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Essays on Dispersion, Fairness Perception and Partitioning of Online Prices

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ESSAYS ON DISPERSION, FAIRNESS PERCEPTION AND PARTITIONING OF ONLINE PRICES

by

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ABSTRACT
ESSAYS ON DISPERSION, FAIRNESS PERCEPTION AND PARTITIONING OF ONLINE PRICES

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Under the Supervision of Professor Sanjoy Ghose

My dissertation is primarily on online pricing, by empirically investigating how formats and structures of prices influence consumer responses and subsequent purchasing behavior, brand choice, etc. Currently, three essays of my dissertation explore topics on price fairness perception, price dispersion, as well as price partitioning.

First, although previous researchers have tested effects of price changes on consumer's perceptions on price (e.g., Maxwell 1999, Campbell 2007), little work has focused on the effects of prices/costs levels on online price judgments and virtually none has examined it jointly with both internal/external reference prices from multiple comparison parties. Less work has applied price decreasing and increasing together to observe (un)fairness or associated them with asymmetric liking and disliking judgments (Herr and Page 2004). To fill this gap, we employ an expected utility model incorporating emotional factors such as disappointment (elation) and regret (rejoicing) to model online price fairness perceptions. We demonstrate a two-stage evaluation and find interesting asymmetric patterns of significant effects of four emotions on price fairness. Second, there does not exist yet a quantitative review synthesizing and explaining the discrepancy of findings on price dispersion. An empirical generalization is conducted to statistically and

quantitatively summarize in which way online price dispersion goes, and what are the true determinants of the magnitude of price dispersion in E-commerce. By a meta-analysis study, we find that product category, measurement of price dispersion, controlling for heterogeneity in the study and so on, are significant factors. Third, shipping and handling (S&H) fee is examined as a popular form of partitioned price offered by E-tailers. We employ a Gain-and-Loss Utility model incorporating different levels of price gains and losses presented to customers in the transactions to model online purchase behaviors in a strategic pricing framework. We find significant asymmetry in the effects of price surcharges and price discounts on purchase quantity as well as on how customers organize and manage their shopping baskets.

Keywords: price fairness, price dispersion, price partitioning, behavioral pricing, reference price, Meta-Analysis, multi-dimensional pricing, price surcharges, shipping and handling fees, online pricing

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ESSAY I

ASYMMETRIC EFFECTS OF DISAPPOINTMENT AND REGRET ON PRICE FAIRNESS PERCEPTION: A UTILITY MODELING APPROACH

Although previous researchers have tested effects of price changes on consumer's perceptions on price (e.g., Maxwell 1995, 1999, Campbell 1999, 2007), little work has focused on the effects of prices/costs levels (represented by different product attributes and designs) on online price judgments and virtually none has examined it jointly with both internal/external reference prices from multiple comparison parties. Less work has applied price decreasing and increasing together to observe (un)fairness or associated them with asymmetric liking and disliking judgments (Herr and Page 2004, Russell and Carroll 1999). To fill this gap, we employ an expected utility model incorporating emotional factors such as disappointment and regret to model online price fairness perceptions in an attitude-oriented framework, by designing in both positive and negative price differences simultaneously. In addition, multiple price comparison points, contexts of purchasing and transaction, and the characteristics of respondents are considered in the model to evaluate their effects on customers' judgments about price offered online. Using a hierarchical ordinal logit model, we find significant asymmetry in the effects of elation and disappointment, as well as asymmetry in the effects of rejoicing and regret on fairness perception. These also vary across product designs and reference price levels.

1. Introduction

Think about this scenario: Ann purchased a small digital gadget on Amazon.com and spent $60 with free shipping fee. Before long, she found a similar product online at price $50. It is okay, thought Ann, no big difference, huh.

The other day, Ann wanted to buy an electronic device on the Internet. Multifarious websites provided quite a lot model options and prices. After checking several E-tailers' offers, Ann made a decision matching her own expectation and spent $400 on this digital device. Several days later, she found her friend Dave had also bought one, but he only paid $300. Look at the price I paid, I'm so disappointed, said Ann. However, she soon got delighted again and showed no regret at her purchase any more after finding that the same model was labeled at $500 in store. What a nice price I've got online, Ann told to herself.

Is $400 that Ann has paid fair?

Consumers are comparing prices all the time. A price comparison can be done at any time when it is convenient to consumers, especially in the current socially-networked world and web-oriented marketplace. After taking great efforts in looking for the products at the best price, customers keep on learning about price increasing and decreasing. However, do they always feel unfair when they find the price decreases? Is the price forever fair if their own purchasing prices are lower than those of other offers?

Starting from research on justice (Homans 1961) and equity theory (Adams 1965), to the numerous studies on marketplace factors through price comparison processes (Zeithaml 1988, Campbell 1999, etc.), and the papers on new moderators such as pre-purchase goals, price-matching refund policies (Xia, et al. 2009), and culture effects (Bolton, Keh and Alba 2009), researchers have developed various theories and models to explain how consumers perceive price (un)fairness. From previous studies, we conclude that 1) price judgment is perceived through comparisons and acknowledgement of price change; 2)

consumers are using multiple comparison parties, involving price or procedure with self standard, other references or marketplace norms (Xia, Monroe and Cox 2004). 3) cognitive reactions are used to explain (un)fairness perceptions. Positive emotions mirror fairness perception, while negative emotions signal unfairness or less fairness (Campbell 2004).

Although previous researchers have tested effects of price changes on consumer's perceptions on price (e.g., Maxwell 1995, 1999, Campbell 1999, 2007), little work has focused on the effects of prices/costs levels (represented by different product attributes and designs) on online price fairness judgments and virtually none has examined it jointly with both internal and external reference prices from multiple comparison parties. Less work also has applied price decreasing and increasing together to observe (un)fairness or associated them with asymmetric liking and disliking judgments simultaneously (Herr and Page 2004, Russell and Carroll 1999).

To fill this gap, we employ an expected utility model incorporating both positive and negative emotional factors such as elation and disappointment, as well as rejoicing and regret to model online price fairness perceptions in an attitude-oriented framework, by designing in price increasing and decreasing simultaneously. In addition, multiple price comparison points, contexts of purchasing and transaction, and the characteristics of respondents are considered in the model to evaluate their effects on customers' judgments about prices offered online. The main contribution of the current study is to empirically examine how price differences associated with various types of emotions influence consumers' perceived fairness on prices, while controlling for the comparative

transaction context variables such as transaction similarity, choice of comparison parties, product price levels, the buyer-seller relationship, and so on.

The current paper aims to capture these differences and see how they might induce different levels of price (un)fairness perceptions. We hypothesize that different types of emotions (e.g., elation, regret, etc.) resulted from positive and negative price differences in two stages of price evaluation (pre-purchase and post-purchase) influence customers' price fairness perception in different ways. Positive gaps between prices lead to positive perception, therefore resulting in a higher level of perceived fairness. Negative gaps between prices lead to negative perceptions, therefore resulting in a lower level of perceived fairness. Meanwhile, the magnitudes of effects are expected to be asymmetric for positive and negative emotional outcomes, and vary across pre-purchase and post-purchase evaluation, as well as product price levels and choices of comparison parties.

The context of our investigation is fairness perception of online prices for digital cameras. We collect and utilize the data from a survey with 202 subjects. Specifically, we design three scenarios with three combinations of digital camera attributes at different price levels and therefore multiple observations are obtained from each subject. In all, we investigate fairness perceptions on 1616 observations. We utilize a hierarchical ordinal logit regression type utility model and find significant asymmetric effects of disappointment and regret on price fairness perceptions.

In the following elaboration, we begin by discussing the concept and framework of price fairness. Then, we use a Disappointment-Regret Model to explain factors that influence

consumers' price (un)fairness perceptions for online purchasing. Finally, we discuss the results and implications from the study.

2. Theoretical Framework and Hypotheses

Price fairness perception is an important issue in pricing, since it focuses on how consumers perceive and respond to prices and it results in different subsequent purchasing behaviors. In this section, we first conduct a literature review by highlighting four important issues regarding fairness perception; then we propose the theoretical framework and hypotheses of our current study.

2.1 How Previous Researches have explained Price Fairness

Starting from 1960s' research on justice (Homans 1961) and Equity theory (Adams 1965), to the numerous empirical studies on marketplace factors through price comparison processes (Zeithaml 1988, Campbell 1999, Bolton, Warlop and Alba 2003, Xia, Monroe and Cox 2004) and recent papers on new moderators such as pre-purchase goals, price-matching refund policies (Xia, et al. 2009), and culture effects (Bolton, Keh and Alba 2009), researchers have developed various theories and models to explain and understand how consumers perceive price (un)fairness. Four important issues can be summarized in existing researches and are elaborated below.

First, price judgment and fairness are perceived through price comparisons and acknowledgement of price changes. From the perspective of consumers, price is what is given up or sacrificed to obtain a product (Zeithaml 1988). So people initially have some expectations and determinations on how much they would like to give up to obtain a certain product. This willingness to pay usually comes from customers' belief and

knowledge about product, previous experiences, and some standard norms. To make further judgment on the price, people need to find a reference point or even multiple reference points (Ordonez, Connolly 2000). And they notice the price changes through comparisons and thus perceive differently based on the changes or gaps they find. From a cognitive aspect of fairness, it can also be defined as a judgment of whether an outcome and/or the process to reach an outcome are reasonable. "It is defined as a consumer's assessment and associated emotions of whether the difference (or lack of difference) between a seller's price and the price of a comparative other party is reasonable, acceptable, or justifiable" (Xia, Monre and Cox 2004). So after comparisons or noticing price changes, people perceive price fairness or unfairness cognitively on whether the gaps or the differences are reasonable or not. Most researches apply price increase to perceive unfairness and some studies provide participants alternative percentages of price discounts (Niedrich, Sharma and Wedell 2001). However, less work has applied price decreasing and increasing together to observe (un)fairness or associated them with asymmetric liking and disliking judgments (Herr and Page 2004, Russell and Carroll 1999).

Second, studies demonstrate that consumers are using multiple comparison points (Ordonez, Connolly and Coughlan 2000). In fact, people are comparing prices all the time especially in a Triple W world where they can find a huge amount of price information. People are faced with past prices they purchase at, reduced prices under promotion or with the maturity of the product in the market, friends' prices, competitor brands' prices, vendor-cost-adjusted prices, and so on. To summarize, the comparison involves price or procedure with self standard, other references or marketplace norms

(Xia, Monroe and Cox 2004). Researchers reach conclusions that there are multiple reference points in fairness assessment, and thus effects vary in different situations.

When making judgment on prices through comparisons, two types of reference points are summarized in terms of two streams of reference price (Mazumdar, Raj and Sinha 2005). The first one is Internal Reference Price, developed by consumer themselves, which is usually defined as self comparison (Xia, Monroe and Cox 2004). It could be consumers' memories, past purchasing prices experienced, expectations based on knowledge of product and initial price they are willing to pay. This reference point from self is easy to obtain and it is formed unconsciously before consumers make any purchasing decision. The second type is External Reference Price, coming from alternative resources other than consumers themselves. It could be the prices people find through another transaction channel, competitor brand, acquaintances such as friends or relatives, or the vendor cost. It is usually defined as third party comparison (Xia, Monroe and Cox 2004), and it is sometimes obtained after a purchase decision. Sometimes, these two types of reference points have influences on each other. For example, the competitor brands prices affect consumers' own expectations and change self comparison points.

Third, much research focused on cognitive reaction accompanied by (un)fairness perceptions. Positive emotions mirror fairness perception on the deal, while negative emotions signal unfairness or less fairness. Concepts of asymmetry and bipolarity of liking and disliking (Herr and Page 2004, Russell and Carroll 1999) can also be applied to price fairness and unfairness perceptions. When consumers are faced with multiple comparison prices, price change plays a causal role in customers' judgments of price. It makes people perceive differently with various emotions accounted with perceptions.

From the definition of (un)fairness perception in cognitive aspect, observed difference between two prices will lead to emotional reactions, which occur concurrently with or even before the fair or unfair perceptions (Campbell 2004, Xia, Monroe and Cox 2004).

Even in the same direction of price change or difference, various types of emotions will be perceived depending on the stages of price evaluation and the associated comparison points. Positive affect includes being happy, pleased, and elated; while negative affect could be feeling disappointed, unhappy, and upset (Russell and Carroll 1999). Inman, Dyer and Jia (1997) use two pairs of opposite emotions expressed by antonyms such as elation and disappointment, rejoicing and regret. They design a choice experiment incorporating these two pairs of emotions to examine the asymmetric disappointment and regret effects on post-choice valuation. In addition, there are even some severe unfairness perceptions discussed, which "typically comes with heat and passion, anger, and outrage; and they insistently press for action or redress" (Finkel 2001). Emotional reaction becomes a very important factor on people's (un)fairness perceptions. This current paper mainly focuses on it to see how different types of emotions induce various levels of price (un)fairness perceptions.

Fourth, there are a few clarifications and recent findings on the (un)fairness concept that helps us to understand people's evaluations of prices further. Fairness is not the absolute opposite of unfairness and it is possible to be clear about one without having clarity about the other (Finkel 2001). Fairness and unfairness may be conceptually different constructs (Xia, Monroe and Cox 2004). This could also be due to the asymmetry in emotional outcomes. So it is easier for us to perceive things to be unfair since notions of unfairness are typically clearer, sharper, and more concrete than notions of fairness. People know

what is unfair when they see or experience it, but it is difficult to articulate what is fair. Besides, fairness is not equal to satisfaction although they are highly correlated (Oliver and Swan 1989a, b). Researchers find different patterns from fairness and satisfaction ratings (Ordóñez, Connolly, and Couglan 2000). Our current research expects to observe asymmetric patterns of fairness and unfairness, by designing in both increasing and decreasing prices simultaneously with the same stimuli.

2.2 Theoretical Framework and Hypotheses

Although previous researchers have tested effects of price changes on consumer's perceptions on price (e.g., Maxwell 1995, 1999, Campbell 1999, 2007), little work has focused on the effects of prices/costs levels (represented by different product attributes and designs) on online price judgments and virtually none has examined it jointly with both internal/external reference prices from multiple comparison parties. Less work has applied decreasing and increasing prices together to observe (un)fairness or associated them with asymmetric liking and disliking judgments (Herr and Page 2004, Russell and Carroll 1999). To fill this gap, we employ an expected utility model incorporating factors such as disappointment and regret to model online price fairness perceptions in an attitude-oriented framework, by designing in both positive and negative price differences simultaneously. In addition, actual price levels represented by product designs, choices of multiple price comparison points, contexts of purchasing and transaction, buyer-seller relationship, and the characteristics of respondents are considered in the model to evaluate their effects on customers' judgments about price offered online. ***Figure 1*** illustrates the main conceptual framework and rationale upon which we elaborate in the following discussions.

----------Insert Figure 1 about here----------

A Two-stage evaluation

A growing number of studies connect price evaluations and purchasing intentions with fairness perceptions. A recent research finds that price fairness perception has influenced shopping intention indirectly through perceived value at the actual paid price (Kukar-Kinney, Xia and Monroe 2007). Actually, consumers start evaluation with some initial judgments right after they compare the actual price online with their own expectations. This self comparison is based on people's own expectations and the price they would like to give up to obtain a certain product. We consider self expectation as an important internal reference point that customer use to compare with the actual prices before they make any decisions when shopping online.

We have previously discussed two types of reference points people use to make price comparisons. However, there is yet no conclusion or inference from previous studies on how people choose comparison points and the possible two-stage procedure of formation of (un)fairness perceptions. In the following elaboration, following Xia, Monroe and Cox (2004), we consider self comparison before the purchasing decision making, and consider the third comparison party after the purchasing decision making. By designing in both self and third party reference points in the study, we expect to capture a two-stage evaluation from customers' initial purchasing intentions to price fairness perceptions.

When consumers are faced with multiple comparison prices during the purchasing and price evaluation procedure, they choose different reference prices at different stages of the procedure, and they judge the price based on differences between these prices. Different reactions and emotions are associated. We hypothesize that people work online

and form their own willingness and expectations, resulting in a certain level of initial purchasing intention in the first stage of price evaluation. Once they make the purchasing decision, customers may compare the price with in-store price, as well as other comparison parties, and finally perceive the price by judging difference between prices offered online and the forgone prices in the second stage of price evaluation.

> $H_{1(a)}$: *(pre-purchase stage)* Price differences between consumer expectations and actual prices provided by E-tailer website result in pre-choice initial purchase intentions. If the actual price is lower than price self expectation, people will have higher purchase intentions; if actual price is higher than self price expectation, people will have lower purchase intentions.

> $H_{1(b)}$: *(post-purchase stage)* As one of main reference points, self belief of purchasing and initial buying intention affects the post-choice price fairness positively. Knowing the actual price of products provided by online websites, customer makes an initial judgment of buying or not. More intended to purchase, more fairness customer will perceive after purchasing when comparing with other third party comparison prices. Although there is a lower forgone price, the actual price is still within their self expectation range or not far from their expected price.

Context of Online Purchasing

Most previous researches put the context of purchasing in a particular department store or regular stores. Internet marketing has become a main stream phenomenon of the marketplace. According to U.S. Census Bureau, 3.6% of total retail sales in U.S come

from E-commerce and yearly about 130 billion dollars sale goes online. However, there is a lack of work on price fairness perception evaluation when online store or E-tailers' website is the purchasing transaction channel.

For online pricing, various conclusions have been made by empirical studies on decreasing or increasing price competition (Bakos 1997, Lal and Sarvary 1999, Lynch and Ariely 1999) and contradictory evidences are found by researchers about price dispersion online compared with traditional stores (Kung, Monroe, Cox 2002, Pan, Ratchford, Shankar 2004). Drawing from those studies on Internet Price Dispersion, websites indeed provide higher price dispersion on prices, which give more options and information for consumers. Large price dispersion online inspires our current research, by focusing on the choice of reference point and comparing with online price and in-store price.

> H_2: Different choice of comparison parties will affect post-purchase price fairness (in the second stage of price evaluation) differently. Apart from self comparison, customer will compare price with other party (online vs. in-store price), other customer, and price from the competitor brand. We expect to see a higher effect from in-store price, since it is directly competing with the online price.

Moderators from Individuals and Market context

Individual purchasing behavior and market context will also affect people's fairness perceptions, such as buyer-seller relationship, individual's previous purchasing

experience, knowledge and familiarity of the marketplace, and customer's sensitivity of prices.

H_3: Relationship between buyer and seller As an emerging relatively new purchasing channel, online E-tailer is different from traditional conventional stores. Relationship between online E-tailer and buyer is also an important factor on price fairness formation. Trust in online seller will improve relationship between buyer and seller, while repeating purchasing behaviors show whether customer know better about online purchasing.

