Risk Profile and Consumer Shopping Behavior in Electronic and Traditional Channels

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ABSTRACT

Empirical research of consumer online shopping behavior has generally established that risk associated with online shopping is an important factor when consumers consider whether to shop online or in a brick-and-mortar store. Literature also indicates the importance of information search and product evaluation in consumer purchasing decisions. Building on these results, this paper develops an economic model that captures consumer shopping channel choices based on shopping channel characteristics and consumer risk profiles—risk-neutral or risk-averse. Analyses of results show that after making purchases through one channel, electronic or traditional, risk-averse consumers tend to be more loyal customers than risk-neutral consumers. Observations from the model, confirmed by numerical examples, show that under certain channel characteristic values, the two types of consumers exhibit split channel behavior—risk-neutral consumers prefer one channel and risk-averse consumers prefer the other. However, risk-neutral consumers are not always more likely to prefer electronic channel than risk-averse consumers. Implications for retailer pricing strategies are discussed.

Keywords: Pricing, E-Commerce, Retail Channel Switching, Consumer Risk Profiles, Consumer Choice, Consumer Utility.
1. Introduction

E-commerce is growing rapidly and has penetrated almost all industries. This trend is amplified by the reduced cost of participation in e-commerce due to the establishment of standards for access and conducting transactions. Given the enormous potential of e-commerce, the number of electronic stores has increased at an unprecedented rate during the last five years. Department of Commerce data (http://www.census.gov/mrts/www/mrts.html) shows that e-commerce retailing accounts for 1.2% of total retailing for the second quarter of 2002, 1.0% for second quarter of 2001, and 0.8% for the second quarter of 2000. These represent 25% increase from 2Q 2000 to 2Q 2001, and 20% increase from 2Q 2001 to 2Q 2002. Will online shopping keep rising and eventually exceed that of other direct marketing at 8%? Theory seems to support this prediction as online search engines and various intelligent agents can dramatically reduce search costs associated with purchase decisions (Alba et. al. 1997; Bakos, 1997; Lee and Clark, 1997). In addition, online stores offer buyers the convenience of placing orders instantaneously from the comfort of their home. However, traditional retail outlets maintain an edge over online storefront in delivering products and services where experience and look-and-feel are very important (Figueriredo, 2000; Rosen and Howard, 2000). Ultimately, the share of online shopping depends on how it compares with brick-and-mortar store shopping in satisfying consumers’ shopping needs. In this paper, we develop an economic model of consumer shopping decision in order to understand different factors affecting a consumer’s decision to either shop online or in-store. To be able to compare consumers who shop online with those who shop in a brick-and-mortar store, this model focuses on shopping for products that are available in both channels through different retailers. Our primary objectives are to explore the behavior of different types of consumers in online and traditional retail channels. In addition, we explore
the strategies that retailers can pursue to segment consumers and to devise different strategies to attract different segments.

We explore these issues by modeling consumers as either risk-neutral or risk-averse and studying how these two types of consumer trade-off among factors such as prices, product range offered, ease of product evaluation, and product acquisition time. An understanding of these trade-offs is important for retailers who want to avoid purely price competition. We start with a brief background of related research that provides justification for our segmenting consumers by their risk profiles and our consideration of factors mentioned above in our model. The rest of the paper is organized as follows: Section 2 investigates the literature and articulates how our work fits into the literature. Section 3 introduces the actual economic model. Section 4 develops propositions based on the model that explain consumer channel shopping behavior and discusses implications for retailers. In Section 5, we present numerical results that further explore consumer channel shopping behavior. Implications of our results and contributions of the paper are discussed in Section 6. Section 6 points out future research topics.

2. Background

Consumer risk perception and risk profile have long been shown to heavily influence a consumer’s decision to modify, postpone, or avoid a purchase decision (Bauer, 1967; Taylor, 1974). Risk neutral consumers are more likely than risk-averse consumers to consummate a purchase transaction when faced with buying a product (or service) with uncertain outcomes or possible loss (Kahneman and Tversky, 1982; Taylor, 1974). In the online environment, studies found evidence that perceived risk associated with online shopping, arising from concerns for system security and difficulty in evaluating products online, is an important factor when consumers consider whether to purchase online or in a brick-and-mortar store (Bhatnagar, Misra,
Search costs, evaluation costs, and price are factors consumers weigh when making a purchase decision (Kotler, 2000; Engel and Kollat, 1978) according to marketing literature. Based on that literature, a consumer purchase process includes five stages: problem recognition, information search, evaluation of alternatives, purchase decision, and post-purchase support. The purchase process starts when a consumer recognizes a problem or need. Information search for desired products or services ensues, which incurs search costs. When a relevant product or service is identified, the consumer examines its product attributes and compares it to other products or services identified to determine whether the product suits her needs. Finally, a purchase decision is made. In a traditional shopping environment, most products are acquired immediately following the purchase. Where a later delivery is required or other post-purchase support is needed, consumers also evaluate the timeliness and quality of those services. In the consumer purchase process articulated above, the two shopping channels, online and in-store, differ dramatically in the levels of efforts consumers have to exert and the levels of uncertainty in each step: Online search engines and intelligent agents dramatically reduce search costs (Alba et. al, 1997; Bakos, 1997; Lee and Clark, 1997). However, online shopping lacks “look-and-feel” (Figueriredo, 2000; Rosen and Howard, 2000) and hence evaluation of product attributes can be difficult (Bhatnagar, Misra and Rao, 2000); Further, in an online environment, the acquisition of a purchased product is not immediate—products have to be delivered from the online retailer to the consumer, un-timeliness of which can be a source of customer dissatisfaction (Jedd, 2000). Since consumers who buy online tend to be those who are time-starved (Bellman, Lohse, & Johnson, 1999) and online shopping tends to be goal-oriented or utilitarian, i.e., “task-oriented, efficient, rational, and deliberate” (Wolfinbarger & Gilly, 2001),
search costs, evaluate costs, and delivery time will be important factors that consumers evaluate when considering buying online or in-store.

