denote the basic value derived from consuming a suitable product. The utility of a buyer indexed by $s \in [0,1]$ is given by

$$u_s \stackrel{\text{def}}{=} \begin{cases} \sigma v - p_O & \text{Buys directly online (without first going to the store)} \\ -\tau & \text{Travels to the store and finds the product unsuitable} \\ v - p_O - \tau & \text{Travels to the store and finds the product suitable, but buys online} \\ v - p_S + s - \tau & \text{Travels to the store, finds the product suitable, and buys at the store.} \end{cases} \tag{1}$$

Figure 2 illustrates the dynamic decision tree facing each potential buyer.

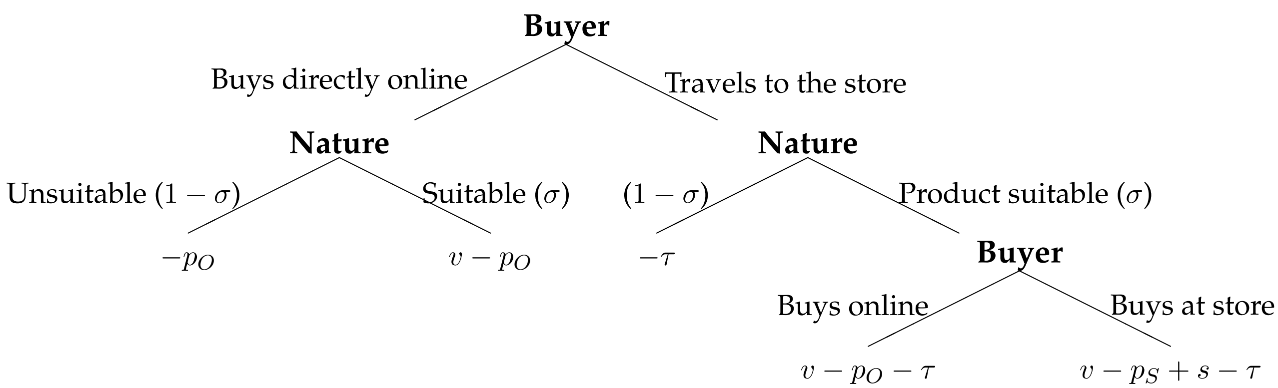

Figure 2: Buyer's decisions and outcomes

Choosing to buy the product online without first going to the store saves the transportation cost τ. However, by forgoing the trip the buyer is unable to inspect the product to determine whether it suits his needs before making the purchase. Thus, the expected gain to a buyer who shops online without first going to the store is $\sigma v + (1-\sigma)0 - p_O$, which corresponds to the left branch in Figure 2 and the first row in equation (1).

The terminal nodes stemming from the right-hand-side branches in Figure 2 show that traveling to the store generates transportation costs τ regardless of whether the product is eventually found to be suitable or unsuitable. If the product is deemed suitable, the buyer can then choose between purchasing it at the store or leaving the store and buying it online. If the product is unsuitable, no purchase is made and the buyer leaves the store with a loss of τ.

To summarize, traveling to the store removes the uncertainty as to whether the product is useful to the buyer. Buying online without first going to the store saves the transportation cost τ, but leaves the buyer with the risk that the purchased product may not prove appropriate. Therefore, the expected value of buying online without seeing the product at the store is reduced from v to σv. In addition, all online buyers (whether or not they visit the walk-in store) fail to receive the after-sale service benefit, s.

2.2 Sellers

Let $n_O(p_O, p_S)$ and $n_S(p_O, p_S)$ denote the *expected* number of online and walk-in store buyers, respectively. The online retailer takes p_S as given and chooses p_O to maximize profit given by

$$\max_{p_O} \pi_O(p_O, p_S) = p_O \, n_O(p_O, p_S). \tag{2}$$

Similarly, the store takes p_O as given and chooses p_S to maximize profit given by

$$\max_{p_S} \pi_S(p_O, p_S) = p_S \, n_S(p_O, p_S). \tag{3}$$

To avoid excessive use of algebra, retailers' costs are omitted from this analysis.