We propose that when the comparative outcome is positive or neutral (third party price is lower than actual purchasing price), trust in the seller and repeated purchasing online has a positive effect on price fairness perceptions. When the comparative outcome is negative (third party price is higher than actual purchasing price), trust in the seller and repeated purchasing online has a negative effect on price fairness perceptions.

H_4: Previous buying/Familiarity of product If customer know better about product and have previous buying behavior, they will perceive more fairness when noticing the change of prices, than those who are not familiar with products or have never bought before.

H_5: Price Sensitivity People perceive differently on price due to different levels of price sensitivity. When the comparative outcome is positive or neutral (compared price is lower than actual price), a more sensitive person will perceive higher fairness of price change. Consumer's price sensitivity

has a positive effect on price fairness perceptions. When the comparative outcome is negative (compared price is higher than actual price), more sensitive person will perceive lower fairness of price change. Consumer's price sensitivity has a negative effect on price fairness perceptions.

Effect of Physical Attribute/Design as Signal of Cost Level

Price is an important causal reason for (un)fairness perceptions. Early in 1970s, Olson (1974), Wheatley and Chiu (1977) have endowed price the characteristic of a product "attribute" (Erickson and Johansson 1985). The multi-attribute evaluation model has been well established and it proves that price is an essential signal of quality and cost (Wolinsky 1983, Bagwell and Riordan 1991). Product differentiations, diverse combinations of product physical attributes and configurations result in different price and cost levels.

Previous researchers examine price fairness perceptions among different categories, ranging from daily consumption items such as polo shirts (Bolton, Warlop and Alba 2003) to durable products such as cars (Herrmann, Xia, Monroe and Huber 2007). We propose that even for the same product category, there would exist various combinations of product attributes and it is an important issue to separately examine different potential cost levels by providing various product attributes as well as designs to discover their effects on people's judgments on the price change.

We hypothesize that potential cost level of product will moderate the effect of price change on price perceptions. Specifically, the effects will be inflated at higher cost levels with larger price gaps, and the effects will be reduced at lower cost levels with smaller

price gaps. For higher price levels equipped with comparatively high configurations and good designs, people will easily perceive more fairness or unfairness since they see big gaps after comparison, while for lower price levels with relatively low configurations and designs, gaps between consumers' own expectations and other third party reference prices are smaller and people will not clearly and sharply perceive price (un)fairness.

> *H_6:* Different combinations of product attributes and levels of designs of product model will affect price fairness perceptions. For a lower configuration or lower design model, people's price perception caused by price change is not as sharp as for higher configuration or better design models. People perceive more (un)fairness as product level price goes higher. As a signal of product quality, actual price level affects price fairness perception positively.
>
> When the comparative outcome is positive or neutral (compared price is lower than actual purchase price), higher actual price level results in higher fairness of price change. Product's actual price has a positive effect on price fairness perceptions. When the comparative outcome is negative (compared price is higher than actual purchase price), higher actual price level results in lower fairness of price change. Product's actual price has a positive effect on price fairness perceptions.

Four Emotions

From consumers' initial purchasing intention in the pre-purchase stage to fairness perception in the post-purchase stage, we expect the see four emotions resulting from price comparisons, which are from elation or disappointment to rejoicing or regret.

H_8: Elation (D^+) In the first stage of price evaluation, when the offered actual price online is lower than customer's expectation, the difference between expected price and actual price is a positive value. We use D^+ to label the positive price difference, since people's response is elation rather than disappointment. In this situation, the higher D^+ is, the larger is the positive difference of actual price and self expectation, resulting in higher price fairness perception. So we hypothesize that D^+ has a positive effect on price fairness.

H_9: Disappointment (D^-) When the actual price is higher than customer's expectation of price, the difference between expected price and actual price is negative, which is termed disappointment and we label it with D^-. In this situation, the higher $|D^-|$ is, the larger is the absolute gap between actual price and self expectations. This results in lower price fairness perception or higher unfairness perception. So we hypothesize that $|D^-|$ has a negative effect on price fairness.

H_{10}: Rejoicing (R^+) In the second stage of price evaluation, when the actual price is lower than the third party comparison price, difference between third party comparison price and actual price is positive, then the difference is termed as rejoicing and we use R^+ to label the positive gap. In this situation, the higher R^+

is, the larger is the positive difference of actual price and forgone comparison price, this results in higher price fairness perception.

H_{11}: Regret (R^-) When the actual price is higher than the third party comparison price, difference between third party comparison price and actual price is negative, then we call it regret labeling with R^-. In this situation, the higher $|R^-|$ is, the higher is the absolute difference of actual price and forgone comparison price, this results in lower price fairness perception.

3. Modeling Framework

3.1 Base Model

Initiated by Shand (1914) and Savage (1954), the utility model including combined positive or negative disappointment and regret is developed by Inman, Dyer and Jia (1997) and applied in psychology and behavior research (Zeelenberg, Dijk, Manstead and Pligt 2000). The generalized model incorporates intuitively appealing notions of disappointment and regret jointly and thus could help explain consumers' reactions to losses and gains on product prices when they compare to other alternative price offers.

Following Inman, Dyer and Jia (1997), in our proposed base model[1], we capture opposite emotions (expressed by antonyms as elated and disappointed, rejoiced and regretted) by price differences of multiple reference prices in the price judging two-stage procedure. We decompose two emotional outcomes into four emotions to reflect asymmetries of

[1] We do not include price expectation in our model as Inman, Dyer and Jia (1997) did, since it is highly correlated with differences of price expectation and actual price. Similarly to Inman, Dyer and Jia (1997), we also do not include the interaction term between regret and disappointment, since the empirical study shows the interaction term's parameter is not statistically significant and it also does not result in a significant improvement in model fit.

people's liking and disliking (Herr and Page 2004) at two stages of price evaluation. When the price gap is negative, i.e., when the customer expects a lower price than the actual price encountered or finds other actual less expensive offers, it results in negative emotions such as disappointment or regret. When the price gap is positive, i.e., the customer pays less than what they expected or notices third party price offers higher than what he/she has paid, the resultant emotion is that of elation or rejoicing (constructs opposite to that of disappointment and regret[2]). Our proposed base model is shown in formula *(1)*.

$$Fairness = \beta_0 + \beta_1 D^+ + \beta_2 D^- + \beta_3 R^+ + \beta_4 R^- \quad (1)$$

$$= \beta_0 + \beta_1\,(Expected\text{-}Actual)^+ + \beta_2\,(Expected\text{-}Actual)^- + \beta_3\,(Forgone\text{-}Actual)^+ + \beta_4\,(Forgone\text{-}Actual)^-$$

The base model consists of four components: 1) elation (D^+) capturing the positive discrepancy between expected and actual price, and 2) disappointment (D^-) capturing the negative discrepancy between expected and actual price 3) rejoicing (R^+) capturing the positive difference between reference price from the forgone item and actual purchase and 4) regret (R^-) capturing the negative difference between reference price and actual price.

Specifically, there are two stages of evaluation when we relate price differences to emotional reactions. Before purchasing, a buyer might be elated (a very high activation positive effect) when the purchasing price is lower than self expectation of price, and the buyer may be disappointed when the purchasing price is higher than the expectation since the expectation is not fulfilled. After making purchasing decision, the buyer might feel

[2] Note that D^+ and D^- (elation and disappointment, respectively) cannot occur simultaneously, nor can R^+ and R^- (rejoicing and regret, respectively)

regretful since the buyer finds another lower price through some other channels (a forgone outcome that might have happened), or will rejoice because the consumer finds a friend who purchases at a higher price level for the same product. The current paper aims to capture those differences and empirically study how they induce various levels of price (un)fairness perceptions.

3.2 Full Model

Further, since the dependent variable in our research (Fairness Perception) is captured by a 1-9 rating scale, we apply a hierarchical ordinal logit model after a trichotomy classification of the response variable.

First, a trichotomy classification is applied to the response variable to explain customers' evaluation on prices and their perceived fairness. Let Price Fairness perception ratings (1-9 scale) be separated into three parts, resulting in outcomes of the multinomial choices respectively. For the resulting ordinal logistic model, perception ratings are decomposed into three levels, with 1-3 scale as "1" Very Unfair, 4-6 scale as "2" Moderate Fair, and 7-9 scale as "3" Very Fair. Therefore, three levels of fairness perceptions are generated to represent customers' judgment on product prices.

$$Fairness\ Perception_i = \begin{cases} 1 = "very\ unfair" & if\ price\ rating\ 1-3 \\ 2 = "moderate\ fair" & if\ price\ rating\ 4-6 \\ 3 = "very\ fair" & if\ price\ rating\ 7-9 \end{cases}$$

Second, since price perception ratings have reflected ordered response to prices and the given reference prices, an ordinal logit model is the most appropriate model to use. Let $\pi_{ij} = Prob(Y_i = \theta_j), j = 1,2$ denote the probability that the response of individual i with product and subject characteristics X falls in the j^{th} response category, where θ_j is a

constant representing the baseline value of the transformed cumulative probability for the j[th] category. Let γ_{ij} denote the corresponding cumulative probability $\gamma_{ij} = \Pr(Y_i \leq \theta_j)$ that the response falls in the j-th category or below, so

$$\gamma_{ij} = \pi_{i1} + \pi_{i2} + \cdots + \pi_{ij}$$

Suppose further that there is an underlying unobserved continuous variable U using the cut point

$$\theta_1 < \theta_2$$

$$Fairness\ Perception = \begin{cases} 1"Very\ Unfair" & if\ U \leq \theta_1 \\ 2"Moderate\ Fair" & if\ \theta_1 < U \leq \theta_2 \\ 3"Very\ Fair" & if\ \theta_2 < U \end{cases}$$

$$U = X\beta' + \epsilon$$

where X is the vector of independent variables, and β is the vector of regression coefficients which we wish to estimate, and error term ϵ that captures the unobserved effects and we assume $\epsilon \sim N(0, \sigma^2)$. There are two groups of observed factors: individual or personal factors, and product attributes or purchasing context factors. For instance, the more the consumer is familiar with the product, the more likely the buyer perceives fairness with positive emotions. Or the more expensive the product is, the more likely the buyer feels unfair when he/she observes a less expensive offer for the same model.

Assume ϵ follows a logistic distribution, which means cumulative distribution of ϵ is $F(\epsilon)$ = exp (ϵ)/(1+exp(ϵ)). For example, the probability that fairness perception falls into "Very Fair" category for example, is shown in formula *(2)*.

$$Prob\left(\text{Very Fair}\right) \qquad (2)$$

$$= \sum_{k=1}^{j} \Pr(U = \theta_2) = \Pr(U > \theta_2)$$

$$= \Pr\left(X\beta^{'} + \epsilon > \theta_2\right) = \Pr\left(\epsilon > \theta_2 - X\beta^{'}\right)$$

$$= 1 - \Pr\left(\epsilon < \theta_2 - X\beta^{'}\right)$$

$$= 1 - \exp\left(\theta_2 - X\beta^{'}\right)/(1 + \exp(\theta_2 - X\beta^{'}))$$

Third, there is a hierarchical structure in the ordered logit model, since we have captured eight price fairness perceptions by designing different product price levels and features, for each of 202 subjects (N=1616). To account for the lack of independence across product models for the same subject, we allow random effects in both intercept and slopes across each independent respondent and control for the within-subject error correlation between price fairness perceptions. In the full model with hierarchy, there are two levels: the collected 1616 price fairness perceptions are at the first individual level. These observations are nested in 202 subjects that we set as the second subject level. Price fairness perception observed within the same subject share several individual characteristics, such as gender, previous shopping experience, and so on. Therefore, we introduce a subject specific parameter α_s in the utility function, and assume $\alpha_s \sim N(0, \sigma_s^2)$ for sth subject.

$$U = X\beta^{'} + \alpha_s + \epsilon \qquad (3)$$

Applying all independent variables into the model shown in formula *(3)*, we have the full utility function shown

$$U = \beta_0 + \sum_{m=1}^{3} \beta_m Group\ Dummy_m +$$
$$\sum_{m=1}^{3} Group\ Dummy_m * [\ \beta_{4m}(Expectation - Actual\ Price)^+ + \beta_{5m}(Expectation - Actual\ Price)^- + \beta_{6m}(Foregone - Actual\ Price)^+ + \beta_{7m}(Foregone - Actual\ Price)^- + \sum_{n=1}^{9} \beta_n X_n\ ] + \alpha_s + \epsilon \quad (4)$$

where Group dummies are 3 product types including Compact DC, Prosumer DC and Large DC; or 3 price comparison points including in-store price, price obtained from Friend, and competitor product price.

X variables represent consumer and market context characteristics, such as previous buying behavior, familiarity of product, etc.

In the full model shown in formula *(4)*, product attributes and choice of references at purchasing online are also designed in the model to see their effects on customers' judgments on price offered online. We first use group dummy variables to form interactions terms, then we include several *X* variables that describe the individual characteristics of respondents in our proposed full model.

Overall, our proposed expected utility model with disappointment (D^+, D^-) and regret (R^+, R^+) has the following features.

1. The model is based on sum of four components, with each representing a factor that logically contributes to consumers' assessments of an offered product price.
2. Following Inman, Dyer and Jia (1997), we decompose emotional factors that might affect customers' post-purchase fairness perception into positive and negative parts to examine the asymmetry of these effects; unlike them, we focus on price fairness perceptions.
3. Consumers' price perception judgment is considered as a two-stage evaluation, with the first stage before their purchase decision by comparing their expectations

on price and the actual price, and the second stage after the purchase decision by comparing reference price and the actual price.

4. More purchasing context factors are considered in the model, including customers' purchase history and familiarity about the product, gender, etc. In addition, interaction terms of the main factor and group dummy variables are used to group people into different reference price scenarios and product design scenarios.
5. To control for the heterogeneity (observed and unobserved) across individual and homogeneity within each individual in a random parameter framework, a hierarchical ordered logit model is used to capture the correlation of error terms.

4. Data and Applications

Subjects. 202 students received extra credits to participate in a survey. Of these 202 subjects, 120 students (57%) are female, 82 students (43%) are male. Approximately 75% of them are senior grade students aging from 18 to 25 years old. As the purpose of this research is to test perception in the marketing area and the product is an electronic device that is popular among students who can afford to buy one, our data collected from higher grade students at a university is appropriate (Mook 1983).

Procedure. At the beginning of each scenario with one type of digital camera, participants were presented with introductive information. Brief descriptions of features and images of digital camera models are provided to help participants recognize the differences and diverse price levels of three product types. Product pictures along with attribute description encourage participants to think more about price ranges they can accept and their own willingness to pay. Therefore, both two types of elaboration

(attribute and image) have eliminated the bias in the information processing and product judgment procedure (Malaviya, Kisielius and Sternthal 1996). The descriptions for three scenarios are shown follow.

Scenario 1:
(Ultra) Compact Digital Camera
(Thickness: < 2" Weight: < 250g Screen: < 2.5"-4.0")

Easy to use, Point-and-shoot automatic cameras. Ultra-compact/Compact digital cameras are designed to provide a moderate feature set, stylish looks, and a tiny, "pocketable" size. With a "slim" body, this category of camera is ideal as "on-the-go" cameras, allowing you to take them almost anywhere.

Scenario 2:
Prosumer/Medium Digital Camera
(Thickness: 2.5"-4" Weight: 300g-400g Screen: 3.5"-4")

Although they sometimes look similar to consumer cameras, "prosumer" (professional-consumer) equipment is packed full of features that serious photographers will love. They have better lenses, higher detail, and much more control over exposure than their cheaper consumer "cousins". But of course, the expense is that we may pay higher price.

Scenario 3:
SLR / Large Digital Camera (with 3× lens or Body Only)
(Thickness: 4+" Weight: > 400g Screen: 2.5"-4.0")

They are professional. The Single Lens Reflex (SLR) design is often associated with professional photography. These cameras look and feel exactly like their non-digital cousins, and they even take the same lenses. Their high performance and extendable USge matches its fairly high price.

Different from previous research methods, we do not manually impose participants' price expectations. Instead, based on the price ranges for each product model we measure respondent's expectation by calculating their expected price (Helgeson and Beatty 1987, Inman, Dyer and Jia 1997). Therefore, after being presented the context-based details of camera features and visual images of the cameras, participants were first asked to specify their lowest and highest expected price points for these cameras, by writing down a low price and a high price in the form shown below. Meanwhile, the chances of encountering low or high price are given to explain the trend and direction of prices due to the price dispersion for online purchasing for each specific model.

> Prices on line are known to vary over time. So there is a chance that you can face a high (premium) price point or a low (economy) price point on the specific day/time occasion that you plan to buy the product.
>
> Let us assume that, on E-tailer websites you've got 60% chance of getting a low price, 40% chance of getting a high price.
>
> For above displayed model (M1), what do you think these prices are likely to be?
> **60% chance of Low Price: $_____ 40% chance of High Price: $_____**

After specifying their expectations on the given product model, the participant could find the actual price[1] under a covered post-it, or by turning back the page. At this moment, respondents are asked to tell their Initial Purchasing Intention, by providing the ratings on *"how likely are you to purchase at this actual price level?"* (1 = "very unlikely", and 9 = "very likely"). Then, participants are presented a forgone price from a third party price point, which is also exposed by uncovering post-it, or found by turning back the page.

> Let us assume that you finally purchased online at above actual price level.
>
> Then in a couple of months, you find the price of the same model purchased at traditional store (other than website) is **$85**

The third party price levels were randomly provided in different sequences to the respondents. Some subjects saw a higher (than actual price) price followed by a lower price; other subjects saw a lower (than actual price) price followed by a higher price. In addition, third parties can come from varying sources. In this study we utilized three different third party sources: prices paid by friends, in-store brand prices, and prices of competitor brands. The third party source name was randomly presented to subjects.

Finally, respondents were asked to rate their fairness perceptions on the actual price of the product, by telling their exact Fairness Perception in a given 1-9 likert-scale (1 = "very unfair", and 9 = "very fair") for the question *"What do you think about the actual price you paid to make the online purchase?"* The procedure was repeated in three scenarios with three combinations of camera attributes at different levels and eight observations were obtained from each subject. At the end of survey, participants indicated their gender, age, and other information such as previous purchasing experience, and familiarity with product category.

Price set and price change. We provide eight digital camera models from three types. The actual price sets[3] are $70, $90, $260, $280 for (ultra) Compact DC; $540, $600 for Prosumer/Medium DC; and $500, $700 for Professional SLR/Large DC. These prices are collected on Amazon.com from various DC models distributed not long before the time

when we took the survey and we use the mode price from price distribution for each model. ***Table 1*** describes the main features for cameras in each scenario.