An understanding of how consumers trade off those factors mentioned above is important when a retailer is faced with devising a pricing strategy, determining product offerings, or designing online storefront, among others. An online retailer can choose to increase the range of product options offered, which may deter a consumer from searching for alternatives and later buying from elsewhere. This strategy may eventually reduce consumer price sensitivity by distracting consumers from focusing their purchase decisions on price alone. For example, Amazon.com do not have the lowest price (Smith, Bailey and Brynjolfsson 1999), but consumers still regularly buy from them, which may due in part to their exhaustive list of carried titles, although their brand and service are also important. Although recent empirical studies have shown that the range of product offerings can create customer lock-in in the online brokerage industry (Chen and Hitt, 2001), the issue has not been studied analytically.

An online retailer, as another strategy, can focus on enabling easy product quality evaluation by providing gigabytes of product demonstration data or virtual reality software. Note that for certain digital products, touch-and-feel can even be better with the help of various virtual reality tools. This approach may attract those consumers who value and are willing to pay premium for services (Grover and Ramanlal, 1999; Lynch and Ariely, 2000) and hence reduce price sensitivity for the segment of consumers the retailer intends to attract and keep.

Delivery of most categories of products purchased online has served as a deterrent for online shopping (Rosen and Howard, 2000). However, online channel can compete with traditional retailers along this dimension for many product categories and has an advantage for digital products such as news and information. Therefore, considering this dimension is
extremely important for retailers who often need to take into account the relative strength or weakness of either channel in product delivery. In sum, past and present research points at the importance of understanding consumer behavior with respect to shopping channel choices. Trade-offs between price, search costs, evaluation costs, and delivery time seem to be important factors highlighting consumer channel shopping behavior. Literature also supports the notion that considerations of these factors are influenced by consumer risk profile. In the next section, we introduce our economic model that takes into account these factors and consumer risk profile.

3. Model Development

We assume that each product is offered in two retail channels: the traditional or physical channel, denoted by T, and the electronic channel through the Internet, denoted by E. Buyers make their decisions to purchase based on the net utility derived from buying a product. The net utility is the utility from consuming a product less the costs of efforts of product search and evaluation, dollar equivalent of delivery time, and the price paid to obtain the product. We assume that all consumers derive the same utility, denoted by V, from consuming one unit of the product, whether it is purchased from channel E or channel T. We only focus on the economic factors affecting a consumer’s decision to purchase a product and do not take non-economic factors, such as personal interest, satisfaction, habits, culture, social class, motivation, attitude and beliefs, into consideration. This is appropriate in the scope of this paper because, as mentioned before, online shoppers tend to be time-starved and use the internet for shopping activities that are goal-oriented.

Conforming to search literature, the search cost, denoted as S, is modeled as a function of the number of products searched, a (Bakos, 1997). We model the evaluation cost C as a function of quality certainty level, q; When comparing product attributes, quality is relatively hard to
evaluate, especially for online shopping. Literature suggests that consumers may be apprehensive about buying something without touching or feeling it because of quality certainty issues (Figueriredo, 2000; Bhatnagar, Misra and Rao, 2000). Therefore, in our model, evaluation costs are modeled as a function of quality certainty level. Goods with a higher quality certainly level (due to reputation for example) incur lower evaluation costs. When a product is associated with a known brand name or when a product is evaluated in-store where consumers can look-and-feel, consumers are more certain about whether or not a product will suite their needs (Smith, Bailey and Brynjolfsson, 1999; Lynch and Ariely, 2001). Collectively, we refer to search and evaluation costs as buyer effort, denoted by B. The framework of our consumer purchase decision model is presented in Figure 1, below.

![Figure 1: A Basic framework for consumer purchase decision](image)

Based on the framework described above, we construct the consumer utility function with four parts, assuming additive separability:
\[ U_{\text{total}}(a, q, w, p) = V + U_{\text{effort}}(S(a) + C(q)) + U_{\text{waiting}}(w) + U_{\text{price}}(p) \]  

where \( V \) is the utility derived from consuming a product, and \( U_{\text{effort}} \), \( U_{\text{waiting}} \), and \( U_{\text{price}} \) are utility loss from buyer effort, delivery time, and price, respectively. We have assumed separability of each of the components contributing to the total utility for the purpose of analytical tractability, as is common in the economics and marketing literature (e.g. Holmstrom, 1979; Mowrey, 2000).

We assume that consumers are heterogeneous in their risk preferences. We consider two types of consumers: risk-neutral, denoted by N, and risk-averse, denoted by A. Risk profiles of consumers reflect their attitude towards uncertainty and information asymmetry between channels, which in turn influence their shopping behavior (Taylor, 1974). Risk-averse buyers are more sensitive to uncertainty and are willing to pay premiums to reduce it. Consequently, they are more likely to be brand conscious. Ceteris paribus, risk-averse consumers are likely to evaluate more products in order to reduce the level of uncertainty associated with any one product. Consequently, we model these two types of consumers as perceiving different amounts of disutility from the same level of effort, delivery time, or expenditure. This is dealt with in Section 3.1 where we choose different shapes of disutility functions for these two types of consumers.

The two shopping channels, E (online) and T (in-store), incur different search costs associated with searching for the same number of products. This is because online shopping allows consumers to search different products from one computer screen. The two shopping channels also incur different evaluation costs for a product with the same level of quality certainty because in-store shopping affords the consumers the advantage of look-and-feel. These differences are dealt with in Section 3.2 where we choose different disutility functions for the
two channels. In sum, taking into account difference in risk profile and channels, equation (1) can be rewritten as equation (2) below:

\[ U_{i,j}^{\text{total}}(a, q, w, p) = V + U_{i,j}^{\text{effort}}(S^i(a) + C^i(q)) + U_{i,j}^{\text{waiting}}(w) + U_{i,j}^{\text{price}}(p), \forall i, j \]

where \( j = A \) (Risk-averse) or \( N \) (Risk-neutral) indicates the type of consumers, and \( i \) and \( k \) = E (Electronic) or T (Traditional) indicates the channel.

Next, we present the specific shapes of all utility components for the two types of consumers and the two shopping channels.