3 Equilibrium Prices and Market Shares

This section characterizes two equilibria as described in Figure 3.

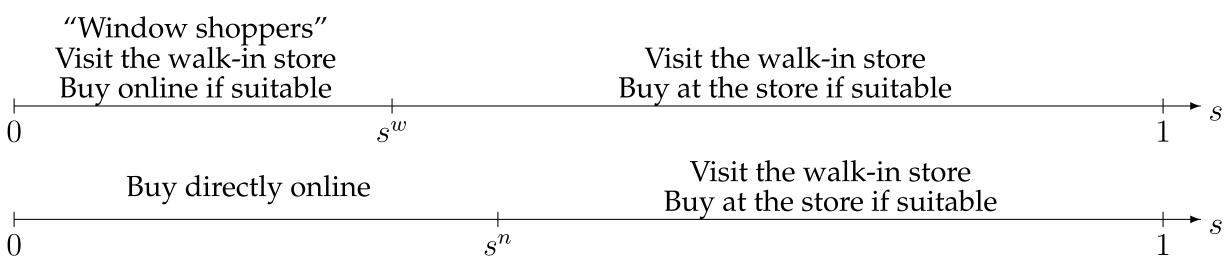

Figure 3: Equilibrium division of buyers between the online and walk-in retailers. *Top*: Equilibrium with "window shopping." *Bottom*: Equilibrium with no "window shopping."

In Figure 3, buyers who attach high value to after-sale services (high s) will buy at the store, if they find the product suitable. The top part of Figure 3 displays buyers with low s who visit the store and then buy online (if they find the product suitable). In contrast, the bottom part of Figure 3 shows buyers with low value of s who skip visiting the store and buy directly online without knowing whether the product is suitable for them.

3.1 In-store Decision

Suppose a buyer indexed by s travels to the brick-and-mortar store (right-hand-side branch of Figure 2). According to equation (1) and Figure 2, if this buyer finds the product suitable (probability σ), the buyer chooses to purchase from the store rather than from the online retailer if and only if $v + s - p_S - \tau \geq v - p_O - \tau$; hence if

$$s \geq s^w \stackrel{\text{def}}{=} p_S - p_O. \tag{4}$$

That is, store buyers are those who place a sufficiently high value on after-sale service ($s \geq s^w$), whereas online buyers do not place much value on after-sale service ($s < s^w$), see the top part of Figure 3. Note that the transportation cost τ is treated as sunk after the potential buyer travels to the store, and therefore does not factor into a buyer's purchase decision after a store visit is made. For this reason τ does not appear in (4).

3.2 Equilibrium with window shopping

This section characterizes the equilibrium displayed on the top part of Figure 3. Appendix A shows that this equilibrium exists if the transportation cost parameter (τ) is bounded from above so that $\tau < \tau^w \stackrel{\text{def}}{=} (1 - \sigma)/3$.

From the top part of Figure 3, the expected number of buyers from the online and the store are $n_O = \sigma s^w$ and $n_S = \sigma(1 - s^w)$, respectively. Substituting into (4) and then into (2) and (3) yields the equilibrium prices, market shares, and profits given by

$$p_O^w = \frac{1}{3}, \quad p_S^w = \frac{2}{3}, \quad s^w = \frac{1}{3}, \quad \pi_O^w = \frac{\sigma}{9}, \quad \text{and} \quad \pi_S^w = \frac{4\sigma}{9}, \tag{5}$$

where superscript "w" denotes equilibrium with windows shopping. Therefore, with window shopping, the online retailer charges a lower price, has a lower market share, and earns a lower profit compared with the walk-in store.

Aggregate consumer surplus is computed by

$$CS^w = s^w \left[\sigma(v - p_O^w) - \tau\right] + \int_{s^w}^{1} \left[\sigma(v + s - p_S) - \tau\right] ds = \sigma v - \frac{\sigma}{9} - \tau. \tag{6}$$

Total welfare is defined as the sum of aggregate consumer surplus and retailers' profits. Therefore,

$$W^w = CS^w + \pi_O^w + \pi_S^w = \sigma v + \frac{4\sigma}{9} - \tau. \tag{7}$$

The first term in (7) is the total value gained by σ buyers from using the product. The second term is total benefit from after-sale service offered only to store buyers, which is computed by $\sigma \int_{s^w}^1 s\, ds$. The last term is aggregate transportation cost borne by all consumers because, unlike the equilibrium described in the next subsection, here all consumers visit the store to learn whether the product is suitable.