----------Insert Table 1 about here----------

Considering that price dispersion exists (Ratchford 2009, Pan, Ratchford and Shankar 2004) and prices on line usually vary over time (Ancarani and Venkatesh, 2004) or vary across different sellers (Baye and Morgan 2009), we tell participants that *"there is a chance that you can face a high (premium) price point or a low (economy) price point on the specific day/time occasion that you plan to buy the product."* This chance

[3] The actual price we enter in the survey is the mode price of multiple price offers provided online that match the attributes combination

(probability) is captured by calculating the probability that price options on line is lower or higher than the mode of the price distribution (which we consider as the actual price).

In addition, price change between actual and forgone price is set as 20% price decrease and 20% increase of the actual price offer. Based on different levels of actual prices, we obtain different price changes by taking 20% up and down on the actual prices. ***Table 2*** summarizes all forgone prices with the positive and negative offset on the base of actual price, which are randomly distributed to participants with equal probability. Being exposed to eight product models, half the participants noticed the price increases for the first four models, with the following price decreases for the latter four models, while the other half noticed the price decreases first following by price decreases.

----------Insert Table 2 about here----------

Measuring Expectation. Different from previous research methods, we do not put manipulations on participants' price expectations. Rather, we ask them to tell a range of prices given higher and lower chance of encountering high and low price. Therefore, for each product model we measured consumer's expectation by calculating their expected price (Helgeson and Beatty 1987, Inman, Dyer and Jia 1997) by the formula below.

$$Expected\ Price\ (Expectation) = prob._{low} \times price_{low} + (1\text{-}prob._{low}) \times price_{high}$$

Price comparison Points. In the study, we put online channel as the context of transaction for buying the DC product, which is the pure-play E-tailer's website such as Amazon.com, Ebay.com, etc. As one popular channel for electronic product, pure-play E-tailer's website provides rich information about price offers and product features.

Therefore, we assume participants learn or at least realize the price dispersions online (Pan, Ratchford and Venkatesh 2004).

To capture the effect of comparison points and regret-type (as opposed to disappointment-type) effects on fairness perception, we set three reference price channels including In-store, Friend and Competitor brand as price comparison parties against online purchasing. In addition to the Self Expectation comparison in the 1st stage price evaluation, these three reference points, which we consider in the 2nd stage price evaluation, have been examined in previous studies and are the main resources of price information (Kukar-Kinney, Xia and Monroe 2007). However, no study has empirically examined three channels together and tested the effect of information resource on price perceptions jointly. In the current study, three channels are evaluated as the transaction contexts and they are also randomly distributed among participants, with three randomly assigned groups. Of all 202 subjects, 82 respondents (40.6%) are randomly assigned in "In-store" group, and 65 respondents (32.2%) are assigned in "Friend" group, and 55 students (27.2%) are assigned in "Competitor" group. Which channel as reference price information has the most significant effect on price perception is remained to be explored in the following test.

5. Results

5.1. Basic Descriptive Statistics

We first examine consumer's overall price judgments in terms of their initial purchase intention and fairness perception, for groups exposed to three types of product. ***Table 3*** shows the overall average ratings and average rating for (ultra) Compact,

Prosumer/Medium and SLR/Large digital cameras. We find significant differences between three types of digital cameras in both initial purchase intention (F value = 19.72, p value =.000) and price fairness perception (F value = 21.75, p value =.000). It is understandable since two price judgment (purchase intention and fairness perception) themselves are not significant different from each other (t = .45, p value =.65).

----------Insert Table 3 about here----------

We present consumer's price judgment on price increase and price decrease respectively in ***Table 4***, in terms of their initial purchase intention and fairness perception. Consistent with our expectation and previous research, subjects should have been happier when the actual price they find is lower than their expectation, and when they find a foregone price more expensive than their purchasing price and vice versa.

----------Insert Table 4 about here----------

In addition, ***Table 5*** shows the trichotomy classification results, indicating that three categories of fairness perception have significant differences in the perception ratings. In a 1-9 scale rating, people feel "very unfair" when they rate price at 1.98 on average, "moderate fair" when the average rating is 5.1 and they feel "very fair" with the average rating to be as high as 7.92. We capture the fairness perception in a better way by designing a 1-9 scale than a 1-3 scale, because consumer rate their perception in a more detailed format and it can be transformed into a 1-3 scale easily.

----------Insert Table 5 about here----------

5.2 Estimation Results

Our analysis shows that both disappointment (D^+, D^-) and regret (R^+, R^-) have statistically significant asymmetric effects on price fairness perceptions, which also vary across different product types and comparison parties. In addition, initial purchase intention, trust in online websites, importance of price in decision making, familiarity of product and customer's gender are significant factors on price perception.

Effects of Emotions and the moderating role of price level

Table 6 presents the parameter estimates for fairness perception model we propose in *(4)*, when it is grouped by product types representing three price levels: less expensive, moderate expensive and more expensive product.

----------Insert Table 6 about here----------

As expected, for less expensive products (compact DC) with price from $70 to 280$, the effects of four emotions are all significant but perform differently in both magnitude and signs. Both disappointment (β= -.508) and regret (β=-.885) have negative impacts on price fairness perception while elation (β=.308) and rejoicing (β=.503) positively affect price fairness, which is consistent with our hypotheses H_8-H_{11}. Magnitudes of rejoicing and regret effect are greater than magnitudes of elation and disappointment respectively, indicating that the comparison between actual price and forgone price has higher effect on consumer's judgment of fairness that the comparison between actual price and self expectation. The post-purchase evaluation plays a more important role.

More interestingly, the absolute impact of disappointment is greater than that of elation. Reflecting a similar pattern, the absolute impact of regret is greater than that of rejoicing.

This finding implies that the asymmetry effect of positive and negative emotion exists in fairness perception judgment, which is consistent with Inman, Dyer and Jia (1997).

For a more expensive product (SLR/Large DC) with price $500 and $700, we also find similar patterns of effects on price fairness perceptions. Both disappointment (β=-.570) and regret (β=-.835) have negative impacts on price fairness perception and the absolute magnitude of regret effect is again higher than that of disappointment effect, confirming the asymmetry of negative emotions in two stages of price evaluation for higher-end product. However, effects of positive emotion related to elation (β=-.094) and rejoicing (β=.009) are not significant.

If we compare the two groups of significant effects from disappointment and regret, for lower-end product ($\beta_{disappointment}$=-.508, β_{regret} = -.885) and high-end product ($\beta_{disappointment}$=-.570, β_{regret} = -.835), we could find that the directions are consistent by showing both negative effects, and the magnitude of effects are very close. Therefore, we could generalize the consistent findings for less expensive and more expensive product, that when consumers feel disappointed about the actual price or feel regretful for a forgone price, they will judge the price of the product they purchase at to be unfair. Meanwhile, the regret has a greater negative impact than that of disappointment.

For moderately expensive product (Prosumer/Medium DC) with prices $540 and $600, we do not observe any significant effects from emotions, although the signs of parameter estimates show consistency with other two groups.

Effects of Emotions and the moderating role of price comparison points

We then examine consumer's overall price judgment in terms of their initial purchase intention and fairness perception, for groups exposed to three comparison points. ***Table 7*** shows the overall average ratings and average rating for In-store comparison group, Friend comparison group and Competitor brand comparison group. We find significant differences between three comparison groups in initial purchase intention (F value = 6.02, p value =.002) but no significant differences in price fairness perception (F value = .77, p value =.465).

----------Insert Table 7 about here----------

Table 8 shows the parameter estimates for fairness perception model we propose in *(4)*, when it is grouped by third party price comparison including In-store, Friend and Competitor brand.

----------Insert Table 8 about here----------

As expected, in-store prices have significant impacts on fairness perceptions. When consumers are faced with forgone price obtained from in traditional stores, the effects of four emotions are all significant and also perform differently in both magnitude and signs. Both disappointment (β=-.351) and regret (β=-.763) have negative impacts on price fairness perception while elation (β=.204) and rejoicing (β=.308) positively affect price fairness, which is also consistent with our hypotheses H_8-H_{11}. Similar to our previous finding, magnitudes of rejoicing and regret effect are greater than magnitudes of elation and disappointment respectively, indicating that the post-purchase evaluation influence more than the pre-purchase evaluation.

Similarly, the absolute impact of disappointment is greater than that of elation. Reflecting a similar pattern, the absolute impact of regret is greater than that of rejoicing. This finding again confirms that the asymmetry effect of positive and negative emotion exists in fairness perception judgment when we use in-store price as the resources of forgone price that consumer use to compare with the actual price.

When price comparison party is friend, someone who is the consumer's acquaintance, we find that only regret (β=-.847) has significant negative impact on price fairness perception. And when the forgone price is obtained from a competitor brand, we observe that only rejoicing (β=-.427) and regret (β=-.570) have significant influences on price fairness, and both show negative signs. By comparing the absolute magnitude of effect, regret has the highest influence and one dollar gap between forgone price and actual price will result in the largest decrease (β=.847) in price fairness perception.

Effects of Individual and Market Context Variables

In addition to effects of four main emotions we focus on to explain price fairness, we have also examined how individual demographic variables, consumer's history of purchasing behavior, and their initial purchase intentions influence fairness perceptions.

First, in accordance to hypothesis H_3, results show that relationship with online seller has positively significant effect on consumer's judgment of prices. As shown in ***Table 6***, when we model price fairness grouped by product types, we observe significant effect of trust for all three types of digital cameras, with consistently positive parameter estimates ($\beta_{\text{trust /compact DC}} = .465$, $\beta_{\text{trust /medium DC}} = .863$, $\beta_{\text{trust /large DC}} = 1.063$). We find that the impact for large DC type is the highest, indicating that the more expensive item

consumers are purchasing, the higher involvement and the more important role trust in the sellers play in the evaluation. However, repetition purchasing shows a negative effect ($\beta_{\text{repetition /Large DC}} = -.380$) when consumer evaluates prices for SLR/large DC. The consumer involvement is high for repeated buyer on expensive items, and therefore consumers are even more sensitive to any change or difference of prices than those who do not repeatedly purchase in the same transaction channel. Thus, repeat buyer's fairness perception significantly is lower than that of non-repeat buyers.

Second, as shown in ***Table 8***, when we model price fairness grouped by comparison points, whether enough information is provided by the seller also affects fairness judgment positively ($\beta_{\text{information /friend}} = .380$). If the consumers acquire forgone price information through their friends, the more product and price information they learn from the online channel, the more fairness they perceive when they notice the price differences. Meanwhile, we find importance of price in consumer's purchasing decision making is positively ($\beta_{\text{price importance/ competitor}} = .265$) affecting fairness perception, for competitor group, which supports hypothesis H_5.

Third, we find gender plays an essential role in price fairness perception, whichever product type we examine or when we use in-store price as the comparison point. When we examine price fairness across product types, gender dummy shows significantly negative effect with female as the base level, meaning that male customers rate fairness lower than female customers, for all three types of digital cameras ($\beta_{\text{gender/compact DC}} = -.535$, $\beta_{\text{gender/prosumer DC}} = -.676$, $\beta_{\text{gender/large DC}} = -.589$). Similarly, when we test price fairness across comparison points, gender dummy also shows significantly negative

effect, indicating that male customers rate fairness lower than female customers, for in-store price comparison ($\beta_{\text{gender/in-store}} = -.831$).

Finally, as expected in our hypothesis H_1, consumer's initial purchase intention in the pre-purchase stage is closely related to fairness perception, by showing a significantly positive sign and large magnitude in its parameter estimates, whichever product type we examine or whichever price comparison point we use to compare with the actual purchase. When we examine price fairness across product types, initial purchase intention shows a positive effect, meaning that customers who have higher initial purchase intention before their purchase decision will perceive more fairness than those who have lower purchase intention at the beginning. The effect is significantly high for all three types of digital cameras ($\beta_{\text{intention/compact DC}} = .853$, $\beta_{\text{intention /prosumer DC}} = 1.409$, $\beta_{\text{intention /large DC}} = 1.274$) as shown in ***Table 6***. Similarly, when we test price fairness across comparison points, the effect is significantly high for all three comparison points ($\beta_{\text{intention/in-store}} = 1.236$, $\beta_{\text{intention /friend}} = 1.160$, $\beta_{\text{competitor}} = 1.245$) as shown in ***Table 8***.

6. Discussions

In sum, we propose an expected utility model incorporating four emotional factors from Disappointment-Regret model, by designing both positive and negative price differences simultaneously in the attitude-oriented framework. Our theoretical framework includes the role of choices of price comparison points, two stages of price evaluation, price levels represented by product attributes and designs, as well as four main emotions as the key stimuli of price fairness perceptions.

We derive three sets of hypotheses from our theory. Specifically, the first group of hypotheses is regarding choices of price comparison points in two stages of price evaluations. From empirical study, we find significant evidence to support these hypotheses, indicating that pre-purchase evaluation of price by comparing consumer's self will expectation and the actual price significantly has a positive effect on price fairness after purchase decision making. The higher the initial purchase intention, the higher the fairness perception. Further, the post-purchase evaluation influences more than pre-purchase evaluation on fairness perception, indicating that even if we are faced with a higher price offer than our own expectation, resulting in a lower purchase intention, it is possible that we could still feel fair when we find a forgone price higher than the actual price. Customers may feel first disappointed and then rejoice, resulting in a high fairness perception for the price offer. In addition, the choice of comparison points plays a moderating role on effects on price fairness and we find in-store price has the highest effect on price fairness when we compare with online price offer.

The second group of hypotheses is regarding individual and market context variables. We also find significant evidence to support our expectations that seller-buyer relationship is important for customer's fairness perception formation. Trust in online seller and whether people can obtain enough information on the website are influencing consumer's judgment on prices. The more trust people have in E-tailer, or the more information provided by E-tailer, the higher fairness perception people will perceive, even if they notice a negative price difference that should have negatively affected fairness perception. In addition, the importance of price in customer's purchase decision is positively affecting fairness perception. The more important price plays in the decision

making, more fairness people perceive after price comparison. However, if consumers are repeat buyers, they more sensitive and conscious about online purchasing, and results show that they perceive more unfairness after price comparisons. Moreover, female and male consumers behave quite differently on fairness perceptions, with the results indicating that the male customer rates fairness significantly lower than female customer, no matter which types of digital cameras they purchase.

The third group of hypotheses is regarding the four emotions we focus on. We have captured both significant effects of signs and magnitude of price differences on fairness perception that are associated with elation and disappointment in the pre-purchase stage, rejoicing and regret in the post-purchase stage. Asymmetric effect does exist in fairness perception. The effects of negative emotion (disappointment and regret) are higher than those of positive emotion (elation and rejoicing). In some sense, it is easier for people to perceive unfairness than fairness.

For managers, our findings suggest that online E-tailers need to ensure that they provide enough price and product information on their websites. It is important to keep a close relationship with customers since loyalty is related to both trust and repetition of purchase. Price information plays an essential role in customer evaluation, before and after customer's decision making. More price offers online is not a negative sign for E-tailers; however it might even be helpful for the E-tailer. When customers are faced with large price dispersions online, they keep on obtaining price information from the third parties and form a new will expectation on the product. If the price dispersion is left skewed, customer might form a higher price expectation. The question is when is the

proper time for customer to be exposed to other price offers, since post-purchase evaluation is more important in their fairness perception formation.

While providing support to our theoretical framework, our results have some limitations. First, we focus on price fairness perception as the dependent outcome, even though there are some other subsequent behavioral actions, such as perceived value, future purchase intention, and recommendation for other people. It would be good if we can assess these actions jointly with fairness perception to how these might subsequently affect customer's purchasing behaviors. Second, we set the price change as 20% of the actual price in the current study, including both price increasing and decreasing. We do not design a lower or higher percentage of price change since our structure is already very complex. We should, therefore, test how more options of price change will affect price fairness perception. These limitations shed some light for future research to handle.

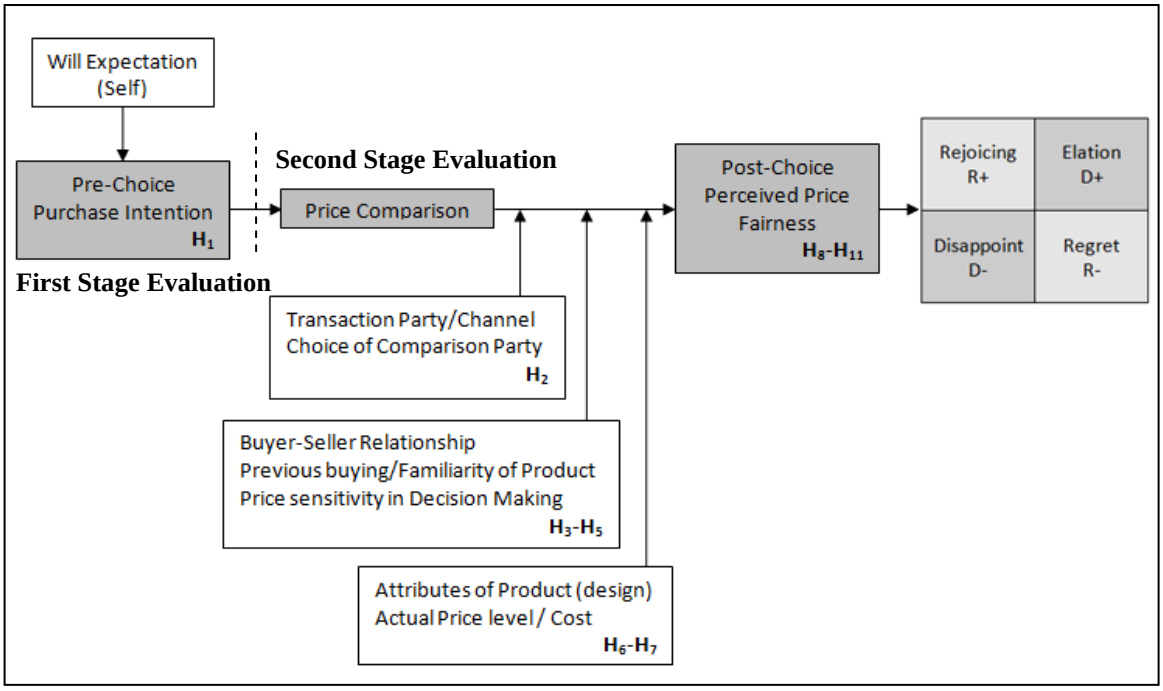

Figure 1. Conceptual Framework

Table 1. Main Features and Price Range of Three Digital Camera Types

Type	Features	Actual Price	Prob.(Low)	Prob.(High)	Cost level
(ultra) compact	Thickness < 2" Weight < 250g Screen <2.5"	70 90 260 280	.60 .55 .50 .45	.40 .45 .50 .50	low
Prosumer /Medium	Thickness 2.5"-4" Weight 300g-400g Screen 3.5"-4"	540 600	.40 .50	.60 .55	medium
SLR /Large	With 3× lens or Body Only Thickness 4" Weight > 400g Screen 2.5"-4.0"	500 700	.55 .40	.45 .60	high