### 3.1 Different Shapes of Disutility Functions for the Two Types of Consumers

In this paper, we effectively assumed that all consumers perceive the same level of risk when faced with the same uncertain scenario. However, their behaviors can be different due to their different risk tolerance. We use a negative exponential function to model the perceived disutility by risk-averse consumers from efforts, delivery time, and price. This function has been widely used to model risk aversion (Basso and Pianca, 1997; Brockett, 1987; Chun and Tang, 1995; McCarl, 1990; Rao, 1990). Consistent with the literature, we use a linear function to model the perceived disutility by risk-neutral consumers. The actual functions are represented below:

\[
\begin{align*}
U_{i,k}^{A}(x^i) &= -V(e^{d_k x^i} - 1), \quad x^i < \frac{\ln 2}{d_k}, \quad i = E \text{ or } T, \quad k = \text{effort, waiting, or price} \\
U_{i,k}^{N}(x^i) &= -\frac{V}{k} x^i, \quad x^i < k
\end{align*}
\]

where \( x^i \) represents the level of effort, the length of wait, and the price, respectively, in each of
the three associated disutility functions. When \( x^i > \frac{\ln 2}{d_k} \), the price, length of waiting, or level of effort exceeds the maximum that a risk-averse consumer would tolerate. Consequently, the consumer will choose not to participate in the market, similarly for risk-neutral consumers when \( x^i > k \). \( d_{\text{effort}}, d_{\text{waiting}}, d_{\text{price}} > 0 \) are the risk parameters, measuring the level of risk-aversion towards buyer effort, delivery time and price, respectively. Higher \( d \)'s indicate higher risk-aversion. In the exponential utility functions, the risk aversion measure is constant (Jaquette, 1976), representing the constant risk-aversion towards costs. Increasing risk-aversion is not used because its response function has been shown to be quite similar to that obtained using constant risk aversion (Moskowitz and Plante, 1984), however, the former function is more computationally complex.

### 3.2. Shapes of Disutility Functions for the Two Channels

Shopping online allows consumers to search product information from different vendors from one computer screen hence search costs, when shopping online, will increase more slowly with the number of products searched than shopping in-store. Hence, we assume that \( \frac{\partial S^E}{\partial a} > 0 \), \( i = E \) or \( T \), but \( \frac{\partial^2 S^E}{\partial a^2} > 0 \) and \( \frac{\partial^2 S^E}{\partial a^2} = 0 \), i.e, in traditional channel, the marginal search cost increases with the number of products, and in electronic channel, it is constant. Both increasing and constant marginal search costs in the number of products searched are a common assumption

\[ V - V(e^{d_k x^i} - 1) > 0 \iff \frac{\ln 2}{d_k} > x^i \]
in economics literature (Moskowitz and Plante, 1984; Bakos, 1997). For ease of analysis, the actual functions chosen are quadratic for channel T and linear for channel E, as follows:

\[
\begin{align*}
S^T(a) &= k_0^T a^2 + k_1^T a + k_2^T, \quad k_0^T, k_1^T, k_2^T > 0 \\
S^E(a) &= k_1^E a + k_2^E, \quad k_1^E, k_2^E > 0
\end{align*}
\] (4)

In terms of evaluation costs, we assume decreasing evaluation costs when quality increases, i.e., \( \frac{\partial C^i}{\partial q} < 0 \). In addition we assume that marginal evaluation costs are decreasing in quality as well, i.e., \( \frac{\partial^2 C^i}{\partial q^2} < 0 \), for both channels. The hyperbolic functions are chosen to represent evaluation costs for both the traditional and electronic channels with different function parameters for different channels, as follows:

\[
C^i(q) = k_3^i + \frac{k_4^i}{q}, \text{ where } i = E \text{ or } T, \quad k_3^i \geq 0, k_4^i > 0;
\] (5)

In sum, the two channels differ in buyer efforts for both the search costs and evaluation costs. The buyer effort functions can be represented as follows with first equation presenting the buyer effort in traditional channel and the second equation representing the effort in electronic channel:

\[
\begin{align*}
B^T(a, q) &= S^T(a) + C^T(q) = k_0^T a^2 + k_1^T a + k_2^T + k_3^T + \frac{k_4^T}{q} \\
B^E(a, q) &= S^E(a) + C^E(q) = k_1^E a + k_2^E + k_3^E + \frac{k_4^E}{q}
\end{align*}
\] (6)

\[2\] Note that \( k_2^T \) denotes the minimum effort required even when search does not take place. This cost can be interpreted, for example, the cost incurred in locating the product on the shelf. Similarly, \( k_2^E \) denotes the minimum effort required for online shopping.
Based on equations (2), (3), and (6), using \( d_1, d_2, d_3 \) to represent \( d_{\text{effort}}, d_{\text{waiting}}, d_{\text{price}} \), respectively, and using \( \bar{B}, \bar{w}, \bar{p} \) to represent \( \text{effort}, \text{waiting}, \text{price} \), respectively, the consumer utility functions characterizing the purchasing decision for each type of consumers in each shopping channel are represented below:

\[
\begin{align*}
U_{\text{total}}^{E,N}(a, q, w^E, p^E) &= V - \frac{V}{B} (k_1^E a + k_2^E + k_3^E + \frac{k_4^E}{q}) - \frac{V}{w} w^E - \frac{V}{p} p^E \\
U_{\text{total}}^{E,A}(a, q, w^E, p^E) &= V - V[e^{d_1(k_1^E a + k_2^E + k_3^E + \frac{k_4^E}{q})} - 1] - V(e^{d_2 w^E} - 1) - V(e^{d_3 p^E} - 1) \\
U_{\text{total}}^{T,N}(a, q, w^T, p^T) &= V - \frac{V}{B} (k_0^T a^2 + k_1^T a + k_2^T + k_3^T + \frac{k_4^T}{q}) - \frac{V}{w} w^T - \frac{V}{p} p^T \\
U_{\text{total}}^{T,A}(a, q, w^T, p^T) &= V - V[e^{d_1(k_0^T a^2 + k_1^T a + k_2^T + k_3^T + \frac{k_4^T}{q})} - 1] - V(e^{d_2 w^T} - 1) - V(e^{d_3 p^T} - 1)
\end{align*}
\]  

(7)

Simple algebra will show that these functions are quasi-concave and hence satisfy all necessary properties of a utility function.