3.3 Equilibrium with no window shopping

This section characterizes the equilibrium displayed on the bottom part of Figure 3. Appendix A shows that this equilibrium exists if the transportation cost parameter (τ) is bounded so that $\sigma(1-\sigma)/(\sigma+2) \stackrel{\text{def}}{=} \tau^n < \tau < 2\sigma$.

From the utility function (1), Buyers indexed by $s \in [0, s^n]$ on the bottom part of Figure 3 are better off buying directly online than going to the store if $\sigma v - p_O \geq \sigma(v + s - p_S) - \tau$ or,

$$s \leq s^n \stackrel{\text{def}}{=} \frac{\sigma p_S + \tau - p_O}{\sigma}. \tag{8}$$

From the bottom part of Figure 3, the expected number of buyers from the online and the store are $n_O = s^n$ and $n_S = \sigma(1 - s^n)$, respectively. Note that n_O is independent of σ because consumers cannot inspect the product if they buy directly online. Substituting into (8) and then into (2) and (3) yields the equilibrium prices, market shares, and profits given by

$$p_O^n = \frac{\sigma+\tau}{3}, \quad p_S^n = \frac{2\sigma-\tau}{3\sigma}, \quad s^n = \frac{\sigma+\tau}{3\sigma}, \quad \pi_O^n = \frac{(\sigma+\tau)^2}{9\sigma}, \quad \text{and} \quad \pi_S^n = \frac{(2\sigma-\tau)^2}{9\sigma}, \tag{9}$$

where superscript "n" denotes equilibrium with *no* windows shopping.

Aggregate consumer surplus is computed by

$$CS^n = s^n(\sigma v - p_O^n) + \int_{s^n}^{1} [\sigma(v + s - p_S) - \tau]\, ds = \sigma v + \frac{\tau^2 - 2\sigma^2 - 10\sigma\tau}{18\sigma}. \tag{10}$$

Total welfare is therefore given by

$$W^n = CS^n + \pi_O^n + \pi_S^n = \sigma v + \frac{(2\sigma - \tau)(4\sigma - 5\tau)}{18\sigma}. \tag{11}$$

4 The Effects of Window Shopping

This section compares the two equilibria characterized in subections 3.2 and 3.3 and displayed in Figure 3. Figure 4 summarizes the restrictions on the transportation cost parameter (τ) that ensure existence of each type of equilibrium.

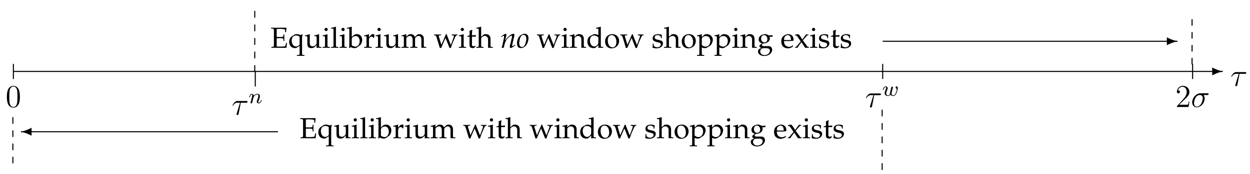

Figure 4: Range of transportations cost and existence of equilibria. *Note*: The thresholds τ^w and τ^n are defined in (A.1) and (A.2), respectively.

Figure 4 shows that in the extreme case where potential buyers do not bear any cost of going to the store ($\tau = 0$), the window shopping equilibrium is (not surprisingly) unique. For any $\tau \in [\tau^n, \tau^w]$ both equilibria exist. For high transportation cost ($\tau \in (\tau^w, 2\sigma]$) the only equilibrium is with no window shopping as going to the store just to inspect the product is too costly.