Table 2. Price offset between actual price and forgone price

Type	Actual Price	Price increase (20%)		Price decrease (20%)	
		Forgone Price	Price Gap	Forgone Price	Price Gap
(ultra) compact	70	85	-15	55	15
	90	110	-20	70	20
	260	310	-50	210	50
	280	320	-50	220	50
Prosumer /Medium	540	650	-110	430	110
	600	720	-120	480	120
SLR /Large	500	600	-100	400	100
	700	840	-140	560	140

Table 3. Distribution of Data across Product Types

Price Comparison Parties	# of Subjects	# of Observation	Initial Purchase Intention[1]		Price Fairness Perception[2]	
			Mean	Std.	Mean	Std.
(ultra) Compact	202	807 (1 missing)	5.352	2.439	5.456	2.277
Prosumer/Medium	202	402 (2 missing)	4.896	2.557	4.475	2.598
SLR/Large	202	402 (2 missing)	4.543	2.667	4.690	2.695
Overall	202	1616	5.035	2.548	5.076	2.497

[1] Significant difference (F value = 19.72, p value =.000)
[2] Significant difference (F value = 21.75, p value =.000)

Table 4. Distribution of Data across Product Price Change

Price Change		# of Subjects	# of Observation	Initial Purchase Intention[1]		Price Fairness Perception[2]	
				Mean	Std.	Mean	Std.
1st Stage	Expectation > Actual	202	888 (3 missing)	6.20	2.30	5.88	2.35
	Expectation < Actual	202	722 (3 missing)	4.09	2.34	4.42	2.42
2nd Stage	20% increase in forgone price	202	806 (2 missing)	5.37	2.49	6.01	2.30
	20% decrease in forgone price	202	705 (3 missing)	4.68	2.55	4.11	2.31

[1] Significant difference in 1st stage (M=2.112, t value = 18.16, p value =.000) and 2nd stage of comparison (M=.697, t value = 5.54, p value =.000)

[2] Significant difference in 1st stage (M=1.465, t value = 12.24, p value =.000) and 2nd stage of comparison (M=1.899, t value = 16.5, p value =.000)

Table 5. Distribution of three categories of Fairness Perception

Three categories	# of Observation	Price Fairness Perception[1]	
		Mean	Std.
Very Unfair "1"	496	1.98	.88
Moderate Fair "2"	525	5.10	.80
Very Fair "3"	550	7.92	.83
Overall	1616	5.07	2.49

[1] Significant difference (F value = 734.7, p value =.000)

Table 6 . Model Estimates for Fairness Perception (Grouped by Product Types)

Variables	Estimate	Std. Error	P-value	VIF
Intercept (Fair =Very Fair)	**-1.193****	.477	.013	-
Intercept (Fair =Moderate Fair)	**1.251*****	.477	<.01	-
Compact DC Group	.05	.507	.921	2.9
Medium DC Group	1.466	1.004	.144	3.9
Large DC Group (base)	-	-	-	-
Previous Buying/ Compact DC Group	.162	.304	.594	3.3
Trust/ Compact DC Group	**.465****	.180	.010	2.4
Repeat/ Compact DC Group	.266	.182	.144	2.4
Familiarity/ Compact DC Group	.065	.137	.635	1.4
Information/ Compact DC Group	.196	.125	.116	1.2
Price Sensitivity/ Compact DC Group	.047	.145	.746	1.6
Price Importance/ Compact DC Group	.112	.145	.746	1.6
Gender/ Compact DC Group	**-.535***	.243	.028	1.9
Initial Purchase Intention/ Compact DC Group	**1.236*****	.109	<.01	1.5
Asymmetric Disappointment/ Compact DC Group				
Elation D^+ (Actual<Expected)	**.308***	.171	.072	1.3
Disappointed D^- (Actual>Expected)	**-.508*****	.177	<.01	1.8
Asymmetric Regret/ Compact DC Group				
Rejoicing R^+ (Actual<Forgone)	**.503***	.294	.081	4.5
Regret R^- (Actual>Forgone)	**-.885*****	.299	<.01	3.4
Previous Buying/ Medium DC Group	-.328	.368	.372	4.3
Trust/ Medium DC Group	**.863*****	.226	<.01	2.4
Repeat/ Medium DC Group	-.343	.225	.128	2.5
Familiarity/ Medium DC Group	-.044	.167	.790	1.5
Information/ Medium DC Group	.142	.157	.365	1.2
Price Sensitivity/ Medium DC Group	-.120	.175	.493	1.6
Price Importance/ Medium DC Group	.171	.174	.325	1.6
Gender/ Medium DC Group	**-.676***	.306	.027	2.3
Initial Purchase Intention/ Medium DC Group	**1.160*****	.140	<.01	1.3
Asymmetric Disa./ Medium DC Group				
Elation D^+ (Actual<Expected)	-.125	.153	.414	1.2
Disappointed D^- (Actual>Expected)	-.016	.108	.886	1.5
Asymmetric Regret/ Medium DC Group				
Rejoicing R^+ (Actual<Forgone)	.594	1.049	.571	5.8
Regret R^- (Actual>Forgone)	-1.504	1.147	.190	5.7

Variables	Estimate	Std. Error	P-value	VIF
Previous Buying/ Large DC Group	-.116	.381	.760	4.3
Trust/ Large DC Group	**1.063*** **	.234	<.01	2.4
Repeat/ Large DC Group	**-.380***	.230	.098	2.4
Familiarity/ Large DC Group	.158	.169	.352	1.4
Information/ Large DC Group	-.179	.159	.261	1.2
Price Sensitivity/ Large DC Group	-.179	.181	.323	1.6
Price Importance/ Large DC Group	.050	.177	.776	1.6
Gender/ Large DC Group	**-.589***	.309	.057	2.3
Initial Purchase Intention/ Large DC Group	**1.245*** **	.139	<.01	1.3
Asymmetric Disappointment/ Large DC Group				
Elation D^+ (Actual<Expected)	.094	.077	.226	1.3
Disappointed D^- (Actual>Expected)	**-.570***	.282	.059	1.3
Asymmetric Regret/ Large DC Group				
Rejoicing R^+ (Actual<Forgone)	.009	.311	.977	2.2
Regret R^- (Actual>Forgone)	**-.835*** **	.282	<.01	2.8

*** < .01
** < .05
* <.1

Table 7. Distribution of Data across Price Comparison Parties

Price Comparison Parties	# of Subjects	# of Observation	Initial Purchase Intention[1]		Fairness Perception[2]	
			Mean	Std.	Mean	Std.
In-store	65	519 (1 missing)	4.78	2.52	4.96	2.53
Friend	55	440	5.35	2.60	5.15	2.58
Competitor	82	652 (4 missing)	5.02	2.50	5.10	2.40

1 Differences are significant (F = 6.02, p value = .002)
2 Differences are not significant (F = .77, p value = .465)

Table 8. Model Estimates for Fairness Perception (Grouped by Price Comparison Party)

Variables	Estimate	Std. Error	P-value	VIF
Intercept (Fair =Very Fair)	**-1.047*** **	.384	<.01	-
Intercept (Fair =Moderate Fair)	**1.295*** **	.384	<.01	-
In-Store Group	-.305	.532	.567	6.2
Friend Group	.262	.617	.671	5.2
Competitor Group	-	-	-	-
Previous Buying/ In-Store Group	.571	.350	.103	3.1
Trust/ In-Store Group	.306	.242	.207	2.6
Repeat/ In-Store Group	.244	.231	.291	2.5
Familiarity/ In-Store Group	**-.300***	.166	.072	1.3
Information/ In-Store Group	.161	.158	.306	1.2
Price Sensitivity/ In-Store Group	-.123	.206	.551	2.4
Price Importance/ In-Store Group	.102	.225	.651	2.4
Gender/ In-Store Group	**-.831*** **	.320	<.01	2.2
Initial Purchase Intention/ In-Store Group	**.853*** **	.117	<.01	1.4
Asymmetric Disappointment/ In-Store Group				
Elation D^+ (Actual<Expected)	**.204***	.109	.06	1.2
Disappointed D^- (Actual>Expected)	**-.351*** **	.114	<.01	1.4
Asymmetric Regret/ In-Store Group				
Rejoicing R^+ (Actual<Forgone)	**.308*** **	.112	<.01	1.8
Regret R^- (Actual>Forgone)	**-.763*** **	.137	<.01	1.9
Previous Buying/ Friend Group	-.183	.488	.708	5.7
Trust/ Friend Group	.220	.281	.434	3.3
Repeat/ Friend Group	.008	.300	.978	3.6
Familiarity/ Friend Group	.097	.231	.674	2.0
Information/ Friend Group	**.380***	.231	.074	1.7
Price Sensitivity/ Friend Group	-.055	.241	.818	2.5
Price Importance/ Friend Group	.142	.223	.526	2.1
Gender/ Friend Group	-.511	.376	.174	2.7
Initial Purchase Intention/ Friend Group	**1.409*** **	.144	<.01	1.5
Asymmetric Disa./ Friend Group				
Elation D^+ (Actual<Expected)	.168	.121	.167	1.2
Disappointed D^- (Actual>Expected)	-.090	.149	.548	1.6
Asymmetric Regret/ Friend Group				
Rejoicing R^+ (Actual<Forgone)	.168	.158	.287	1.8
Regret R^- (Actual>Forgone)	**-.847*** **	.142	<.01	1.7

Variables	Estimate	Std. Error	P-value	VIF
Previous Buying/ Competitor Group	.317	.375	.399	4.4
Trust/ Competitor Group	-.017	.198	.931	2.1
Repeat/ Competitor Group	.003	.198	.989	2.2
Familiarity/ Competitor Group	.262	.151	.105	1.4
Information/ Competitor Group	.033	.150	.827	1.2
Price Sensitivity/ Competitor Group	-.033	.164	.839	1.2
Price Importance/ Competitor Group	**.265***	.150	.078	1.2
Gender/ Competitor Group	-.332	.276	.228	2.0
Initial Purchase Intention/ Competitor Group	**1.274*** **	.115	<.01	1.2
Asymmetric Disappointment/ Competitor Group				
Elation D^+ (Actual<Expected)	.071	.098	.470	1.2
Disappointed D^- (Actual>Expected)	-.083	.118	.481	1.4
Asymmetric Regret/ Competitor Group				
Rejoicing R^+ (Actual<Forgone)	**.427*** **	.123	<.01	1.7
Regret R^- (Actual>Forgone)	**-.570*** **	.117	<.01	2.0

*** < .01
** < .05
* <.1

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ESSAY II
DETERMINANTS OF PRICE DISPERSION IN E-COMMERCE: A META-ANALYTIC REVIEW

The notion of one price law that follows from a model of perfect competition no longer exists, especially in the context of E-commerce. Reasons include consumers' extensive online search efforts, increasing adoption of mixed pricing strategy by companies, proliferation of differentiated services, as well as markups and markdowns by sellers to meet demand uncertainty. Those trends have sparked considerable research on price dispersion, defined as the magnitude of price variation for any given physically identical product items, which is either spatial (across sellers at one point in time), or temporal (prices vary within a seller over time). However, empirical analyses on the nature of price dispersion have led to conflicting results. There does not exist yet a quantitative review synthesizing and explaining the discrepancy of these findings. In the present research, the authors conduct a Meta-Analytic review on 790 price dispersions collected from studies across 34 articles between 1998 and 2010. By a hierarchical linear model, we systematically integrate and uncover 1) significant underlying factors that are driving price dispersion in different directions, such as scales and measurements of price variation, average price level, product category, distribution channel, geographic scope, etc., 2) whether neglect of heterogeneity in the study or other research characteristics result in discrepancy of findings, 3) the method bias-corrected mean price dispersion online.

1. Introduction

With the explosive growth of e-commerce activities and online purchasing, the notion of one price law that follows from a standard model of perfect competition (Stigler 1961) no longer works. There exists ubiquitous and persistent online price dispersion, even in the markets for apparently homogeneous products (Baye, Morgan, Scholten 2004b). Drivers for price dispersion include consumers' extensive online search efforts, increasing adoption of mixed pricing strategy by companies, proliferation of differentiated online services, as well as frequent markups/markdowns by E-tailers to meet demand uncertainty and competitive rivalry within industry, etc. Consumers are broadening their online search efforts over time or through different channels by realizing the possibility of other prices they are unaware. Such search efforts are limited since customers need to balance the money they save from the searching with the potential search costs. According to Ratchford (2009), a rational consumer will accept a price above the minimum (lowest acceptable price, Stoetzel 1970) when the expected gain from searching further is less than the cost. This is because it only pays to search up to the point where the marginal benefits of search equal its marginal costs on the Internet. Consumers would accept a price higher than the minimum, while companies want to offer different price online. Therefore, price dispersion exists widely and persistent in the digital world.

These trends have sparked considerable research from a variety of perspectives to explain price dispersion, defined as the magnitude of price variation for any given physically identical items. It is either spatial (across sellers at one point in time), or temporal (prices vary within a seller over time) (Varian 1980). In most researches, the price dispersion is

spatial, meaning there is "price distribution of an item with the same measured characteristics across sellers at a given point in time" (Pan, Ratchford and Shankar 2004). Price dispersion reflects differences in prices charged for the identical products. It is usually indicated by measures such as range and standard deviation of prices, or these two measures weighted by the average price resulting in the percentage of differences and coefficient of variation respectively.

However, empirical analysis on the nature of price dispersion has led to mixed and contradictory results, thereby debates existing in different studies. For example, empirical evidence has showed results in both directions that online price dispersion is either decreased[4] or increased[5], or at least no lower[6] relative to offline price dispersion. Some studies[7] find no significant evidence to support reduced price dispersion in the digital channel. Moreover, although various factors are taken into account by different studies, these possible drivers are found affecting price dispersion in different directions, including for instance, product mean price[8], market structure[9], channel service in terms of shipping fees[10], and search cost[11]. For example, studies conclude commonly significant factors with either positive or negative direction, such as the effect of market structure

[4] Morton et al. 2001, Tang and Xing 2001, Brown and Goolsbee 2002
[5] Clemons 1998, Brynjolfsson and Smith 2000, Ancarani and Shankar 2004
[6] Bailey 1998, Pan, Ratchford and Shankar 2002
[7] Lehmann 2003, Scholten and Smith 2002
[8] e,g., Pan, Ratchford and Shankar 2001, 2002, Baylis and Perloff 2002 verses. Pan, Ratchford and Shankar 2003b, 2007, Grover, Lim and Avagani 2006
[9] e.g.. Cohen 2000, Baye, Morgan and Scholten 2004a verses. Ruppert and Kattuman 2003, Lidsey-Mullikin And Grewal 2006)
[10] e,g., Brynjolfsson and Smith 2000, Baye and Morgan 2004 verses. Ancarani and Shankar 2004
[11] e.g., Sorensen 2000, Zhao 2006, Walter, Gupta and Su 2006 verses. Ellison and Ellison 2004

represented by the number of competitors is found either increasing[12] or decreasing[13] price dispersions with greater, or even non linear[14] as a "double-edged sword".

Therefore, there is great need for a quantitative review summarizing and synthesizing those findings, by modeling observation or estimate of price variation and its all possible drivers. To fill this gap and explore the truth, the current research proposes a Meta-Analytic study by digging into some common factors and discrepancy of findings. The main contribution of the current study is to quantitatively and comprehensively analyze the online price dispersion and empirically aggregate and generalize the results from previous studies across periods of market development and categories of product. By a systematic Meta-Analytic review, we investigate how well price dispersion on the Internet are explained by the factors in previous research studies, how the results vary across studies and time periods, and how other related factors explain price dispersion.

We put the context in the E-commerce, and provide quantitative generalizations on 790 online price dispersions from studies across 34 previous articles between 1998 and 2010. Using a hierarchical linear model, we systematically integrate and uncover 1) significant underlying factors that drive price dispersion in different directions, such as scales and measurements of price variation, average price level, product category, distribution channel, geographic scope, etc., 2) whether neglect of heterogeneity in the study or other research characteristics result in discrepancy of findings, 3) the method bias-corrected mean price dispersion online.

[12] e,g., Baye, Morgan and Scholten 2003, Ruppert and Kattuman 2003
[13] e.g., Clay, Krishman and Wolff 2001, Baye and Morgan 2004
[14] e.g., Cohen 2000, Baye, Morgan and Scholten 2004a, Morgan, Orzen and Sefton 2006

We organize the remainder of this article as follows. We next provide the theoretical background from detailed literature review for our research. We then describe the methodology and data that we use for our investigation. Next we present our empirical approach and results. We conclude with a section summarizing our findings, providing some managerial implications.

2. Framework and Hypotheses

In the previous empirical studies, researchers take into account different sources in electronic market (Pan, Ratchford and Shankar 2004, Ratchford 2009) to explain price dispersion. According to the nature of these factors, we categorize them into three parts, including marketing, consumer and retailer/E-tailer characteristics. From a market perspective, for example, factors include mean price level[15], price competition[16], market structure[17] represented by the number of competing companies, and product rank or popularity in the market[18]. From a customer perspective, researchers have examined consumer's awareness of information[19], search costs[20]. From a distribution channel perspective, factors examined include retailer type[21], differentiation in channel services[22] and so on. Baye Morgan and Scholten (2005) summarize that price dispersion stems from either frictions related to the acquisition and transmission of information (search intensity

[15] Pan, Ratchford and Shankar 2001, Baylis, Perloff 2002, Lindsey-Mullikin, Grewal 2006
[16] Smith, Bailey and Brynjolfsson 1999, Cohen 2000
[17] Cohen 2000, Baye, Morgan, Scholoten 2002, 2004a, 2005, Pan, Ratchford and Shankar 2001, Ratchford, Pan, and Shankar 2003, Morgan, Orzen, Sefton 2006
[18] Clay, Krishnan, Wolff 2001, Lee and Gosain 2002
[19] Smith, Bailey and Brynjolfsson 1999
[20] Brynjolfsson and Smith 2000, Baye, Morgan and Scholten 2005, Grover, Lim and Ayyagari 2006
[21] Zettelmeyer 2000, Pan, Shankar and Ratchford 2003b, Ancarani and Shankar 2004, Venkatesan, Mehta, Bapna 2007, Yang, Gan and Tang 2010
[22] Brynjolfsson and Smith 2000, Baylis, Perloff 2002, Baye, Morgan, Scholten 2004a, Ancarani, Shankar 2004, Ancarani, Jacob and Jallat 2009

proxied by marketing variables that affect the benefits and costs of search) or the subtle differences in firm's service levels and environmental factors, which matches with three components of market, consumer and E-tailer's perspectives.