### 4. Model Analysis

In this section, we derive propositions to characterize consumer trade-off among different model parameters.

**Proposition 1**: For both risk-neutral and risk-averse shoppers, 
\[
\frac{\partial a}{\partial p^E} > 0, \quad \frac{\partial a}{\partial w^E} > 0, \\
\frac{\partial a}{\partial p^T} > 0, \quad \text{and} \quad \frac{\partial a}{\partial w^T} > 0, \text{iff} \quad a > \frac{k_1^E k_4^T - k_2^E k_1^T}{2k_4^E k_0^T}.
\]

**Proof**: See Appendix B.

Condition \( a > \frac{k_1^E k_4^T - k_2^E k_1^T}{2k_4^E k_0^T} \) implies that for differentiated products, consumers will search more product options as price or delivery time goes up. This implies that, in order to charge a higher price, a vendor should reduce consumer search costs by carrying a larger variety of products so that a consumer can evaluate his consideration set at a single source instead of
searching for alternatives elsewhere. Put it in another way, this proposition indicates that, due to ease of comparison-shopping online, consumers are likely to exhibit variety-seeking behavior for both low-ticket and high-ticket products. This behavior deviates from that found in traditional channel where consumers show variety seeking behavior only for low-ticket products such as cereal and canned foods (Givon, 1984 and Bawa, 1990). The practice of carrying large collection of varied products are found in reality in the prime example of Ashford.com—a leader in online luxury goods retailing—which charges more than its traditional counterparts, but carries altogether more than 15,000 styles of products from over 400 leading luxury brands (Ashford.com, 2001).

**Proposition 2:** Let $w^d = w^T - w^E$, $p^d = p^T - p^E$, and $S^d = S^T - S^E$. For both risk-neutral and risk-averse shoppers, if $\frac{\partial S^d}{\partial a} > 0$, then $\frac{\partial a}{\partial p^d} < 0$ and $\frac{\partial a}{\partial w^d} < 0$.

**Proof:** See Appendix B.

It is generally true that, as a consumer search more and more products, the search costs increase faster in traditional channel than in electronic channel (i.e., $\frac{\partial S^d}{\partial a} > 0$). Therefore, proposition 2 implies that if the price or waiting time in traditional channel is higher, consumers tend to search less. It also implies that, for products with fewer alternatives, price competition becomes the dominant form of competition for customers.

**Proposition 3:** If $d_1 > \frac{1}{B}$, $d_2 > \frac{1}{w}$ and $d_3 > \frac{1}{p}$, then the risk-neutral consumers derive more utility than risk-averse consumers from either the electronic or the traditional channel.

**Proof:** See Appendix B.
Figure 2 illustrates proposition 3 graphically for the electronic channel. The dotted line separates the region where the proposition holds ($d_1 > \frac{1}{B}$, $d_2 > \frac{1}{w}$ and $d_3 > \frac{1}{p}$) from where it does not hold ($d_1 > \frac{1}{B}$, $d_2 > \frac{1}{w}$ but $d_3 < \frac{1}{p}$).

To see how this proposition may be useful in understand consumer shopping behavior, let us look at a scenario where both types of customers prefer the same shopping channel. Here we assume that $B^T > B^E$, $w^T > w^E$ and $p^T > p^E$. Clearly, both types of consumers will choose electronic channel under these conditions. The issue of interest here is whether one type of the consumers are more likely than the other type to switch from online shopping to in-store shopping when model parameters change, or equivalently, whether online retailers can build

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3These parameter values are used in Figure 2: $B = 30$, $w = 15$, $p = 50$, $d_1 = 0.035 (\geq \frac{1}{B})$, $d_2 = 0.07 (\geq \frac{1}{w})$, $B^E = 5$, $w^E = 1$, $p^E = 25$ and $V = 100$. 
customer loyalty by targeting the customers that are less likely to switch. Let

\[ U_{d,A}^{d,A} = U_{total}^{E,A} - U_{total}^{T,A} \quad \text{and} \quad U_{d,N}^{d,N} = U_{total}^{E,N} - U_{total}^{T,N}. \]

We derive the following related proposition characterizing the two types of consumers:

**Proposition 4:** If \( d_1 > \frac{1}{B} \), \( d_2 > \frac{1}{w} \), \( d_3 > \frac{1}{p} \) and \( B^T > B^E \), \( w^T > w^E \), \( p^T > p^E \), both types of consumers prefer electronic channel to traditional channel and risk-averse consumers will have a higher utility difference between electronic channel and traditional channel than risk-neutral consumers, i.e., \( U_{d,A}^{d,A} > U_{d,N}^{d,N} \).

**Proof:** See Appendix B.

Figure 3 illustrates Proposition 4 graphically. The dotted vertical line is \( d_3 = \frac{1}{p} \), which separates the region where the proposition holds (to the right) from where it does not hold (to the left). In both regions, \( U_{d,N}^{d,N} \) and \( U_{d,A}^{d,A} \) are positive, indicating that both types of buyers prefer the electronic channel. When the condition of the Proposition 4 holds (to the right), risk-averse consumers have a higher utility difference between electronic channel and traditional channel than risk-neutral consumers.\[\]

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\[ ^4 \] Consumer loyalty can represent either a consumer’s desire to return to a particular Website (vendor loyalty) or his desire to purchase a particular product (product loyalty). Here, it is interpreted as vendor loyalty.

\[ ^5 \] These parameter values are used in Figure 3: \( \bar{B} = 30 \), \( \bar{w} = 14 \), \( \bar{p} = 40 \), \( d_1 = 0.035 (> \frac{1}{B}) \), \( d_2 = 0.072 (> \frac{1}{w}) \), \( B' (=10) > B' (=9) \), \( w' (=2) > w' (=1) \), \( p' (=15) > p' (=10) \) and \( V = 100 \).
Propositions 3 and 4 together show that, risk-averse consumers prefer the electronic channel in a stronger term than risk-neutral consumers under model parameter values specified in Proposition 4. Under these conditions, risk-averse consumers are more likely to build loyalty to online retailers and are more likely to exhibit repeat buying behavior. This result seems to be counter-intuitive at first glance as commonsense seems to tell us that risks associated with online shopping should deter risk-averse consumers. However, a careful examination of risk-averse consumers reveals that they prefer a channel that is more familiar and offers more certainty. As a result, once risk-averse consumers are enticed to a channel, they tend to stay with that channel for longer time than risk neutral consumers because switching channels involves uncertainty.