To compare profits, aggregate consumer surplus, and total welfare under under the two equilibria described in Figure 4, suppose that the transportation cost parameter lies in the intermediate range described in Figure 4 so that both equilibria exist. Formally, let $\tau^n < \tau < \tau^w$ where τ^w and τ^n are defined in (A.1) and (A.2), respectively.

4.1 Profit comparison

Subtracting (9) from (5) yields $\pi_O^w - \pi_O^n = -\tau(2\sigma + \tau)/(9\sigma) < 0$ and $\pi_S^w - \pi_S^n = \tau(4\sigma - \tau)/(9\sigma) > 0$ because $\tau < 2\sigma$. This proves the following result:

Result 1. *Let $\tau \in (\tau^n, \tau^w)$. Then, the walk-in store (online retailer) earns a higher (lower) profit under the window shopping equilibrium compared with the equilibrium with no windows shopping. Formally, $\pi_S^w > \pi_S^n$ and $\pi_O^w < \pi_O^n$.*

Figure 5 displays four equilibrium profit levels as functions of the transportation cost of traveling to the walk-in store (τ). Result 1 and Figure 5 show that the walk-in store earns a higher profit

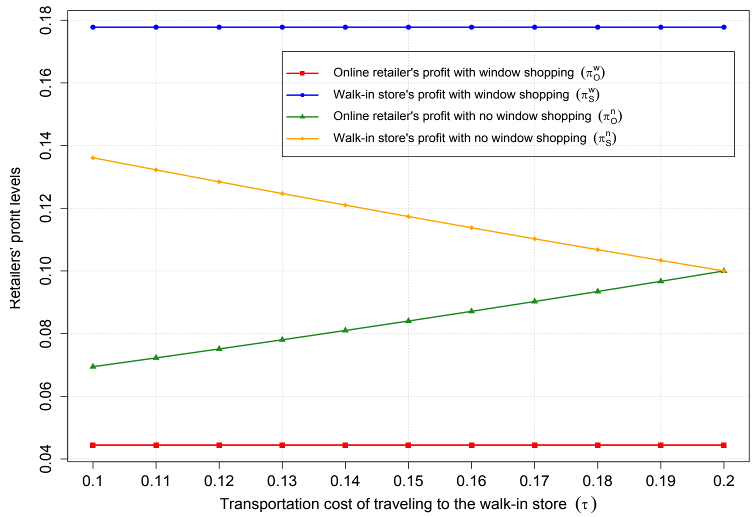

Figure 5: Comparing windows shopping with no window shopping: Retailers' profit levels as functions of the transportation cost of traveling to the walk-in store (τ). *Note*: Simulations assume that $v = 4$ and $\sigma = 0.4$, and hence $\tau \in (\tau^n, \tau^w) = (0.1, 0.2)$.

under window shopping. At first glance, this result may seem counterintuitive because, under windows shopping, s^w consumers (see Figure 3) visit the walk-in store and then leave store to purchase online. However, this explanation neglects a very important advantage to the walk-in store from window shopping which is the way consumers look at the transportation cost. That is, once a consumer visits the store, the consumer views the transportation cost as sunk and the decision whether to buy at the store or online depends only on two factors: The relative prices, $p_S^w - p_O^w$, and the value consumer s attaches to after-sale service. In contrast, in the absence of window shopping, all potential buyers take into consideration a third factor which is the transportation cost of traveling to the walk-in store. Therefore, window shopping increases the competitive advantage of the walk-in store relative to the online retailer because it eliminates its main disadvantage which is the transportation cost.

This discussion shows that window shopping serves as a key marketing tool for attracting consumers to visit the walk-in store in order to facilitate the decision to buy at the store for consumers who place high value after-sale service. To see the significance of this marketing tool, subtracting (9) from (5) yields $s^w - s^n = -\tau/(3\sigma) < 0$, which proves the following result:

Result 2. *The market share of the walk-in store (online retailer) is larger (smaller) under window shopping compared with no windows shopping. Formally,* $1 - s^w > 1 - s^n$.

Result 2 is illustrated in Figure 3 which shows that the walk-in store's market share on the top figure is larger than its share on the bottom figure.