2.1 From a Market Perspective

From a market perspective, with the growth and maturity of e-commerce, researchers evaluate impacts of a number of market characteristics involving features of the digital market on price dispersion. Each specific market differs in structure, consumer involvement of online purchasing, fraction of popular product, heterogeneity of product, and so on. Among these possible factors, market structure, mean price level and product popularity are repeatedly examined in different contexts to evaluate their effects on the level of prices and its dispersion.

Market Structure Baye, Morgan and Scholoten (2004, 2004a) prove that market structure represented by the number of competing firms has a significant effect on observed price dispersion online, even after controlling for shipping costs and firm heterogeneities. They argue that in the online environment, firms change price levels randomly to create uncertainty for other competitors. The number of competitors also reflects the competitiveness of the market and researchers consider it as a "double-edged sword" (Cohen 2000, Baye and Morgan 2009), leading to a potential nonlinear relationship between the number of players and magnitude of price dispersion.

Product Base Price Level Product's mean price level is an important characteristic of a certain market as a key signal of product quality and cost, which determines consumer's willingness to pay, purchasing involvement, and so on. Mean price might also lead price

dispersion in two directions (Lindsey-Mullikin and Grewal 2006). From a market efficiency perspective, the prices of standardized items online are driven to a common level and therefore results in lower price dispersion. From a contextual influence of relative price perspective, base price level reflects consumer involvement and search cost and therefore higher prices drive people involve more and search more, which results in higher price dispersion. Researchers find empirical support for both two directions of relationship between average price and price dispersion (Pan, Ratchford and Shankar 2002, Baylis and Perloff 2002).

Product popularity The popularity of a certain product reduces customer's search cost and thus potentially has effects on price dispersion. Whether selecting products from bestselling items or randomly (Clay, Krishnan and Wolff 2001), or from a mainstream or a niche market (Lee and Gossain 2002) will result in variations in prices are discussed and examined. In addition to these three mainly focused market characteristics, other market factors such as product category, geographic scope and area will be discussed in the hypotheses settings.

2.2 From Consumer Perspective

Information search cost Search cost of asymmetrically informed consumers is examined from several aspects as the most typical and prevalent source of price dispersion online. Research in relationship between information search and price dispersion originates from early discussions in traditional physical markets by Stigler (1961), who propose that price dispersion is prevalent due to information asymmetry, and Bakos (1997) puts it into an electronic market context in which buyers and sellers communicate in a digital format. From a consumer standpoint, there are three types of search costs: 1) consumer's cost on

time and effort in searching for price information (typically lower prices), 2) product quality information, and 3) brand information such as a competing brand for a potential substitute. More search costs spent, more additional price quotes and product related information obtained.

Search Cost in a digital world In the online market, based on the Salop and Stiglitz (1977) model of price differences across informed and uniformed consumers, Baylis and Perloff (2002) find in their empirical study that the way firms vary the prices for informed and uninformed consumers or serious shoppers is one of the reasons why prices for a homogeneous good still vary across retailers. Many researchers argue that search costs and price dispersion are much lower compared with those in traditional physical stores. For example, it takes only a few mouse clicks on the computer to figure out product prices on E-tailer's website. Also some price comparison sites such as BizRate.com and NexTag,com provide a list of price quotes from different sellers charging for the same item at one time. The whole searching procedure can be finished in a few seconds. Therefore, information asymmetry between consumer's costs of obtaining/acquiring information and firm's costs of transmitting information to consumers is expected to be dramatically reduced and lower when everything goes online, thereby resulting in a convergence in prices with reduced price dispersion at the lowest competitive level (Grover, Lim and Ayyagari 2006). Zhao (2006) studies various degrees of price dispersion and finds it positively correlated with higher consumer search cost, more intense competition and greater consumer heterogeneity.

Discrepancy in findings However, the contention that low search costs result in one price without too much price dispersion is not fully supported by empirical studies and

persistent online price dispersion has still been found in the literature. Baye, Morgan and Scholten (2005) summarize theoretical models from a information search perspective (benefit, cost of search, purchase frequency, number of sellers, price persistence). The study reveals that reductions in consumer search costs need not reduce price dispersion and their empirical study shows that both online and offline price dispersions are sizable, pervasive, and persistent -- and do not purely stem from subtle differences in firms' products or services. Ellison and Ellison (2004) consider that price search engine plays a dominant role in Internet-based retailing and they examine how online and offline retail get affected by obfuscations that firms bring to consumers, theoretically and empirically. They conclude that the extent to which the Internet will reduce consumer search cost is not clear and the Internet allows firms to adopt a number of strategies that make search more difficult. Looking at the dark side of information, Grover, Lim and Ayyagari (2006) examine information overload (due to too many alternatives for customers) and information equivocality (due to ambiguity such as quality uncertainty in online marketing) as two negative attributes of information that lead sellers to different pricing decision and strategies in digital markets. Authors propose that even with techniques such as usage of search engines in the Internet, consumers actually spend a higher degree of time and effort (Du, 2004) since some want to be compensated by finding a lower price while others will abandon further search by finding it too costly to locate the lowest price in the market, thereby leading to a higher price dispersion. Consumers in a digital market can also have opportunisitic purchasing behaviors. Ratchford (2009) summarizes that although more salient online price information increases consumer price sensitivity and discourage high prices, richer non-price information leads to lower consumer price

sensitivity and wider range of prices. In whichever direction price dispersion goes, it can be concluded that costly search mostly contribute to price differences.

2.3 From a E-tailer Perspective

From a E-tailer perspective, a pure play E-tailer or the online branch of a retailer differs in nature from traditional physical brick-and-mortar stores, thereby influencing price competition, price structure and distribution, and the level of price dispersion in the web-oriented purchasing environment. When purchasing goes digital, store's location is no longer a dominant element that affects consumer's information search cost. Research studies take E-tailers' characteristics such as firm ranking, type of distribution channel, and service quality into account (e.g., Brynjolfsson and Simith 2000, Baylis and Perloff 2002, Ancarani and Shankar 2004) to investigate their effects on online price dispersion.

Firm ranking, Channel service A number of studies examine firm ranking, channel service as important E-tailer characteristics that affect degree of price dispersion. Baylis and Perloff (2002) find high priced stores remained high-priced with superior service and low-priced remained low priced with poor service. Brynjolfsson and Smith (2000) take shipping and handling charges and tax into account and find no significant difference in price dispersion. Pan, Ratchford and Shankar (2002) find the proportion of online price dispersion explained by retailer's service quality to be small, by examining prices from both pure-play E-tailers and bricks-and-clicks. Cao, Gruca, Smith (2004) use customer ratings to measure pre-purchase and post-purchase service to explain price dispersions in the online book market and they find that differences in pre-purchase service satisfaction do not contribute to price differences across sellers and that higher prices charged by the

three market leaders are due to higher pre-purchase and post-purchase satisfaction ratings.

Switching to Multichannel In addition for channel services, the trend of retailers' switching from pure brick-and-mortar market to multichannel retailing due to boost of e-commerce activity and online purchasing gives rise to a stream of research on online price dispersion and a comparison between different types of channels.

Discrepancy in findings On the one hand, researchers empirically observe smaller priced dispersion online compared with that from conventional stores. For example, Brynjolfsson and Smith (2002) find smaller price dispersion online (pure-play Internet E-tailers) than offline (bricks-and-mortar retailers) when controlling for E-tailer's branding, awareness and trust by using Web traffic as a proxy for market share. Morton, Zettelmeyer and Silva-Risso (2001) compare dealer (offline) and online car retailing, and conclude that Internet referrals increase buyer information and bargaining clout, thereby resulting in smaller price dispersion online. Tang and Xing (2001) compare pricing in DVD category between online branch of multichannel retailers (bricks-and-clicks) and pure-play E-tailers, observing that the prices from pure Internet retailers are significantly lower and the price dispersion is much smaller (less than a half of) than that from online channel of multichannel retailers.

On the other hand, a number of research studies also find online price variation is no less than that of offline retailers. Lehmann (2003) finds no evidence for lower prices and price dispersion advertised in the online medium, for the nearly homogeneous services – holiday packages from online travel agencies. Similarly, Ancarani and Shankar (2004)

compare price dispersions of Book and CDs among three types of retailers: pure-play Internet, brick-and-mortar (traditional) and bricks-and-clicks (multichannel) and found price dispersion online (pure-play Internet) is higher than offline (brick-and-mortar), while it becomes lower after accounting for shipping fees in two formats (single shipping fee, and shipping fee divided among 3 items). In addition, Xing, Yang and Tang (2006) discover that the online branch of multichannel retailers charge significantly higher prices (of DVDs) than dotcoms (pure-play firms that do not have a physical presence); then prices tend to converge over time, therefore reducing price dispersion. The mixed findings that multichannel retailer have higher posted price than pure-play E-tailers' posted price can be explained if turns out that traditional retailers have even higher posted prices, thereby allowing multichannel retailer to be positioned between pure-play and traditional players (Ancarani and Shankar 2004).

2.4 Why a Meta-Analysis is needed

Overall, these potential drivers proposed and examined from three perspectives should jointly affect the direction and magnitude of price dispersion. Starting from consumers' awareness of information and search effort, if dispersion itself is a function of the average amount of search, it is then a function of the nature of the commodity (Stigler 1971). Search intensity from consumer's perspective is closely related with market and retailer characteristics. For example, more competitive and more repetitive sellers in the market, higher expenditures by the customer on product buying, or larger geographic area coverage in the market, a greater the amount of search effort and vice versa.

Understanding price dispersion is essential to both marketing researchers and practitioners, from the perspectives of consumers, sellers and the whole marketplace. The

high levels of price dispersion are a strong empirical disconfirmation for the frictionless commerce and price convergence hypothesis (Bakos 1997) as well as a signal that it might be possible to design and implement consumer value-based pricing strategy by different types of competing retailers (Ancarani, Shankar 2004). It is also important to find the true drivers of price dispersion for different environmental settings, and examine the possible alternative offerings in the market and how they affect consumer's choice and purchasing behavior.

About the true drivers of price dispersion, Ratchford and Shankar (2004) point out that the online cases are examined in many studies under different settings of marketing environments; however, which matters most or least remains an unanswered question. Moreover, measurements of price dispersion, cross-category differences, base price levels, volume sold, services and reputation of retailer/E-tailer are proposed to be the research directions and some previous research had not covered these yet by then. A recent article by Ratchford (2009) emphasizes that product differentiation is another plausible cause of price dispersion and service factors including reliability, shopping convenience, product information and shipping and handling are identified to explain price definition. Existing evidence indicates that much of price variation cannot be explained by differences in retail services, at least with current measures of services. Other aspects of E-tailer characteristics including trust and reputation can also be considered to be factors on different prices.

To test hypotheses of the theoretical interest and research-oriented factors, we categorize independent variables for our Meta-Analysis into three categories including market characteristics, channel characteristics and research characteristics (See ***Figure 1***).

----------Insert Figure 1 about here----------

3. Methodology

3.1 Database Compilation

We identify documents and compile the database from the following sources. 1) All relevant papers and references in previous price dispersion empirical studies and review literatures[23] and references in these articles; 2) All available computerized bibliographic publication search services from database such as ABI/INFORM, EBSCO, ScienceDirect; 3) All relevant working papers in the research topic domain available on the web; 4) Papers obtained through hand searching in journals. Here we define paper as a distinct document (e.g., journal article, unpublished paper, or working paper), and define study as a distinct data source for price dispersion. Since one paper mostly reports multiple price dispersions from different data sources with various product categories or price structures with or without shipping and handling fees, we treat them as multiple studies. Further, we include no duplication or redundant paper on data sets (e.g., Ancarani and Shankar 2004). Applying all these definition and restrictions, we retrieve information from data sets that include 790 price dispersions from 34 distinct research papers from 1998 to 2010, covering price data obtained from February 1997 to November 2006 with the integrated sample size as large as 373,147.

To select research works from previous literatures, we make the selection of papers on well-specified subjects, e.g. internet pricing, price dispersion, price variation, consumer

[23] Pan, Ratchford, Shankar 2004, Smith, Bailey, Brynjolfsson 1998, Pan, Ratchford, Shankar 2001, 2002, Baye, Morgan, Scholoten 2002, Gatti, Kattuman 2003, Ancarani, Shankar 2004, Baye, Morgan, Scholten 2005, Varun, Lim, Ayyagari 2006, Venkatesan, Mehta, Bapna 2007, Gailey 2009

information search, etc., and we decide to include unpublished papers to avoid publication bias (file drawer problem).

3.2 Price Dispersion in the Meta-Analysis

By applying quantitative summarization to collections of research, Meta-Analysis focuses on finding out the overall direction and magnitude of the price dispersion across studies. The online price dispersions in our Meta-Analysis are obtained from physically identical or similar product items sold by single or multiple channels and stores at one period of time or over time. For online markets covered in the current study, we only include price information obtained through E-tailer or online branch of conventional retail store, starting around the year of 1997. In addition, we include both absolute and relative measurements that are used most commonly by previous researches when evaluating the level of price variation over time or across sellers. Absolute measures include price range and standard deviation, while relative measures are usually percentage of price difference and relative difference from the mean price, which is also called coefficient of variation. Specifically, four price dispersion measures covered in the current study include: 1) the coefficient of variation of the price distribution, defined as price standard deviation divided by mean price, 2) the percentage difference of the highest and lowest price, defined as price range divided by mean price, 3) the standard deviation of the price distribution, 4) the price range. First two are relative percentage measures while the latter two are absolute measures.

Our selection of data restricts articles on price dispersion based on five criteria.

1. We limit price dispersion to four commonly used measures. From the search process, we recognize the coefficient of variation of the price distribution and the percentage of difference of prices to be the two most commonly used relative metrics reported in studies and price range, standard deviation of price as the two most commonly used absolute metrics reported. For example, Baye, Gatti, Kattuman, and Morgan (2002), Pan, Ratchford and Shankar (2002) use coefficient of variation and the percentage of difference as two measures of price dispersion, while Sorensen (2000), Ancarani, Shankar (2004), Lindsey-Mullikin, Grewal (2006) use price range, standard deviation of price as two measures of price dispersion, and Baye, Morgan and Scholten (2004b, 2005) use both absolute and relative measures.

   To conduct the analysis with comparable metric of price dispersion, we implement model estimation separately for relative and absolute data sets. Therefore, we exclude other measures of price dispersion, such as ratio of difference of item price and overall mean price (Lee and Gossain 2002), difference of mean price and minimum price (Morgan and Scholten 2004a), difference of two lowest prices (Baye, Morgan and Scholten 2004a, 2006), difference between lowest price and 12^{th} or 24^{th} lowest price (Ellison, Ellison 2004), and other index used for a specific product category such as airfares examined by Marin and Koo (2009). We also exclude research papers for data selection that have not reported any price information in details (e.g., Lin, Chen, Song 2009) or those that only provide theoretical or experimental analysis or

review (e.g., Smith, Bailey, Brynjolfsson 1998, Lee 2002, Goolsbee 2002, Biswas, Burman 2009).

2. Price dispersion obtained from empirical studies with the real digital market data (panel data or time series data) of prices, price dispersions, price variations, price competitions are included in our study. In these studies, price information is obtained from online branch of retailers or pure-play Internet E-tailers that charge prices differently to examine pricing behavior on the Internet, the value of information, price competition, or product differentiation in the market. Usually, the prices are collected for physically identical or similar products across one or more than one product categories in one period of time or over time. Therefore, we exclude price dispersion merely obtained from pure conventional physical store (bricks-and-mortar retailers) (Cohen 1998, Cohen 2000, Morgan, Orzen and Sefton 2006, Zhao 2006, Yiu, Wong and Chaupaper 2009) without information on online price disepersion. In addition, price is defined as either online posted/quoted/listed price or other price such as normalized price, price perception, weighted price by product item ranking, sales, or popularity of E-tailers. We include all of them in the data and specify a dummy variable to identify different price definitions.

3. Price dispersion derived from estimation of price levels, product sales and brand rankings (Ratchford, Pan and Shankar 2003) is included in the study**.**

4. Price dispersion derived from mean prices, price ranges, price standard deviation and/or relevant data reported in the paper is added to the data set of our study.

Since we can indirectly calculate price dispersion if we have the data of mean price, standard deviation of price, and price range reported in the paper, we obtain more price dispersion observations and broaden our data set. For example, if a certain paper uses price range as the measure of price dispersion and reports mean price at the same time, we then could calculate the percentage of difference by dividing price range over its mean and obtain other measurements of price dispersion covered in our study.

5. We find significant price dispersions claimed in the research studies from several product categories and mainly categorize them into fast-moving consumer goods (such as Books, CDs, foods, etc.), electronics and computer product (such as scanner, digital camera, MP3s, etc.) and services (such as online air flight ticket). We exclude durable product category such as cars (Morton, Zettelmeyer, Silva-Risso 2001) because the nature of a durable product varies a lot from those other products. In addition, the mean price of durable product (such as cars) is very high and these observations should be excluded as outliers in our data.

Table 1 summarizes 34 papers examined in our Meta-Analysis study and information including authors, year, publication title and product examined.

----------Insert Table 1 about here----------

The quest for price dispersion yields a set of 34 articles (see ***Table 1***) and a total of 820 price dispersions. 30 price dispersion observations (.5% of all data) are considered as outliers and are omitted from the study, since they are outside the interval of the mean

price dispersion plus or minus six times the standard deviation. The final number of price dispersions is 790 from 34 articles.

The final data covers a period of 12 years of research studies, from the growth stage (before year 2000) to the mature development of the Internet use in E-commerce. Data includes price dispersion measurements from the North America (US and Canada), Australia, Europe (UK, Ireland, Germany, France, Italy, Netherlands, Spain, Sweden, UK, Denmark), and Asia (China, Singapore). Categories covered are wide in scope, ranging from popularly examined fast consuming products such as Books, DVDs, CDs, prescription drugs, computer and electronic products such as laptops, PDAs, digital camera, scanner, to the less covered consumer service products such as airline ticket offerings of Online Travel Agents (OTA), phone unlocking, etc. The total sample size integrated from 34 papers is 347,147. Of the final 790 price dispersions examined in the current Meta-Analysis, we have 358 (45%) absolute measures (standard deviation and Range) and 432 (55%) relative measures (coefficient of price variation and percentage of price difference). In between, the average price dispersion for relative measure is 21.2, with standard deviation 24.6, and the average price dispersion for absolute measures (standard deviation and range of price) is 73.9 and its standard deviation is 153.7.

3.3 Independent Variables and Hypotheses

Market Characteristics

Market characteristics are mostly examined in previous research studies for explaining online price dispersion and a solid theoretical foundation has been established in previous research. We include them to synthesize prior research to explore whether and how these

factors affect the magnitude and direction of price dispersion while controlling for all other variables.