Since most consumers are risk averse to some degree, Proposition 4 indicates that consumers are more likely to be repeat shoppers at sites such as Amazon.com than at sites that operate purely based on price competition such as Priceline.com. Proposition 4 provides support for strategies of online retailers that focus on customer accounts maintenance, preference
identification, and community building so that existing customers will feel an affinity to the online retailer and will be less likely to be enticed away by other retailers. The corollary below investigates consumer behavior under conditions specified by Proposition 4 but when parameter values change.

**Corollary:** Under conditions specified by Proposition 4, as $B^r$, $w^r$ or $p^r$ increases, the gap, $U^{d,A} - U^{d,N}$, increases. As $B^r$, $w^r$ or $p^r$ decreases, the gap decreases.

**Proof:** See Appendix B.

Figure 4 illustrates the Corollary graphically and explores the impact of prices on the gap, $U^{d,A} - U^{d,N}$, which measures relative inclination of risk-averse customers to stay with the electronic channel compared with risk-neutral consumers. Clearly, as $p^r$ increases, the gap increases because $U^{d,A}$ increases faster than $U^{d,N}$ does, which is due to the fact that an increase in $p^r$ draws more risk-aversion behavior from risk-averse consumers than from risk-neutral ones. Similarly, as $p^E$ increases, $U^{d,A}$ decreases faster than $U^{d,N}$ does.

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Parameter values used are the same as in footnote 5, plus $d_s = 0.03 \left( \frac{1}{p} \right)$.
For traditional channels, a similar proposition is derived in Proposition 5 below after setting $U^{d,A} = U^{T,A} - U^{E,A}$ and $U^{d,N} = U^{T,N} - U^{E,N}$. 

**Proposition 5**: If $d_1 > \frac{1}{B}$, $d_2 > \frac{1}{w}$, $d_3 > \frac{1}{p}$ and $B^T < B^E$, $w^T < w^E$, $p^T < p^E$, both types of consumer prefer traditional channel to electronic channel. In addition, risk-averse consumers will have a higher utility difference between traditional and electronic channels than risk-neutral consumers, i.e., $U^{d,A} > U^{d,N}$. 

**Proof**: See Appendix B.

Clearly, when $B^T < B^E$, $w^T < w^E$ and $p^T < p^E$, both types of consumers will choose traditional channel. This proposition shows that, risk-averse consumers prefer the traditional channel in a stronger term than risk-neutral consumers under model parameter values of Proposition 5. Again, risk-averse consumers tend to be more royal customers than risk-neutral consumers in the traditional channel as well. Online retailers wishing to entice consumers from traditional channels should target risk-neutral consumers first. This supports the suspicion that risk-neutral consumers will be the first to try online offerings.

Due to the complexity of the model, we next use some numerical examples to investigate
behaviors of the two types of consumers studied here and to point out strategies for retailers.

5. Consumer Channel-Switching Behavior

In the preceding section, we analyzed the scenarios in which both risk-neutral and risk-averse shoppers prefer the same shopping channel. In this section, we use numerical examples to analyze scenarios in which the two types of consumers prefer different shopping channels.

Often, retailers offer products through both electronic and traditional channels. Pricing strategies and other characteristics have to be carefully designed to avoid cannibalization of one channel over another. For consumers, choice of a channel depends largely on economic factors relevant to a consumer’s channel choice, i.e., search cost, evaluation cost, delivery time, and price. In fact, most consumers are cross-shoppers and tend to shop in a channel for products suitable for that channel. For example, consumers may buy flowers online but shop at a local jeweler for expensive jewelry. A retailer may influence a consumer’s channel choice by changing some or all of the economic factors modeled in this paper. For example, the retailer may consider raising price but at the same time reducing search cost through advertising and/or reducing evaluation cost by providing more product information and demonstration.

**Observation 1:** For certain values of $S^T > S^E$, $C^T < C^E$, and $w^T = w^E$, there exist prices $P^E > P^T$, such that risk-averse shoppers will choose traditional channel but risk-neutral shoppers will choose electronic channel.

Conditions in Observation 1 can occur with products such as durable goods where evaluation of the product is difficult in an online setting and the product requires professional delivery and installation. Needing delivery and installation results in the same delivery time whether the product is bought online or in-store. Let the parameter values be $\bar{B} = 40$, $\bar{w} = 10$, $p = 25$, $d_1 = 0.01$, $d_2 = 0.06$, $d_3 = 0.025$, $S^T = 10$, $S^E = 2$, $e^T = 5$, $e^E = 7.5$, and $w^T = w^E = 1$. 
Table 1 gives prices, $P_E > P_T$, where risk-averse shoppers choose traditional channel but risk-neutral shoppers prefer electronic channel. Keeping $P_T$ the same (e.g., $P_T = 10$) and reducing $P_E$ to below the corresponding lower bound ($P_E < 11.89$), both types of consumers will prefer shopping online. Similarly, keeping $P_T$ the same (e.g., $P_T = 10$) and raising $P_E$ to beyond the corresponding upper bound ($P_E > 13.44$), both types of consumers will prefer shopping in-store.

<table>
<thead>
<tr>
<th>$P_T$</th>
<th>$P_E$ range</th>
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<tbody>
<tr>
<td>10</td>
<td>[11.89 13.44]</td>
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<tr>
<td>11</td>
<td>[12.85 14.44]</td>
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<td>12</td>
<td>[13.80 15.44]</td>
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<td>13</td>
<td>[14.76 16.44]</td>
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<tr>
<td>14</td>
<td>[15.72 17.44]</td>
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<tr>
<td>15</td>
<td>[16.67 18.44]</td>
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</table>

Table 1: Price of $P_T$ and the corresponding range of $P_E$ where risk-averse shoppers will choose traditional channel but risk-neutral shoppers will choose electronic channel.