Figure 3 shows that the online retailer's market share under window shopping is smaller than under no window shopping. This is because, under window shopping, once a consumer travels to the walk-in store, the online retailer loses its transportation cost advantage (transportation cost is viewed as already sunk by the consumer). In contrast, with no windows shopping, all consumers make the decision whether to buy online *before* they choose to travel to the walk-in store at the stage when the online retailer has a transportation cost advantage over the walk-in store. Consequently, as shown in Figure 5, the online retailer's profit is lower under window shopping than with no windows shopping.

Finally, Figure 5 shows that in the absence of windows shopping the online retailer's profit increases and the walk-in store's profit decreases with the transportation cost parameter τ. This is because the walk-in store becomes more costly relative to buying directly online. Note that profits under window shopping are invariant with respect to τ because under window shopping the decision whether to buy online is made after the consumer visits the store.

4.2 Welfare comparison

Subtracting (10) from (6) and (11) from (7) yields $CS^w - CS^n = -\tau(8\sigma + \tau)/(18\sigma) < 0$ and $W^w - W^n = -\tau(4\sigma + 5\tau)/(18\sigma) < 0$. This proves the following result:

Result 3. *Let* $\tau \in (\tau^n, \tau^w)$. *Then, aggregate consumer surplus and total welfare are lower under the window shopping equilibrium compared with the equilibrium with no windows shopping. Formally,* $CS^w < CS^n$ *and* $W^w < W^n$.

Figure 6 displays aggregate consumer surplus and total welfare as functions of the transportation cost of traveling to the walk-in store (τ).

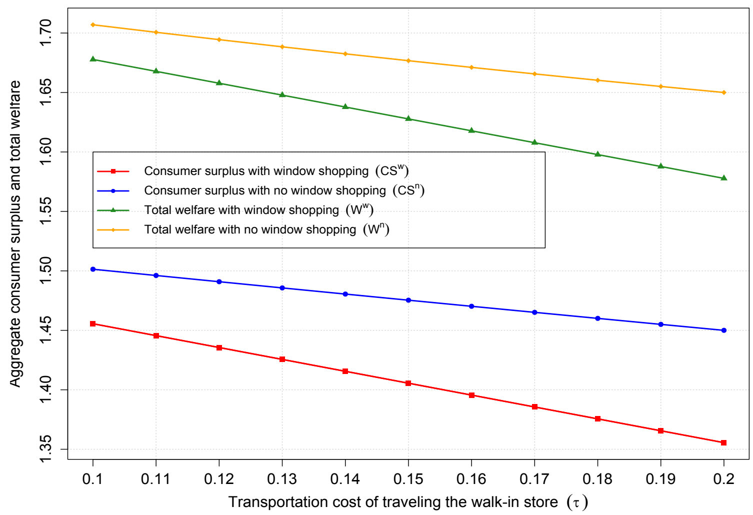

Figure 6: Comparing window shopping with no window shopping: Aggregate consumer surplus and total welfare as functions of the transportation cost of traveling to the walk-in store (τ). *Note*: Simulations assume that $v = 4$ and $\sigma = 0.4$, and hence $\tau \in (\tau^n, \tau^w) = (0.1, 0.2)$.

Figure 6 shows that, with or without window shopping, consumer surplus and total welfare always decline with the transportation cost (τ). This is because in this model transportation costs are viewed as a net loss to the economy. This also explains why both consumer surplus and welfare are lower under window shopping, because under window shopping *all* buyers travel to the store to inspect the product. In contrast, in the absence of window shopping, consumers indexed by $s \in [0, \bar{s}]$ do not visit the store, thereby saving the transportation costs which viewed as "real" costs to the economy in this model.

5 Conclusion

This article shows that in industries where online retailers compete with brick-and-mortar walk-in stores, window shopping or showrooming may actually enhance the profit of the walk-in store compared to an equilibrium where window shopping is not exercised, or simply not possible for some other reason. The key to this result is consumers' dynamic decision making process which is illustrated in Figure 2. Therefore, a decision regarding where to buy made at the walk-in store is substantially different from the decision made before the consumer leaves his house. Initially, the walk-in store is at a disadvantage because potential buyers can forgo the transportation cost by purchasing directly online. Window shopping eliminates this disadvantage because once a consumer visits the store, transportation costs are viewed as sunk and therefore become irrelevant to the decision where to make the purchase.