Mean Price (+). The mean price (average of the prices offered by all the E-tailers carrying the identical or similar product) is known to affect price dispersion, reflecting both consumer involvement (Kujala and Johnson 1993) and contextual influence of relative prices (Lindsey-Mullikin, Grewal 2006). Given the centralized nature (Stigler 1961) of pricing information on the Internet, researchers expect to find increased common price which is likely to make retailers more vigilant about their pricing strategies and more likely to provide competitive prices in the marketplace. As one consequence of such competitive benchmarking from the Internet and market efficiency perspective, Lindsey-Mullikin, Grewal (2006) propose that the prices of standardized items are driven to a common level and therefore results in lower price dispersion. Similarly, some other studies find average price is negatively related to price dispersion (e.g., Pan, Ratchford and Shankar 2003b, 2007, Ratchford, Pan and Shankar 2003, Grover, Lim and Avagani 2006, Venkatesan, Mehta and Bapna 2007).

From the nature of price perspective, if we consider the contextual influence of relative prices (Lindsey-Mullikin, Grewal 2006), the other direction of relationship between price dispersion and mean price is to be hypothesized. As an essential signal of quality and cost (Wolinsky 1983, Bagwell, Riordan 1991), base price level represents the amount of money sellers charge and customers pay for the product, which also reflects consumer involvement (Kujala and Johnson 1993). Moreover, most previous marketing practitioners and researchers examine price dispersion from different multiple categories, ranging from daily consumption items such as milk and soft drink (Bolton, Warlop, Alba

2003) to durable product such as electronic product (Baye, Morgan, Scholten 2004a), with large variation in prices. Meanwhile, different price levels in the same category may imply product differentiated quality and potential cost levels, hence thereafter are also influence price variations and could be an important causal reason for price dispersion. Therefore, two possible directions may be found in the relationship between mean price and dispersion. Pan, Ratchford and Shankar (2001) find increase in absolute price dispersion (price range and standard deviation) with price level or involvement while relative price dispersion (percentage of price difference and the coefficient of variation of price) declines with price and high involvement products exhibit less relative price dispersion. Baylis, Perloff (2002) find high priced stores remained high priced and superior service, while low-priced remained low priced and poor service.

In the current Meta-Analysis, we propose that for lower price level with relatively low configuration and designs of product, price will not change sharply; while for higher price level equipped with comparatively high configuration and more complex features, price dispersion would seem obvious even with small percentage of price change. A product's actual price level has a positive effect on price dispersion. We also include in our model a quadratic term of the mean price to capture the possibility of non-linear relationships.

> *H_1: Price dispersion is higher in market settings involving products with higher base prices than products with lower base prices.*

Product Category. Previous empirical studies have developed studies on various product categories, from less expensive CDs, Books, to higher priced categories such as Laptops,

Air flights, Cars; from daily used consumer product such as drinks, milk to product with longer life time circle such as computer memory, CPU, and printer; from physical products to invisible service products.

When evaluating price dispersion, some research studies have only examined one product category[24], while many other researches cover multiple product categories[25]. When more than one category is evaluated, it is more reasonable to separately investigate each product category to guarantee product homogeneity rather than combining them together to calculate the price dispersion.

The differences among product categories may affect the degree of dispersion in prices (Peterson et al. 1997). Products in different categories vary in their inherent natures, frequency of purchasing, customers' involvement, price level, usage, purchasing channel, post-purchase services, etc. (Pan, Ratchford, Shankar 2007). When Rupert and Kattuman (2003) test the number of firms in the market, they also take into the differences among different product categories into account. Even within the same broad definition of product category, authors include category dummies to capture industry differences between consoles, games, CDs, PDAs, Printers and Scanners. Similarly, to eliminate contamination by unmeasured product heterogeneity, Pan, Ratchford, Shankar (2007) investigate homogeneous items within product categories and find significant and consistent effects of product categories for both two measures of price dispersion (price

[24] Cohen 2000, Clay, Sorensen 2000, Krishnan, Wolff 2001, Tang, Xing 2001, Lee, Gossain 2002, Clemons, Hann, Hitt 2002, Clay, Krishnan, Wolff, Fernandes 2002, Arnold, Saliba 2002, Chevalier, Goolsbee 2002, Hong, Shum 2006

[25] Cohen 1998, Pan, Ratchford, Shankar 2001, Baylis, Perloff 2002, Baye, Gatti, Kattuman, Morgan 2002, Scholten, Smith 2002, Pan, Ratchford , Shankar 2002, Gatti, Kattuman 2003, Pan, Shankar, Ratchford 2003b, Ratchford, Pan, and Shankar 2003, Baye, Morgan, Scholten 2004, Baye, Morgan 2004, Baye, Morgan, Scholten 2005, Walter, Gupta, Su 2006, Grover,Lim, Ayyagari 2006, Venkatesan, Mehta, Bapna 2007, Pan, Ratchford, Shankar 2007, Hu, Wang 2010

range and standard deviation). They have observed different degrees of price dispersion in categories of books, computer software, and computer hardware.

> *H_2: Fast-moving consumer goods have the largest price dispersion, and electronic/Computer have smaller price dispersion, while the service product has a moderate level of price dispersion.*

Number of categories (+). Most previous studies examine homogeneous products with single product category while some studies pool all products together and examine multiple categories at one time to examine price dispersion across different categories. More product categories involved represent combination of different price levels, product usage, consumer purchasing involvement etc. and therefore may result in higher price dispersion, since the prices from different categories do not converge.

> *H_3: Price dispersion will increase when more categories of products are examined together.*

Number of Sellers (Market Structure) (+). As defined before, price dispersion is the magnitude of price variation for given physically identical items. It can be spatial that occurs across multiple sellers at one point in time or temporal that occurs when prices vary within a seller over time. So how many sellers are in the market or examined in the study is an important factor on how large price variation could be. Most previous studies examine prices across sellers and try to cover as many retailers/E-tailers as possible in the market.

Cohen (2000) first points out that the number of alternatives from competitors in the market is “a double edged sword”. On the one hand, price dispersion is reduced with greater rivalry. On the other hand, distortion in information function also increases and it results in enlarged price dispersion. Some other researchers also find empirical support for a non linear relationship between the number of sellers in the market and level of price dispersion (Ratchford, Pan, and Shankar 2003b, Baye, Morgan, Scholten 2004a, Morgan, Orzen and Sefton 2006, Venkatesan, Mehta and Bapna 2007, Baye and Morgan 2009). For example, Baye, Morgan, Scholten (2004a) find that levels of price dispersion vary systematically with the number of listing retailers and the prices do not converge after controlling for shipping costs and firm heterogeneities, although the average range in prices falls when the number of competing firms decreases. Their empirical study tends to show an inverted U-shaped relationship. Therefore, a nonlinear relationship between number of retailer/E-tailer and price dispersion could be proposed.

Empirically, a single direction of the relationship is also found in a number of studies, in either a positive or a negative way. Baye, Morgan, Scholten (2003) examined the effect of the number of firms and rank of firms on the value of information (measured by the difference between average price and the minimum price). The value of the price information varies systematically with the number of firms listing prices. It is about 11 percent when only two firms list prices, compared to about 20 percent when more than 30 firms list prices. Similar positive relationship is also found by Ruppert and Kattuman (2003). Conversely, the lower price dispersion resulting from greater competition with more players in the market is discovered by studies such as Krishnan, Wolff (2001), Pan, Ratchford and Shankar (2001), Baye and Morgan (2004), Clay, Krisnan and Wolff

(2001), Lindsey-Mullikin and Grewal (2006). The pattern of how market structure affects price variation is not only tested in US market, but also in other areas. For example, Baye, Gatti, Kattuman and Morgan (2002) put the context in Europe and examine the impact of the Euro on prices charged by online retailers within the EU. Their model examines the effect of the varying number of competing firms across countries on average prices and suggests that as the number of competing firms in a given country becomes larger, prices tend to be more competitive resulting in reduced price dispersion.

To investigate how settings of the number of retailers and E-tailers affect magnitude of price dispersion, we include it in our model as a market characteristic. To capture the possibility of a non-linear relationship, we also include a quadratic term in the model. Although more players in the market make the competition fiercer, more retailers/E-tailers suggest heterogeneity of product features, services bundled, store image, as well as more market alternatives and information, etc., hence we propose that larger the number of sellers, the greater price variations would be.

> *H_4: Price dispersion is higher when there are more sellers in the market with a more competitive environment.*

Product Rank /Popularity (+). When examining price dispersion, homogeneity of products is an important selection criterion. Some literatures take product rank or popularity into account and find that, for more popular items with potential more buyers, the price dispersion is larger since it reduces customers' search effort and the demand is also with more forces. For example, substantial amount of price dispersion for online book industry is found especially for bestselling books, due to more discounts for

bestselling books and typically zero discount for random books (Clay, Krishnan, Wolff 2001, Clay, Krishnan, Wolff, Fernandes 2002), which is contrary to their expectation that more advertised products should exhibit less variation because of greater information flow and easier consumer search. By comparing current-hit albums and old-hit albums, Lee and Gosain (2002) suggest that the degree of price dispersion depends on the product type, whether the product is a popular (mainstream) or a niche product. So we propose that price dispersion from products with higher rank and popularity (such as best selling items) is larger than that from randomly selected product items, without consideration of popularity.

> *H_5: Price dispersion from products with higher rank and popularity (such as best selling items) is larger than that from randomly selected product items, without consideration of popularity.*

Search Effort (-). Search cost of prices as well as price information efficiency among customers is considered to be one of the key drivers of price dispersion (Brynjolfsson and Smith, 2000, Baylis and Perloff 2002, etc.).

Bakos (1997) first analyzes the role of electronically mediated markets in lowering search costs, and proposes that lower search costs should lead to lower and more homogeneous prices. Empirically, the prediction is not supported by many studies for several measures of dispersion. For example, Ellison and Ellison (2004) consider price search engine to be a dominant player in Internet-based retailing and examine how online and offline retail get affected by obfuscations that firms bring to consumers, theoretically and empirically using difference between the lowest price and the 12^{th} or 24^{th} lowest price as the measure

of price dispersion. They conclude that the extent to which the Internet will reduce consumer search cost is not clear and Internet allows firms to adopt a number of strategies that make search more difficult. Baye, Morgan and Scholten (2005) theoretically and empirically reveal that reduction in consumer search cost reduces price dispersion. From information search in terms of benefit, cost of search, purchase frequency, number of sellers, price persistence, they propose three different frameworks of information acquisition/transmission, including sequential search, fixed sample search and a clearinghouse model and reveal that reduction in consumer search cost tend to reduce price dispersion. Grover, Lim and Ayyagari (2006) explicitly examine the dark side of information and points out that overload and equivocality of information are two dark attributes of information, which lead sellers to different pricing strategy in e-markets. Similarly, some other studies find positive relationship between search cost and price dispersion (Zhao 2006, Walter, Gupta, and Su 2006).

> *H_6: Price dispersion is lower when search effort for product price information is considered in the data.*

Retailer/E-tailer Channel Characteristics

Characteristics of the retailer lead to another main stream of drivers that researchers propose and examine to explain price dispersion in previous empirical studies. They focus on the heterogeneity of channels in different research studies. We assess the effect of E-tailer characteristics in the study by including two main factors that are mostly discussed in the previous literature: type of channel, and channel services represented by

whether shipping & handling fees are accounted in the study, as well as the related interactions.

Type of E-tailer. With an obvious trend in E-commerce with the emergence of Internet as a significant channel, more traditional brick-and-mortar retailers go beyond their traditional channel and establish an on-line branch channel (Zettelmeyer 2000). Therefore, types of channel examined in the current study include 1) multichannel with both online and offline branches, 2) physical store which is called bricks-and-clicks retailer, and 3) the pure play E-tailer.

One question is that whether multichannel retailers with both online and offline channels charge price differently from pure-play E-tailers with a single online channel, and whether the type of transaction channel is the reason for the price dispersion. By comparing price dispersion between multichannel and pure E-tailer, we could prove a strong empirical confirmation or disconfirmation for the frictionless commerce and price convergence hypothesis (Bakos 1997); this would signal that it might be possible to design and implement consumer value-based pricing strategy by different types of retailers (Ancarani and Shankar, 2004). Multichannel retailers combine online and offline channels, with prices likely reflecting the variability in prices of all the retailers in both channels, and therefore will likely have greater price dispersions than other types of retailers (Ancarani and Shankar, 2004). If the brick-and-click channel has a wide geographic scope, those retailers can provide value added services such as the ability to order products online and pick up or return offline, or return by mail at no charge. This kind of offer helps customers save time and provides ease of using the online channel to check product attributes and reviews without going to the store. For pure-play E-tailers

,lower price dispersion is predicted to be lower due to the lower inventory costs of the single distribution (Venkatesan, Mehta, Bapna 2007).

Empirical evidences show contradictory results to the theoretical prediction of price convergence. A few studies find larger price difference for pure-play E-tailers (pure click) than multichannel[26] while some findings point in the opposite direction[27]. Xing, Tang and Tang (2006) find that multichannel retailer has much higher price dispersion measured by price standard deviation than that among pure-play one, however as time elapses, the price dispersion among pure-play becomes larger. Yang, Gan and Tang (2010) studies evolution of toy price dispersion over two periods of time and find price dispersion of multichannel is higher than that of pure-play ones at the beginning and does not change much over time. Above all, we propose[28] that retailer type is one reason for the price dispersion online (Pan, Ratchford, Shankar, 2004) and multichannel retailers have higher prices than pure-play E-tailers.

> *H_7: Price dispersion is larger when retailers selling the product are of multichannel type, which contains both traditional in-store channel and E-tailer channel than that of pure-play E-tailer.*

[26] i.e., Pan, Shankar and Ratchford 2003b use percentage difference in price as the measure of price dispersion, Ancarani and Shankar 2004 observe higher dispersion from pure-play than that of multi-channel retailers when using price range as the measure

[27] i.e., Tang and Xing 2001 find price dispersion among pure-play Internet retailers is smaller or even less than a half of that among multichannel retailers, Ancarani and Shankar 2004 when they use standard deviation as the measure of price dispersion

[28] We do not include pure physical bricks-and-mortar retailer as one type of channel because in the current study we focus more on drivers of online price dispersion in recent two decades and do not include price dispersion from pure physical stores.

Service (shipping and handling) (-). Prices with and without shipping and handling costs across online and offline types of retailers might result in various price dispersions based on full prices and this is also managerially important. Previous empirical analyses have examined prices both with and without adjustments for retailer services. It is possible that E-tailers offer more of the service if it could obtain a large enough price increase to cover its cost. Therefore service differentiation is considered as one reason for price dispersion.

Empirical studies define a set of measures for E-tailer services and examine effects of those components on price dispersions, such as ease of ordering, product selection, online delivery, tracking, shipping and handling, etc. (Pan, Ratchford , Shankar 2002), E-tailer website's reliability, shopping convenience, and certification (Ratchford, Pan, and Shankar 2003). They find that the proportion of online price dispersion for both pure-play E-tailers and bricks-and-clicks does can be explained by the E-tailer characteristic (service quality); however the effect is small. Baylis, Perloff (2002) take E-tailers' rankings into account and find high priced stores remained high-priced with superior service and low-priced ones remained low priced with poor service. They examine whether firms charge a higher price to consumers who desire services or to those who are ignorant. Their service premium model gets empirical evidence from digital camera and scanner market.

Shipping and handling fee is one important characteristic that a traditional retailer does not have as a form of price partitioning. Some studies get consistent result by examining the prices including or excluding shipping fee. For example, Ancarani, Jacob and Jallat (2009) find higher degree of online price dispersion than offline, with or without shipping costs. Similarly, Baye, Morgan, Scholten (2004a) find that after controlling for shipping

costs and firm heterogeneities, the prices do not converge, although the average range in prices falls when the number of competing firms decreases. To further evaluate its effect, some studies focus merely on shipping and handling fee as representative of retailer service quality and take it into account to compare price dispersion with and without it. Ancarani and Shankar (2004) find the absolute price dispersion (range) from Internet retailer to be higher than the traditional retailer, while it becomes lower after accounting for shipping fees in two formats (single shipping fee, and shipping fee divided among 3 items). However, some studies do not find significant empirical support of the effect of channel services on price dispersion. Brynjolfsson and Smith (2000) take shipping and handling charges and tax into account and find no significant difference before and after. Similarly, Scholten and Smith (2002) compare online price dispersion with and without shipping fees and find that adjusting for transaction costs only slightly reduces price dispersion by 1% and the results are not significantly different.

Following Ancarani and Shankar (2004), we consider shipping and handling fee as the representative of channel service provided, and propose that including or not including it in product prices will have an effect on the magnitude of price dispersion, and the prices including shipping and handling fee will have lower dispersion than that does not include it.

> *H_8: For product items that have already included shipping and handling fees in prices, price dispersion will be lower than those without shipping and handling fees accounted in prices.*

Research/Study Characteristics

To control the heterogeneity of research studies such as the year of data, research model and consideration of heterogeneity control, and the process of the data collection, etc., we include several research and study characteristics in the Meta-Analytic analysis.

Price Dispersion Measure. As we have discussed previously, excluding all other less used measures, four most commonly used measures of price dispersion grouped into relative and absolute measure data sets are examined in the current study. Different measures of price dispersion capture different information about price variation and therefore it is essential to distinguish which measure has a larger or smaller magnitude of price dispersion. Researchers usually adopt multiple measures of price dispersion to guarantee robustness of results and they also examine various outcomes by using different measures for price dispersion. For instance, Ancarani and Shankar (2004) find that the comparison of price dispersion between multichannel and pure play retailers depends on the measurement of price dispersion, and using range as measure of price dispersion results in a larger value than using standard deviation. Baye, Morgan and Scholten (2005) also point out that standardization of the data is needed if we want to compare magnitude of price dispersion across product categories and over time. Coefficient of variation is advantageous compared to other measures, since it preserves the comparative static predictions of the model of interest. Moreover, range as a measure of price dispersion is also widely used but like coefficient of variation, it suffers from a potential theoretical defect that the apparent price dispersion is arguably not economically relevant because the unique transactions price is the marginal cost. They

agree that the predicted impact of drivers on levels of price dispersion depends not only on the model, but also on the metric used for measuring dispersion.