Figure 5: Consumer utility and channel choices for example 1
Observation 2: For certain values of $S^T > S^E$, $C^T > C^E$, and $w^T < w^E$, there exist price values of $P^E > P^T$, such that risk-neutral shoppers will choose traditional channel and risk-averse shoppers prefer electronic channel.

Observation 2 is illustrated with these parameter values: $\bar{B} = 30$, $\bar{w} = 10$, $\bar{p} = 20$, $d_1 = 0.015$, $d_2 = 0.04$, $d_3 = 0.01$, $S^T = 5$, $S^E = 2.5$, $C^T = 5$, $C^E = 2.5$, and $w^T = 1$, $w^E = 2$. Table 2 gives prices, $P^E > P^T$ where risk-neutral shoppers choose traditional channel but risk-averse shoppers prefer electronic channel. Keeping $P^T$ the same (e.g. $P^T = 10$) and reducing $P^E$ to below the corresponding lower bound ($P^E < 11.33$), both types of consumers will prefer shopping online. Similarly, keeping $P^T$ the same (e.g. $P^T = 10$) and raising $P^E$ to beyond the corresponding upper bound (e.g. $P^E > 13.68$), both types of consumers will prefer shopping in-store.

<table>
<thead>
<tr>
<th>$P^T$</th>
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<tbody>
<tr>
<td>10</td>
<td>[11.33 - 13.68]</td>
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<tr>
<td>11</td>
<td>[12.33 - 14.65]</td>
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<tr>
<td>12</td>
<td>[13.33 - 15.61]</td>
</tr>
<tr>
<td>13</td>
<td>[14.33 - 16.58]</td>
</tr>
<tr>
<td>14</td>
<td>[15.33 - 17.54]</td>
</tr>
<tr>
<td>15</td>
<td>[16.33 - 18.51]</td>
</tr>
</tbody>
</table>

Table 1: Price of $P^T$ and the corresponding range of $P^E$ so that risk-neutral shoppers will choose traditional channel but risk-averse shoppers will choose electronic channel.
The above two examples illustrate how retailers can segment consumers by offering channel discriminatory-pricing so consumers would self-select their desired channel. The elements of this channel-based discriminatory-pricing include offering different combinations of product information and variety, search convenience, and delivery time. Since online shopping is conducive for price comparisons, online retailers that charge a premium should truly provide added benefits that competitors do not offer; otherwise, undifferentiated services will be bought on price alone. For example, the Wall Street Journal Online edition is charging a relatively high subscription rate for online access to its pages, which few print publications have managed to do. The Journal's success is due to its personalized search and archive features, along with 24-hour instant news alerts for online readers only (Bonchek and Loewe, 1999). If online offerings cannot distinguish themselves from in-store offering, cannibalization of one channel over another can occur as is the case with many book sellers (Wileman, 1999; McLean, 2000).
6. Discussions and Conclusions

In this paper, we develop an economic model of consumer shopping decision that takes into account consumer risk profiles and the substitution effects of economic factors such as prices, product range, ease of product evaluation, and product acquisition time. An examination of these substitution effects highlights the importance of quick delivery for online shopping, especially when the product in question requires long lead-time, as is the case with customized or rare items. For commodity items, the substitution effects suggest that a higher premium can be charged by providing a wide range of choices and comparison mechanisms so consumers incur lower search and evaluation costs. By modeling consumers as either risk-neutral or risk-averse, we are able to explain why consumers repeatedly buy from retailers such as Amazon.com who do not have the lowest price: once attracted to a site, risk-aversion keeps consumers there. Aversion to risk also explains why there is price dispersion in the cyberspace even though some predicted that ease of price search online would result in uniform pricing across retailers.

By focusing on substitution effects of various economic factors and consumers’ risk-aversion in online shopping environments, we propose that retailers wishing to attract customers should develop strategies that segment consumers into two types: risk-neutral or risk-averse. We predict that risk-neutral consumers will be the first ones who can be enticed away from traditional retailers. In order to obtain them as customers, retailer should focus on providing valued added service enabled by online shopping (e.g. search engines, impressive storefront design, and evaluation tools such as virtual reality). To retain customers, retailers should build virtual communities or engage in other relationship building techniques so risk-aversion will play a role in creating customer lock-in.

Our model also provides insights into consumer variety-seeking behavior online. As we
mentioned before, existing marketing literature indicates that, in traditional channels, consumers engage in variety-seeking behavior mostly for low-ticket items while high-ticket item retailers are able to lock-in customers. However, in online environment, due to dramatically reduced search costs, consumers are likely to engage in variety-seeking behavior for both low-ticket and high-ticket items. From retailers’ point of view, even though consumer risk-aversion can be used to create lock-in, a more successful strategy would include offering a variety of products in order to discourage their customers from searching elsewhere.

Our analytical model draws from the economic literature on utility functions and risk profiles and from the marketing literature on consumer behavior. Most of the marketing research on online shopping has focused on analysis of empirical data (Liao and Cheung, 2001; Jardine, 1999; Strader and Shaw, 1999; Poon and Swatman, 1999; Lee, 1998; Peterson, Ridher, Balasubramaniam and Bloomberg, 1997; Jarvenpaa and Todd, 1997; Quelch and Klein, 1996; Mehta and Sivadas, 1995). Our theoretical model is the first attempt in trying to explain and predict consumer online shopping behavior, which in turn provides guidance to multi-channel retailers in designing their channel-specific strategies.

7. Limitations and Future Research

Since our model develops from the consumer preference and transaction based theory, it is subject to limitation inherent to such theories because a utility model can not possibly include all potential factors influencing consumes’ preferences and their choices. For example, retailer branding and trust may take on a heightened importance in electronic marketplaces. As we mentioned earlier, this paper focuses on only the economic factors relevant to consumer purchase decision process, the model does not incorporate non-economic factors, such as brand beliefs, personal interest, habits, culture, social class, motivation, religion, and attitude.
For future work there remain important issues to be explored. One of such issues is the role of different types of intermediaries in the purchasing process. Some intermediaries operate by reducing consumers’ search and evaluation costs. Others can play a new role by aggregating buyers with similar needs and by conducting collective bargaining with potential sellers. For instance, iVillage.com is the women’s network and is formed as a virtual community. Subscribers of iVillage.com possess similar needs and have bargaining power for discounts. The underlying motivational factors are scale economies and risk pooling.