In reality, the competition between online and walk-in retailers is more complicated than the environment analyzed in this paper. The following list suggests some possible extensions of the model. First, the Internet provides product reviews by other buyers, which can be used by online consumers as well as by walk-in store buyers to make buy/not-buy decisions. Therefore, product review information flows in both directions, Bakos (1997).

Second, the retail industry environment is evolving in many ways. Fearing a loss of customers to online retailers, many large brick-and-mortar retailers now offer online shopping with either home delivery or store pickups. In addition, many online retailers offer easy returns, some offer "free returns," and some provide links to webpages where customers can find aftermarket service providers in their area.[5] In addition, online sellers keep introducing more and more products, such as eyeglasses, that until recently were available only in walk-in stores. This is accomplished by offering significant price reductions that are possible because online merchants learn how to bypass the middlemen and shorten the supply chain.[6]

Another issue is taxation. Online retailers are exempt from sales tax in most states in which they are not physically present. This cost advantage is slowly disappearing as more states manage to force online retailers to collect their sales tax.[7]

[5] "The War Over Christmas," *Bloomberg Businessweek*, November 5–11, 2012.

[6] See a March 31, 2013 article in the *New York Times* entitled "E-Commerce Companies Bypass the Middlemen," available at http://nyti.ms/Xl8sLW.

[7] As of January 2014, Amazon already collects sales tax on behalf of Arizona, California, Connecticut, Georgia, Indiana, Kansas, Kentucky, Massachusetts, Nevada, New Jersey, New York, North Dakota, Pennsylvania, Tennessee, Texas, Virginia, Washington, West Virginia, and Wisconsin; see, http://www.amazon.com/gp/help/customer/display.html?nodeId=468512. Goolsbee (2000) estimates that people living in high sales tax locations are significantly more likely to buy online. More recent estimations of the sensitivity of online shopping to sales tax are given in Ellison and Ellison (2009), Einav et al. (2013), and Goolsbee, Lovenheim, and Slemrod (2010), and their references.

Appendix A Sufficient Conditions For the Existence of Equilibria

The equilibrium characterized in subsection 3.2 and on the top part of Figure 3 shows that a fraction σ of the potential buyers indexed by $s \in [0, s^w]$ are window shoppers in the sense that they all first visit the store and then leave the store and buy online if they find the product suitable.

For that equilibrium to exist, it remained to be shown that windows shoppers are better off by first visiting the store in order to examine the product, thereby paying the transportation cost τ, instead of buying directly online without examining the product first (which is the equilibrium characterized in subsection 3.3). The utility function (1) implies that this is the case if $\sigma v - p_O^w < \sigma(v - p_O^w) - \tau$, hence if $\tau < (1-\sigma)p_O^w$. Substituting p_O^w from (5) yields

$$\tau < \tau^w \stackrel{\text{def}}{=} \frac{1-\sigma}{3}. \tag{A.1}$$

Next, the equilibrium characterized in subsection 3.3 and on the bottom part of Figure 3 shows that potential buyers indexed by $s \in [0, s^n]$ buy directly online without first going to the walk-in store. For this equilibrium to exist, it remained to be shown that buyers who buy directly online prefer doing that over going to the store and then buy online if the product is suitable. The utility function (1) implies that this is the case if $\sigma v - p_O^n > \sigma(v - p_O^n) - \tau$, hence if $\tau > (1-\sigma)p_O^n$. Substituting p_O^n from (9) yields

$$\tau > \tau^n \stackrel{\text{def}}{=} \frac{\sigma(1-\sigma)}{\sigma+2}. \tag{A.2}$$

Note that (A.2) also ensures that the consumers indexed by $s > s^n$ are better off buying at the store rather than online after they visit the store. Finally, to have $p_S^n > 0$, (9) implies that $\tau \leq 2\sigma$ must be assumed.

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