> *H_9: Price dispersion derived from percentage of price difference (price range/mean price) is higher than that from coefficient of variation (price standard deviation/mean price); Price dispersion derived from price range is higher than that from price standard deviation.*

Price Definition. As discussed in the section of data collection, we find previous empirical studies test price dispersion based on prices of either regular online posted/quoted/listed price or other prices including price discount (Bailey 1998), prices weighted by sales or purchase quantity (Walsh and Whelan 1999, Lee and Gossain 2002) or E-tailer popularity (Brynjolfsson and Smith 2000), price index (Baye, Gatti, Kattuman, and Morgan 2002), and price perception (Pan, Shankar, Ratchford 2002). Therefore, we use a dummy variable to identify price definition to see whether regularly defined price or other prices will result in different levels of price dispersion. Since other prices are not the real quoted price in the online market but are determined by some other factors such as purchase quantity, consumer's perception, we expect to see more variation in the corresponding price dispersions than those from regularly defined price.

> *H_{10}: Price dispersion derived from regularly defined price is higher than that from other prices such as prices weighted by sales, price perception and so on.*

Year of Data. As the Internet develops into a relatively robust channel for commerce, it is important to understand how the maturity of this channel over years has influenced price variation in the market.

At different stages, price dispersion proves to be different due to the usage of the Internet channel to make purchase, with the development of cross-channel sales strategies, infomediaries and shopbots (Smith, Bailey and Brynjolfsson 1999), improved supply chain management, and new information markets. For example, both prices and price dispersions from multiple websites are found to be no lower than conventional channel in an early exploratory study by Bailey (1998), which could be attributed to the immaturity of the Internet market in the year of 1997 with only a few popular E-tailers and fewer online purchasing behavior comparative to purchases in physical stores.

Following Pan, Ratchford and Shankar (2006), based on the data collection time, we include two dummy variables to specify three periods of Internet development including boom (before year 2000), shakeout and reconstructing (2001-2003), and mature (2004-2006[29]). And we propose than as Internet market grows mature over time, price dispersion increases with more information in the market, although there is a decline period during shakeout and reconstruction period.

> *H_{11}: From the boom (before 2000) of Internet market, price dispersion grows as Internet market goes mature (2004-2008), with a declining trend in the shakeout period (2001-2003).*

Customer Heterogeneity (-). Heterogeneity in consumers' knowledge and information search efforts may explain some of the price dispersion. Price dispersion arising from differences in search cost has been analyzed by a variety of researchers. Burdett and Judd (1983) and Stahl (1989, 1996) model the role of search cost in explaining price dispersion

[29] The year of 2006 is the most recent time of price and price dispersion data collected from papers we've covered for Meta-Analysis.

in a setting where consumers engage in a costly search for price quotes. As noted previously, Bakos (1997) analyzes the role of electronically mediated markets in lowering search costs, and finds that lower search costs should lead to lower and more homogeneous prices. Empirically, search costs have been found to explain price dispersion in auto insurance markets (Dahlby and West 1986) and, more recently, in prescription drug markets (Sorensen 2000). The typical result is that some stores charge low prices in an attempt to attract informed consumers while other stores charge high prices to sell to uninformed consumers. Baye, Morgan and Scholten (2003) point out that the classical view is that maturing Internet markets will cause prices to decline toward marginal cost, however a number of papers suggest that firms might avoid this outcome by price discriminating to take advantage of consumers' heterogeneities or obfuscating price information (e.g., Ellison and Ellison, 2004).

If customer heterogeneity is controlled in the study, we expect to see smaller price variation since customers' knowledge about the product features and prices have been considered.

> *H_{12}: Price dispersion is lower when customer heterogeneity is controlled in the study.*

Product Heterogeneity (-). Since products examined in previous studies are not always perfectly physically identical, they are just similar and therefore occurrence of corresponding price variation should not be surprising. Smith, Bailey and Brynjolfsson (1999) point out that even if products are physically identical ones, they are not always good substitutes. Therefore controlling for product heterogeneity using hedonic

regressions or restricting product items when researchers collect the price information are two commonly used methods in previous literatures. However, authors still find price dispersion after taking care of these possible sources from product heterogeneity. So some unmeasured features of product might be the reason behind them.

Early work analyzed the role of product heterogeneity in explaining price dispersion (e.g., Griliches 1961, Chow 1967). A number of researchers control for product heterogeneity and choose products that are apparently homogeneous such as Books, Software, and CDs with the identical ISBN codes for books and the title and main features for Software and CDs (Ancarani and Shankar 2004). Clemons, Hann and Hitt (2002) control for observable product differences for prices of airline tickets offered by online travel agencies (OTAs), considering that different OTAs specialize by systematically offering different trade-offs between ticket price and ticket quality (minimizing the number of connections, matching requested departure and return time). They still find significant price dispersions across OTAs possibly since other aspects of product heterogeneity are not be included such as meal offerings and refund policy which could potentially drive price dispersion (Pan, Ratchford and Shankar 2004). Similarly, when investigating the influence of information and market efficiency on price dispersion, Grover, Lim and Ayyagar (2006) implicitly control for product heterogeneity by ensuring that selected products are homogeneous and guarantee that the 154 observations in their data set are for 154 different products.

Therefore, we expect lower price dispersion in the literature with consideration of product heterogeneity when collecting the data for calculating price dispersion.

H_{13}: Price dispersion is lower when product heterogeneity is controlled in the study.

Country. When price information is collected and examined in different regions, price dispersion might perform differently due to several reasons, such as currency difference, customers' purchasing level, which stage the product is at its life-circle, and the popularity of products in a certain region.

Three main regions are discussed in most previous studies, which are North America, Europe, and Asia. We expect to see lower price variation in a more mature market, such as markets in the North America area. Baye, Gatti, Kattuman, and Morgan (2002) first examine the impact of the Euro on prices charged by online retailers within the EU. They find the Euro changeover neither mitigates price differences nor results in purchasing power parity. In addition, they find significant differences in the prices charged by firms both within and across countries. Further, Gatti and Kattuman (2003) explore a large range of product categories across seven European countries through the dominant European price comparison site and find significant differences in the degree of price dispersion between and across product categories. Lu, Zhou, Bin (2007) focus on China, a fast growing e-commerce market. The study finds that the price dispersion online is larger than that of the traditional market in China for books, while the opposite is true for CDs. Authors think the results can be explained by the characteristics of the Chinese online marketplace, such as immaturity, unbalanced development and diversity. Ancarani, Jacob and Jallat (2009) compare price levels and dispersion online versus offline across the two largest Continental European CD markets (in France and Germany) and find statistically significant differences between the two sample countries. Hu and

Wang (2010) learn how country of origin (COO) affects price dispersions of homogeneous products (completely identical) respectively for products from eBay U.S. and U.K. They find that sellers from the United States enjoy a price premium, compared to U.K. and global markets.

> *H_{14}: Price dispersion is smaller when product items are examined in the markets of the North American area and larger when the study put the context in other areas such as Europe and Asia.*

Manuscript Status (-). Whether the paper has appeared in an academic publication, is an institutional technical report, or is an unpublished working paper is considered as one of the research characteristic that will affect study conclusions. Publication bias can arise when researchers do not submit or fail to publish papers with statistically insignificant or implausible findings. A Meta-Analysis reflects only what is published if only academic publications are included. Since statistically significant effects with better designed studies are more likely to get published, published effects are biased high in that case. Accordingly, we hypothesize that price dispersion is higher in studies from unpublished papers due to its large discrepancy among products without considering heterogeneity of products, and so on.

> *H_{15}: Price dispersion derived from studies in published papers are lower than those derived from studies in unpublished papers.*

Price Comparison Website (Search Engines) (-). It is relatively easier to obtain price quotes from online price comparison sites such as BizRate.com, Alexa.com, Shopper.com, Mysimon.com, PriceScan.com, Ebay.com or Kelkoo (an Internet Price

comparison site in EU) etc. than traditional physical retailers (Sorenson, 2000). The top price comparison website BizRate.com slogan "Never Pay More Than You Have To" is telling customers that huge price dispersion exists in the market and it is not worthy buying if a lower price can be found easily. The price quotes are gathered at the same time across retailers/E-tailers without a large time gap. Since products sold by different firms in online markets are homogeneous, a majority of consumers use price comparison sites to compare price offers and choose the minimum listed price (Baye and Morgan, 2001) and thereby search cost is reduced to the minimum level.

To examine price dispersion, a great deal of researchers use a price comparison website to obtain accurate and easily updated price information for single or multiple product items they examine in their studies[30], while some other researchers collect product prices from single or multiple websites that carry those products[31]. Whether to choose price comparison website or retailer's website also varies across studies due to the heterogeneity of product category, year of the data, website development, convenience of data collection, and so on, resulting in different degrees of price variations.

We propose that price dispersions of price quotes obtained from a single price comparison website is smaller than those from multiple E-tailer websites by more data collection efforts and time.

[30] e.g., Pan, Ratchford, Shankar 2001, 2002, 2007, Pan, Shankar, Ratchford 2002, 2003, Ratchford, Pan, Shankar 2003, Baye, Morgan, Scholten 2003, 2004a, 2004b, Baye and Morgan 2004, JohnLindsey-Mullikin, Grewal 2006, Grover, Lim, Ayyagari 2006, Venkatesan, Mehta, Bapna 2006, Hong, Shum 2006

[31] e.g., Bailey 1998, Cohen 1998, Brynjolfsson, Smith 2000, Clay, Krishnan, Wolff 2000, Lee, Gosain 2001, Baylis, Perloff 2002, Clay, Krishnan, Wolff, Fernandes 2002, Walter, Gupta, and Su 2006, Yang, Gan, Tang 2010, Arnold, Saliba 2002

H_{16}: Price dispersions calculated from price quotes that are obtained from a single price comparison website are smaller than those from multiple E-tailer websites.

3.4 Data Coding

Table 2 is the coding scheme for the dependent variable and **17** independent variables used in our Meta-Analytic study. The selection of these variables is based on previous summary papers and our theoretical hypothesis settings. The current model includes independent variables that are summarized into three categories, including market, channel and research characteristics. Most variables from market and channel characteristics are hypothesized based on previous theory and empirical findings, while some variables of research and study characteristics are considered as covariates that might affect magnitude and direction of price dispersion.

----------Insert Table 2 about here----------

4. Model and Procedure

We apply a hierarchical linear model to estimate the effects of each independent variable on price dispersion, as suggested by Bijmolt and Pieters (2001) and Raudenbush and Bryk (2002) and similar to some other Meta-Analysis studies (e.g., Albers, Mantrala and Sridhar 2010, Bijmolt, Van Heerde and Pieters 2005, Van Den Bultle and Stremersch 2004). In the current study, there are two levels in the model. The 790 price dispersions are at the first individual level. These observations are nested in 34 papers which we set as the second group level. Price dispersion observations within the same paper share several research and study characteristics. Therefore, we allow random effect in both

intercept and slopes across each independent papers and control for the within-literature error correlation between price dispersions.

Using subscript i to denote individual price dispersion observation, j to denote an independent paper, k to denote a covariate, the model structure we use to explain the variations in the observed *Log(PD)* has two levels.

Level 1: $Y_{ij} = \beta_{0j} + \sum_{k=1}^{K} \beta_{kj} X_{k,ij} + e_{ij}$

Level 2: $\beta_{0j} = \gamma_{00} + u_{0j}, \quad \beta_{kj} = \gamma_{k0} + u_{kj}$

Applying Level 2 model into Level 1 model, we have the mixed model shown

Mixed Model:

$$Y_{ij} = \gamma_{00} + \gamma_{k0} X_{k,ij} + u_{kj} X_{k,ij} + u_{0j} + e_{ij}$$

If we combine the random error, and take log transformation for dependent variable, we have the mixed model rewrite as:

$$Log(Price\ Dispersion_{ij}) = \gamma_0 + \sum_{k=1}^{K} \gamma_k X_{k,ij} + u_j + r_{ij}$$

$$where\ r_{ij} = u_{kj} X_{k,ij} + e_{ij}$$

Applying all indedent variables into the model, we have the full mode shown

$$\begin{aligned} LogPrice\ Dispersion_{ij} &= \beta_0 + \beta_1 logMeanPrice_{ij} + \beta_2 (logMeanPrice_{ij})^2 + \beta_3 Category_{ij} + \\ &\beta_4 No.Cat_{ij} + \beta_5 logNo.Sellers_{ij} + \beta_6 (logNo.Sellers_{ij})^2 + \beta_7 Popularity_{ij} + \beta_8 SearchEffort_{ij} \\ &+ \beta_9 MultiCh_{ij} + \beta_{10} Shipping_{ij} + \beta_{11} PDMeasure_{ij} + \beta_{12} PriceDef_{ij} + \beta_{13} Year_{ij} + \beta_{14} DataSource_{ij} \\ &+ \beta_{15} CustomerHet_{ij} + \beta_{16} ProdHet_{ij} + \beta_{17} logSampleN_{ij} + \beta_{18} Country_{ij} + \beta_{19} Publication_{ij} + u_j + r_{ij} \end{aligned}$$

There are two types of price dispersion (relative and absolute) commonly examined in the previous empirical studies, which are relative measure of price dispersion (including coefficient of price variation and percentage of price difference) and absolute measure of price dispersion (including price standard deviation and price range). Since these two measures are not comparable and they have different metrics, we do model estimation twice for two groups of data, of which we have 432 observations for relative data group

and 358 observations for absolute data group. Moreover, covariates common to each paper at the second level include search effort, product popularity, heterogeneity of customer, heterogeneity of competition, data geo scope, price definition, country, data source and manuscript status. All other covariates that vary across papers are at the first level, such as mean price, product category, number of sellers and so on.

There are several issues done regarding the model assumption checks. First, we check the normality of both dependent and independent variables. Since distributions of price dispersion, mean price, number of sellers, and sample size are strongly right skewed, we take log transformation for these continuous variables in our model to satisfy the model assumption of normality. By log transformation for both dependent variable and continuous independent variables, characteristics lead to a percentage increase in the price dispersion rather than an absolute increment (Clemons, Hann and Hitt 2002). Previous studies also use log form of price dispersion with either absolute or relative measures[32], and some studies take log transformation for some independent variables[33] . This appears to be more consistent with actual pricing behavior in the market (e.g., permitting a connection on a $1,000 flight could reduce the price by $200, while permitting a connection to a $150 flight may save only $30). Second, we assess the collinearity of variables by several traditional measures, such as correlation, Variance Inflation Factor (VIF), and condition index. Third, after using a hierarchical linear model we run the residual analysis. Normal probability plot of the standardized residual against predicted price dispersions indicates support for most model assumptions.

[32] e.g., Baye, Gatti, Kattuman, and Morgan (2002), Gatti, Kattuman (2003), and Baye and Morgan (2009)
[33] e.g., Lehmann 2003, Ellison and Ellison 2004) and number of competitors (e.g., Venkatesan, Mehta, Bapna 2007)

5. Results

5.1 Overall Magnitude of Price Dispersion

We present the frequency distribution of the observed price dispersion for two measures in ***Figure 2***. There are 432 relative measures and 358 absolute measures of price dispersion. The overall magnitude of price dispersion for relative measure (M= 21.2, SD=24.6) is significantly lower (p <.001, t-test) than that of absolute measure (M=73.9, SD= 153.7). The "raw" mean from the database indicates that 21.2% relative dispersion exists in one sample data with 432 observations, and $73.9 absolute dispersion exists in the other sample data with 358 observations. Only 6 of 790 observations show no price dispersion, with magnitude of zero. These are retained in the data base to reveal whether independent variables will result in such zero variation in prices.

----------Insert Figure 2 about here----------

5.2 Effects of Determinants

For both relative and absolute measures of price dispersion, we first estimate a full model with main effects of each determinant and a set of relevant interactions effects by adding one interaction at a time. Next we apply likelihood ratio test and check the significance of each newly added interaction to determine the combination of variables. Last we finalize the model by including main effects and the significant interactions in the previous step. In the following sections, we respectively discuss for relative and absolute measures of price dispersion the effects of 1) market characteristic (e.g. mean price, product category, search effort, number of sellers), 2) retailer/E-tailer characteristic (e.g. multi channel, service) and 3) research characteristic (price dispersion type, price definition, year of data).

When Price Dispersion is measured by Relative numbers

Regarding the extent of collinearity of variables, we inspect several measures. Correlation matrix of continuous variables after log transformation is reported in ***Table 3***. The highest bivariate correlation is .38, which indicates low correlation among continuous variables. Moreover, we find the highest VIF of all variables is 6.3, and all condition indexes are lower than 30. Therefore we delete variable with VIF greater than 5 and obtain robust model estimation results. Finally, after using a hierarchical linear model we run the residual analysis. Normal probability plot of the standardized residual against predicted price dispersions indicates support for most model assumptions.

----------Insert Table 3 about here----------

We now report the fixed mean effects (β_k) estimated from the hierarchical model for each determinant in ***Table 4***. In summary, we find 17 out of 26 independent variables including two quadratic form and five post hoc interaction effects to be statistically significant at least at $p < .10$. The overall model fit (Pseudo R^2) is satisfactory, indicating that predictors explained 93.2% of the between-paper variation of price dispersion and 13.7% of the within-paper variation of price dispersion.

----------Insert Table 4 about here----------

Market Characteristic

We find several significant market factors in accordance with H_1, H_2, H_3 and H_4: mean price, product category, number of categories and number of sellers in the market.

Mean Price. We observe a "U-shaped" non-linear relationship between mean price (expressed in logs) and level of price dispersion by both significant main factor and squared term of mean price. Previous studies such as Pan, Ratchford and Shankar (2001, 2002), Baylis and Perloff (2002), Lindsey-Mullikin and Grewal (2006) have only proposed two possible directions. There is yet no study that has even examined the nonlinear relationship. In our Meta-Analysis result, we first observe a decrease in relative price dispersion as average price goes higher (which is consistent with previous findings of negative relationship), however when prices continue increases and reaches a critical point, price dispersion tends to increase (showing a positive relationship).

Product Category and Number of Categories. We find that price dispersion for electronic/computer is significantly lower than that of fast-moving consumer goods, with the univariate means respectively, and the price dispersion of service product is at moderate level however the difference is not significant. The result is similar to the findings of Pan, Ratchford, Shankar (2007) that fast-consuming products such as food, books have the largest relative price dispersion after controlling for the average price. High-financial outlay categories with low differentiation potentially increase price search (Peterson et al. 1997) and thus results in low price dispersion, since we find laptop and desktop computers as well as electronic product have the lowest intrinsic price dispersion.

Consistent with proposal of price dispersion due to category differences, we also find that one more percent increase in category number examined in the study, .leading to a 6 percent increase in the relative price dispersion.

Number of sellers. Different from some studies (e.g., Baye, Gatti, Kattuman, and Morgan 2002, Gatti, Kattuman 2003) using number of firm dummies to examine its effect, in the current meta analysis we use number of sellers (expressed in logs) in the model. We find that market structure represented by the number of sellers has a positive impact on price dispersion, that one more percent increase in number of competitors in the market, leading to a .47 percent increase in relative price dispersion. The result is consistent with findings in the extant literature from Baye, Morgan, Scholten (2003), Ruppert and Kattuman (2003), suggesting that even when competition is getting more fierce, more information and alternatives in the market results in broadened search cost and higher variations in prices. However, we do not find significant squared term in the model as Baye and Morgan (2009), implying that there is no non-linear relationship between the number of sellers and the magnitude of price dispersion. We could understand it since we are looking at the averages of previous findings and the overall effect of the number of market competitors shows a linear trend with a single direction.