From online retailer’s perspective, product bundling can be a strategy used to aggregate products and to further reduce search and evaluation costs for consumers. For long term success, electronic channel have to be integrated with the tradition channels. For example, to purchase a TV set, a customer would prefer browsing and searching through the online store but would rather drive to a brick-and-mortar store to avoid paying shipping and delivery. Incorporating the integration of both channels would dramatically enhance our model.
References


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Appendix A: Notations

\( a \) = number of products searched

\( q \) = level of quality certainty

\( B^i \) = buyer effort in channel \( i \), where \( i = E \) (electronic) or \( T \) (traditional) and \( B^i = S^i + C^i \), where

\( S^i \) = search cost at channel \( i \) and \( C^i \) = evaluation cost at channel \( i \)

\( w^i \) = delivery time from the channel \( i \), where \( i = E \) or \( T \); for example, \( w^E \) = delivery time over the Internet shopping

\( p^i \) = product or service price in channel \( i \), where \( i = E \) or \( T \); for example, \( p^E \) = product or service price over the Internet shopping

\( k_0^T, k_1^T, k_2^T \) = parameters associated with the functional form of \( S^T \)

\( k_1^E, k_2^E \) = parameters associated with the functional form of \( S^E \)

\( k_1^i, k_2^i \) = parameters associated with the functional form of \( E^i \), where \( i = E \) or \( T \)

\( U_{total}^{j} \) = total utility for a type \( j \) consumers derived from purchasing a product through channel \( i \), i.e., \( U_{total}^{j} = V + U_{\text{effort}}^{j} + U_{\text{waiting}}^{j} + U_{\text{price}}^{j} \), where \( i = E, T \) and

\( j = A(\text{risk–averse}) \) or \( N(\text{risk–neutral}) \); for example, \( U_{total}^{E,N} \) = total utility for a risk-neutral buyer derived from purchasing a product online

\( V \) = reservation utility or the maximum valuation of a product

\( U_{\text{cost}}^{j} \) = utility loss for a type \( j \) consumers derived from purchasing a product through channel \( i \), where \( i = E \) or \( T \), \( j = A \) or \( N \), and cost = effort (for purchasing effort), waiting (for delivery time), or price (for product or service price); for example, \( U_{\text{effort}}^{E,A} \) = disutility from purchasing effort for a risk-averse buyer derived from purchasing over the Internet

\( d_{y} \) = level of risk-aversion towards component \( y \) of utility loss, where \( y = 1(\text{effort}), 2(\text{waiting time}), 3(\text{price}) \) and \( d_{y} \geq \frac{\ln 2}{B}, \frac{\ln 2}{w} \) or \( \frac{\ln 2}{p} \); for example, \( d_{1} \) = level of risk-aversion to purchasing effort.
Appendix B: Proofs of Propositions

Proof of Proposition 1:

The risk-neutral shopper: given the system of the implication functions $U_{T,N}^{total}$, $U_{E,N}^{total}$ in $a$, $q$ and by the implication function theorem and Cramer’s rule,

\[
\frac{\partial a}{\partial p^T} = - \frac{\begin{vmatrix} \frac{\partial U_{T,N}^{total}}{\partial p^T} & \frac{\partial U_{T,N}^{total}}{\partial q} & \frac{\partial U_{T,N}^{total}}{\partial a} \\ \frac{\partial U_{E,N}^{total}}{\partial p^T} & \frac{\partial U_{E,N}^{total}}{\partial q} & \frac{\partial U_{E,N}^{total}}{\partial a} \\ \end{vmatrix}}{\begin{vmatrix} \frac{\partial U_{T,N}^{total}}{\partial p^T} & \frac{\partial U_{T,N}^{total}}{\partial q} \\ \frac{\partial U_{E,N}^{total}}{\partial p^T} & \frac{\partial U_{E,N}^{total}}{\partial q} \\ \end{vmatrix}} = \frac{k_4^T B}{p(2k_4 a + k_4^T - k_1^T)} > 0 \text{ iff } a > \frac{k_1^T k_4^T - k_4 k_1^T}{2k_4^T k_0^T}.
\]

The risk-averse shopper: Similarly, given $U_{T,A}^{total}$, $U_{E,A}^{total}$, we have

\[
\frac{\partial a}{\partial p^T} = - \frac{\begin{vmatrix} \frac{\partial U_{T,A}^{total}}{\partial p^T} & \frac{\partial U_{T,A}^{total}}{\partial q} & \frac{\partial U_{T,A}^{total}}{\partial a} \\ \frac{\partial U_{E,A}^{total}}{\partial p^T} & \frac{\partial U_{E,A}^{total}}{\partial q} & \frac{\partial U_{E,A}^{total}}{\partial a} \\ \end{vmatrix}}{\begin{vmatrix} \frac{\partial U_{T,A}^{total}}{\partial p^T} & \frac{\partial U_{T,A}^{total}}{\partial q} \\ \frac{\partial U_{E,A}^{total}}{\partial p^T} & \frac{\partial U_{E,A}^{total}}{\partial q} \\ \end{vmatrix}} = \frac{k_4^E B}{p(k_1^E - 2k_4^E a - k_1^T k_4^T)} > 0 \text{ iff } a > \frac{k_1^E k_4^T - k_4^E k_1^T}{2k_4^E k_0^T}.
\]

The risk-neutral shopper: Similarly, given $U_{T,N}^{total}$, $U_{E,N}^{total}$, we have

\[
\frac{\partial a}{\partial p^T} = - \frac{\begin{vmatrix} \frac{\partial U_{T,N}^{total}}{\partial p^T} & \frac{\partial U_{T,N}^{total}}{\partial q} & \frac{\partial U_{T,N}^{total}}{\partial a} \\ \frac{\partial U_{E,N}^{total}}{\partial p^T} & \frac{\partial U_{E,N}^{total}}{\partial q} & \frac{\partial U_{E,N}^{total}}{\partial a} \\ \end{vmatrix}}{\begin{vmatrix} \frac{\partial U_{T,N}^{total}}{\partial p^T} & \frac{\partial U_{T,N}^{total}}{\partial q} \\ \frac{\partial U_{E,N}^{total}}{\partial p^T} & \frac{\partial U_{E,N}^{total}}{\partial q} \\ \end{vmatrix}} = \frac{k_4^T B}{p(2k_4 a + k_4^T - k_1^T k_4^T)} > 0 \text{ iff } a > \frac{k_1^E k_4^T - k_4^E k_1^T}{2k_4^E k_0^T}.
\]
Proof of Proposition 2:

Let

\[
U^d,N_{total} = U^{E,N}_{total} - U^{T,N}_{total} = \frac{V}{B} \left[ k_1^E a^2 + (k_1^T - k_1^E) a + k_2^T + k_3^T - k_2^E - k_3^E + \frac{k_4^T - k_4^E}{q} \right] + \frac{V}{w} w^d + \frac{V}{p} p^d,
\]

where \( w^d = w^T - w^E \) and \( p^d = p^T - p^E \). By the implication function theorem,

\[
\frac{\partial a}{\partial p^d} = -\frac{\partial U^d,N_{total}}{\partial p^d} = -\frac{B}{p} \cdot \frac{\partial S^d(= S^T - S^E)}{\partial a} < 0 \iff \frac{\partial S^d}{\partial a} > 0.
\]

Similarly,

\[
\frac{\partial a}{\partial w^d} = -\frac{\partial U^d,N_{total}}{\partial w^d} = -\frac{B}{W} \cdot \frac{\partial S^d(= S^T - S^E)}{\partial a} < 0 \iff \frac{\partial S^d}{\partial a} > 0.
\]

Proof of Proposition 3:

Let \( f = \frac{p^E}{p} \). Since \( p^E \leq \bar{p} \) we have \( 0 \leq f \leq 1 \).

Since \( e^{d,p^E} > \frac{p^E}{p} + 1 \iff e^{d,\bar{p}} > f + 1 \iff d > \frac{\ln(f + 1)}{f} \), \( \forall f \iff d \geq \lim_{f \to 0^+} \frac{\ln(f + 1)}{f} \iff \)
\[
\frac{\partial \ln(f + 1)}{\partial f} \quad \text{(by L'Hôpital's rule)} \quad \Rightarrow \quad d_3 > \frac{1}{p}.
\]

We obtain \( d_3 > \frac{1}{p} \Rightarrow e^{d_1^{p^E}} > \frac{P^E}{p} + 1 \). Similarly, we have \( d_1 > \frac{1}{B} \Rightarrow e^{d_1^{B^E}} > \frac{B^E}{B} + 1 \) and

\[
d_2 > \frac{1}{w} \Rightarrow e^{d_2^{w^E}} > \frac{W^E}{w} + 1.
\]

Therefore, \( d_1 > \frac{1}{B}, d_2 > \frac{1}{w}, d_3 > \frac{1}{p} \)

\[
\Rightarrow e^{d_1^{B^E}} > \frac{B^E}{B} + 1, e^{d_2^{w^E}} > \frac{W^E}{w} + 1, e^{d_3^{p^E}} > \frac{P^E}{p} + 1
\]

\[
\Rightarrow U_{total}^{E,N} - U_{total}^{E,A} = V[(e^{d_1^{B^E}} - \frac{B^E}{B}) + (e^{d_2^{w^E}} - \frac{W^E}{w}) + (e^{d_3^{p^E}} - \frac{P^E}{p})] > 0.
\]

Similar analysis with respect to the traditional channel yields:

\[
d_1 > \frac{1}{B}, d_2 > \frac{1}{w}, d_3 > \frac{1}{w} \Rightarrow U_{total}^{T,N} - U_{total}^{T,A} > 0, d_3 > \frac{1}{w}.
\]

**Proof of Proposition 4:**

Let :

\[
F = U^{d,A} - U^{d,N} = V\left[\left(e^{d_1^{B^T}} - \frac{B^T}{B}\right) - \left(e^{d_2^{w^T}} - \frac{W^T}{w}\right) + \left(e^{d_3^{p^T}} - \frac{P^T}{p}\right)\right]
\]

and \( g = e^{dx} = \frac{x^1}{x} \). We aim to prove that \( g \) is a strictly increasing function with

\[
\frac{\partial g}{\partial x} = de^{dx} - \frac{1}{x} > 0.
\]
In Proposition 3, \( d \frac{1}{x} \Rightarrow e^{dx} > \frac{x}{x} + 1 \Leftrightarrow de^{dx} > \frac{dx}{x} + d \). It follows that

\[
\frac{dx}{x} + d - \frac{1}{x} = \frac{d(x + x)}{x} - 1 > 0 , \text{then } \frac{de^{dx}}{dx} > \frac{dx}{x} + d - \frac{1}{x} \text{ and } \frac{\partial g}{\partial x} = de^{dx} - \frac{1}{x} > 0 .
\]

Therefore, \( g \) is a strictly increasing function with respect \( x \), if \( d > \frac{1}{x} \).

When \( B^{x} > B^{E} \), \( w^{x} > w^{E} \), \( p^{x} > p^{E} \), we have \( F > 0 \) and show the proposition 4.

**Proof of Corollary:**

\[
\frac{\partial F}{\partial B^{x}} = V(d_{1}e^{d_{x}B^{x}} - \frac{1}{B}) > 0 , \quad \frac{\partial F}{\partial w^{x}} = V(d_{2}e^{d_{2}w^{x}} - \frac{1}{w}) > 0 \quad \text{and} \quad \frac{\partial F}{\partial p^{x}} = V(d_{3}e^{d_{3}p^{x}} - \frac{1}{p}) > 0 .
\]

\[
\frac{\partial F}{\partial B^{E}} = V(\frac{1}{B} - d_{1}e^{d_{x}B^{E}}) < 0 , \quad \frac{\partial F}{\partial w^{E}} = V(\frac{1}{w} - d_{2}e^{d_{2}w^{E}}) < 0 \quad \text{and} \quad \frac{\partial F}{\partial p^{E}} = V(\frac{1}{p} - d_{3}e^{d_{3}p^{E}}) < 0 .
\]

**Proof of Proposition 5** is similar to that of Proposition 4