Non-Significant Variable. Two factors in market characteristic category are not significant, including whether the study has accounted for product popularity and whether the study has accounted for search cost. We do not observe significant effect of whether items are selected from both popular and random product or not, and whether considering consumers' search costs when selecting items or not, suggesting that price dispersion exists widely in the market no matter whether it is a popular or random item, and no matter whether the study is selecting prices with possible higher or lower search cost.

E-tailer Characteristic

Channel Type. We find that the (log) price dispersion for multichannel type of E-tailer is significantly lower than for pure-play type of E-tailer by 1.52, which supports our hypothesis H_7. The significant difference in price dispersion between multi-channel and pure-play retailer shows much smaller level for multi-channel retailers. The result is consistent with Pan, Shankar and Ratchford 2003b, Ancarani and Shankar 2004. The differences in the nature of different types of online distribution channels can be reasons for variations in prices charged digitally.

First, online branch of multichannel retailer is derived from its conventional channel and it is designed to coordinate prices across online and offline to avoid price competition from itself, so it charges higher prices than its competing rival, the pure-play online retailers with smaller dispersion. Second, services of multichannel retailer have more patterns and flexibility with some bundling with its offline channel. The service price from online branch of multichannel retailer might be higher than those of pure-play E-tailers. In addition, operation cost and efforts for firms to change price labels, efforts and cost for consumers to search price information vary across online and offline, multichannel and pure E-tailers. Third, tax-free strategy, free-shipping fee strategy for some chosen customers from pioneering pure-play Internet retailers such as Amazon.com make it advantageous over traditional retailers and leave some more space for its price dispersion magnitude. Fourth, the mixed findings from previous studies may also be a result of immaturity of Internet marketing and the lack of stable market equilibrium (Pan, Ratchford and Shankar 2004); high competiveness and efficiency might be exhibited as it matures.

Interactions. We also find three interactions between channel type and other variables are significant, including Multi Channel × (log) number of Re/Etailers, Multi Channel × Year of Data (2001 – 2003), Multi Channel × Sample Size. First, interaction of Multi Channel × (log) number of Re/Etailers is positively significant, implying that the number of competitors in the market from a multichannel type of retailer affect (log) price dispersion significantly more than that from a pure-play type of retailer. Second, interaction of Multi Channel × Year of Data Dummy (2001 – 2003) is positively significant, showing that the declining (log) price dispersion from boom period of Internet (before year 2000) to shakeout and reconstruction period (year 2001-2003) is more prominent for multichannel retailer than pure-play retailer. Third, we find significantly positive interaction of Multi Channel × Sample Size and conclude that the (log) sample size in data obtained from a multichannel type of retailer affect (log) price dispersion significantly more than that from a pure-play type of retailer.

Non-Significant Variable. We do not find support for H_8 with respect to shipping and handling fee accounted for in the study, which is consistent with studies (Brynjolfsson and Smith 2000, Scholten and Smith 2002) that find even after controlling for shipping and handling fee, the price dispersion does not change too much. We can understand it since the shipping and handling fee is a small amount of item price with mean level at $434.3 in our Meta-Analysis. As Venkatesan, Mehta and Bapna (2007) have explained, not including shipping and handling in prices is more reasonable. Examining on multiple product categories in the study, shipping and handling fee take up only a small percentage of prices. Then different charges by retailers make comparison difficult, and in some cases, shipping and handling information is not available. Similarly, Pan,

Ratchford, and Shankar (2007) suggest using posted price rather than price with shipping charge to be the basis for price dispersion measures. Our results provide evidence to support the finding that there is no need to include shipping and handling fee in prices when testing price variations, since it makes no significant difference.

Research Characteristic

PD Measure. In accordance with H_9, the results show significant difference between two relative measures of price dispersion. On the contrary to our expectations, the (log) price dispersion calculated from coefficient of variation is significantly higher than that from percentage of difference by .42, indicating that the magnitude coefficient of variation is higher than the other one by 2.65%. Of 432 relative price dispersions, 350 observations are coefficient of variation which shows variability of prices and 82 are percentage of difference which reflects extremes of prices. Therefore we can understand it by concluding that variability of prices has higher magnitude than the difference between price extremes, even after controlling for the average price of product by using relative measures.

In addition, two interactions are significant including PD Measure × # of Re/Etailers and PD Measure. First, interaction of PD Measure × (log) number of Re/Etailers is negatively significant, implying that the affect of number of competitors in the market on (log) coefficient of variation is significantly less than for (log) percentage of difference. Second, interaction of PD Measure × Multi Channel is negatively significant, showing that the declining (log) price dispersion from pure-play retailer to multichannel retailer is less prominent for (log) coefficient of variation than for (log) percentage of difference.

Year of Data. Consistent with our hypothesis H_{11}, overall (log) price dispersion declines significantly from boom (before 2000) denoting 179 observations to shakeout and reconstruction period (2001-2003) denoting 226 observations by .16, indicating that relative measure has declined by 1.45%. This finding is consistent with several studies (Brown and Goolsbee 202, Chen and Hitt 2003, Ancarani and Shankar 2004) capturing decreased price dispersion data collected around year 2001 to 2003 (See ***Table 1***). Moreover, (log) price dispersion increases during the mature period (2004 -2008) than boom period by .46; however it is not significant, probably due to a small sample size for the mature period with about 37 price dispersions.

Figure 3 provides a time-series distribution of price dispersion across 12 years of the data collection from literatures. In accordance to our hypothesis testing result, we can observe more fluctuation of price dispersion in the early stage of Internet development (before 2000) with relatively higher level, and a smooth trend of low level of price dispersion during the shakeout and reconstruction period (2001-2003), as well as a less fluctuated distribution after year 2004, as Internet goes mature, while there is some extremely high magnitude of price variation.

----------Insert Figure 3 about here----------

Product Heterogeneity. We find significant decrease in (log) price dispersion for studies taking care of product heterogeneity by .47, with corresponding 2.95% decrease in overall magnitude of price dispersion, supporting our hypothesis H_{13}.

Country. We use a dummy variable to specify price dispersion data collected from North America area (US and Canada) with 367 observations and other areas such as Asia,

Europe covering 66 price dispersions. Result shows significant evidence to support H_{14}, that (log) price dispersion from North America is significantly higher than that from other areas by .67, indicating that the magnitude of relative measure from US and Canada is 4.68% higher than that from Asia and Europe. The finding is significant but is contrary to our expectation that prices are less dispersed in the more mature market such as the US market. We can understand such a result if we think that although the market goes mature, the Internet technology is also at maturity stage in US area leading higher price dispersions as proved previously. Therefore, the combined result shows that consumers in the highly development digital market actually face more price variations and price options.

Manuscript Status. In accordance to our hypothesis H_9, we find significantly lower (log) price dispersion from published papers than those unpublished ones by .24, with the magnitude in relative price dispersion to be 1.95%. As we expect, published literature have better control in study design and data collection, such as product and consumer heterogeneity, resulting in less variation in prices.

Price Comparison Site. In contrast to the proposed lower price dispersions from a single price comparison website in H_{16}, we find that price dispersion calculated by prices obtained from price comparison website to be higher than those from multiple E-tailer websites

Non-significant Variables. We find three non-significant research-related variables that do not support our hypotheses: customer heterogeneity (H_{12}), price definition (H_{10}) and (log) sample size (H_{17}). Even if customer heterogeneity is controlled in the study, we do

not find significant change in the level of price variation due to customers' knowledge about the product features and prices, indicating that price variation exists widely across customers who obtain price information in different ways. In addition, weighting price by the brand sales, using price perception as a proxy of price information, choosing price information from large or small sample also do not significantly affect price dispersion. This implies for future research on price dispersion, we can select a proper sample to investigate price variation without too much consideration about price format or size of the sample.

When Price Dispersion is measured by Absolute numbers

Different from the unit-free measure of price dispersion, absolute measures of price dispersion directly show the price change in terms of price range and price standard deviation. We expect to find some different results from those of relative measures.

First, regarding the extent of collinearity of variables, we report the correlation matrix of continuous variables after log transformation in ***Table 5***. The highest bivariate correlation is .26, which indicates low correlation among continuous independent variables. Moreover, we find the highest VIF of all variables is 5.4, and all condition indexes are lower than 30. Therefore we delete the variable with VIF greater than 5 and also obtain robust model estimation results. Similarly, we apply hierarchical linear model and run the residual analysis, showing that the standardized residual against predicted price dispersions indicates support for most model assumptions.

----------Insert Table 5 about here----------

The fixed mean effects (β_k) estimated for absolute measure group of data are reported in ***Table 6***. In summary, out of 25 independent variables including two quadratic forms and four post hoc interaction effects, 18 are statistically significant at least at $p < .10$. The overall model fit (Pseudo R^2) is also satisfactory, indicating that predictors explained 86.3% of the between-paper variation of price dispersion and 16.2% of the within-paper variation of price dispersion.

----------Insert Table 6 about here----------

Consistent Results with Relative Measures

For absolute measures of price dispersion, we find several significantly consistent results with those of relative measures, including 1) product category, showing that absolute price dispersion for electronic/computer product is significantly lower than that of fast-moving consumer goods; 2) number of categories, that for one more percent increase in category number included in the study, there is a .66 percent increase in the absolute price dispersion; 3) non-linear effect of the number of sellers in the market, that one more percent increase in the number of sellers competing in the market, leading to a.54 percent increase in absolute price dispersion, while there is no significant effect of the quadratic form; 4) (log) price standard deviation is significantly higher than (log) price range by .53, and its interaction with both (log) number of sellers and Multi Channel is negatively significant, indicating that the effect of number of competitors in the market on (log) price standard deviation is significantly less than (log) price range, and the declining (log) price dispersion from pure-play retailer to multichannel retailer is less prominent for (log) price standard deviation than (log) price range; 5) product heterogeneity accounted for in

the study is also a significant factor that affects price dispersion ; 6) Absolute price dispersion is significantly lower in North American that that in other areas such as Asia and Europe; 7) price dispersion from published paper is lower than that form unpublished works; and 8) whether the price information is collected from price comparison site has a significant effect on price variation.

Different Findings from Relative Measures

Meanwhile, absolute measures of price dispersion still have some differences in nature from relative measures. Relative measures of price dispersion are price range or standard deviated weighted by the average price, while absolute measures are not weighted but the absolute value of price and standard deviation. They also explain similar information about price variation, that price range and percentage of price difference both reflect two extremes (the highest and the lowest) of prices, while price standard deviation and coefficient of variation both show variability of prices. Therefore, in addition to consistent results from two types of measures, we also find some different pattern from them, which might shed some light for future research.

First, although we find a non-linear relationship between mean price and price dispersion for both absolute and relative measures, the shape is different. Results show that there is a concave “U-shaped” relationship between price dispersion for both absolute and relative measures, since the quadratic terms are both positively significant for two groups of data. The difference is that for absolute measure, as mean price increases, price dispersion is always increasing with a positive and increasing marginal effect of mean price. For relative measure, as mean price increases, price dispersion declines at the beginning and

increases as price becomes even larger. It is understandable that absolute measure is not weighted by the average price, therefore resulting in the positive change in price standard deviation or range as price increases, while relative measure is weighted by the average price and it will decrease at the beginning. Second, we find that multichannel type of retailer has significantly higher absolute price dispersion than pure play E-tailers; this is the opposite result of what we have got for relative measure. In addition, its significantly positive interaction with mean price shows that the increase in absolute price dispersion due to the increase of product price is more prominent for multichannel retailer than that for pure-play E-tailer. Third, in addition to the significant lower price dispersion during the year of shakeout and reconstruction of the Internet (2001-2003), as the Internet becomes mature, the absolute price dispersion has significantly increased; while the increase for relative measure is not statistically significant. Fourth, customer heterogeneity considered in the study will result in significant higher price dispersion, which is different from the result for relative measure; while the effect for relative measure is not statistically significant.

6. Conclusion

In sum, we meta-analyzed 790 price dispersions reported or estimated in 34 research papers ranging from 1998 to 2010, covering price and price dispersion information with large geographic and category scope. We obtain several useful generalizations in online price dispersion, which we list in the following section. Then, we present the limitation and future research direction.

Key Empirical Generalizations

The average of relative price dispersions is 21.2%, with coefficient of variation and percentage of price difference to be relative measures; and the average of absolute price dispersions is $73.9, with price range and standard deviation to be absolute measures. Overall, from the boom of E-commerce in 1998 to the maturity of the Internet development in digital marketing since year of 2004 till now, online price dispersions exist ubiquitously and persistently across product categories, countries, and channels in various studies, no matter which measurements and scales we use to describe variations in prices. Price dispersions are overall increasing over time, although there is a decline when the Internet experiences a shakeout and construction period during 2001 to 2003.

Specifically, on average, for both relative and absolute measures, we generalize that price dispersions are smaller for electronic and computer product than those for fast-moving consumer goods. If the study includes multiple product categories, higher price dispersions are expected than those of study covering only one product category. And if more categories are covered, even higher price dispersions are expected. These two results suggest that when researchers choose different products to examine price dispersions, there will be significant differences in results based on categories and the number of categories we decide to include.

There is a non-linear relationship between price dispersions and mean price of products. For absolute measure, price dispersions increase with increasing average price and the marginal increase will be even larger for more expensive products; and for relative measure, price dispersions first decrease and then increase as average price of products

rises from low to high. Market structure represented by the number of sellers in the market also results in different levels of price dispersion, indicating that more competitors in the market, higher price dispersions expected.

Price standard deviation is significantly higher than price range, and similarly, coefficient of variation is also significantly higher than percentage of difference. This finding supports our initial hypothesis that measurements and scales of price dispersion play important roles in the magnitude of price dispersions and it helps to explain why discrepancy exists in previous literatures which use quite different measures to describe price variations. Further, pure-play E-tailer has significant higher price dispersions than multichannel retailer, and the difference is especially more prominent for price standard deviation than price range. This result supports the idea that if we focus on pure-play E-tailer using price standard deviation as measure of price dispersions, we expect to obtain the highest price dispersions. In addition, we find if the study controls for product heterogeneity, lower price dispersions are expected, since researchers have better selected and controlled for the dissimilarity of products that may make price dispersions higher. This also supports the idea that for future research, controlling for product heterogeneity is an essential way to avoid bias in the results.

In general, price dispersions in the North America is higher than those in Asia and Europe, indicating that although the market is mature in the U.S. and Canada, rich information in the market and asymmetry in the information search between seller and buyer results in even wider variations in prices. Finally, dispersions of prices obtained from price comparison sites are even higher than those from multiple E-tailer websites. This result suggests in practice, price comparison sites such as BizRate.com, Alexa.com

have integrated large price information in the market with large price variations and they are good sources for consumers to obtain as much information on prices as possible.

Managerial Implications

According to the model estimation results and hypotheses we've established earlier in this study, we also provide some managerial implications for price competition and pricing strategy. Price levels across three types of retailers reflect the competition across different channels, whereas price dispersions reflect the competition within each channel. Higher or lower levels might imply how these factors drive prices variations to different directions. Channels can effectively differentiate themselves from one another on price (non-price) dimension, or through the combined benefits of convenient access to information, physical inspection, pickup and return of merchandise. Results show that pure-play E-tailers have higher price dispersions, reflecting higher variability in prices, suggesting that there are more opportunities for them to be differentiated from multichannel retailers in the price dimension. Multichannel retailers can then better compete by focusing on some non-price dimensions, such as in-store and online personalization and customization, trust in physical stores, branding strategy, as well as shipping and return convenience they can provide to customers.

Future research

Our study has some limitations that are typical of most meta-analytic research. First, while we have tried to be exhaustive in our literature review, we may have overlooked some publications that estimate price dispersion. Second, in identifying the factors that influence price dispersion, we are limited by the variables that are available in the

original studies. For example, we could not collect data on sales, advertising, or other industry index, so we could not estimate influences of these variables on price dispersion. Third, we limit our meta-analysis on online price dispersion due to the interest in E-commerce context, and we could further include both physical store and online price data and make comparisons.

These limitations provide potential directions for further research. On a more substantive level, researchers in the future should try to analyze effect of sales and advertising on price dispersion. They can analyze durable goods, industrial goods, and more service goods that are not examined too much in previous studies. In addition, future research could also perform a meta-analysis of comparison between online and offline price dispersions, which covers more information from both physical stores and digital markets.

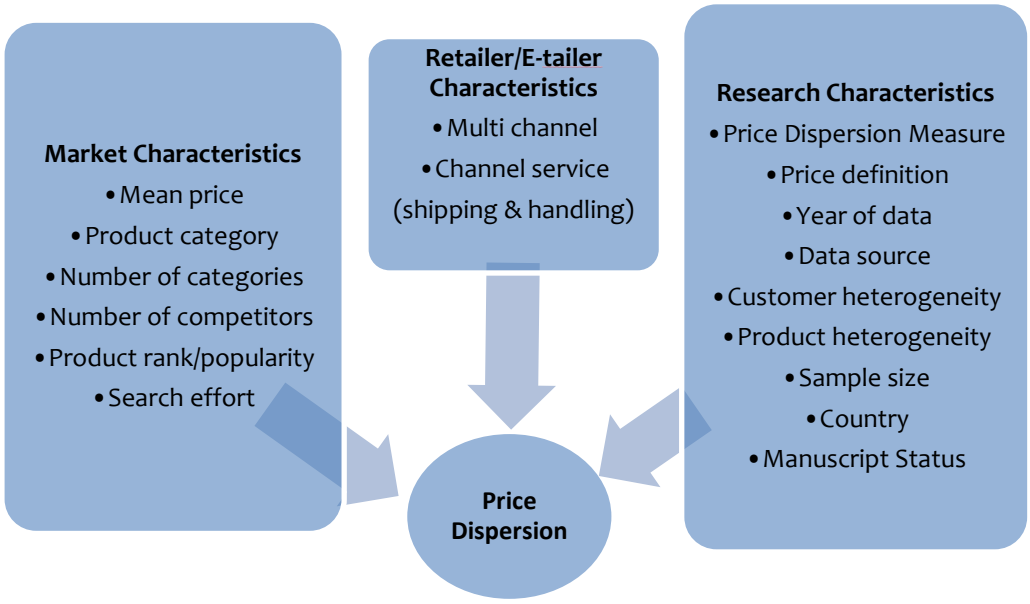

Figure 1. Framework

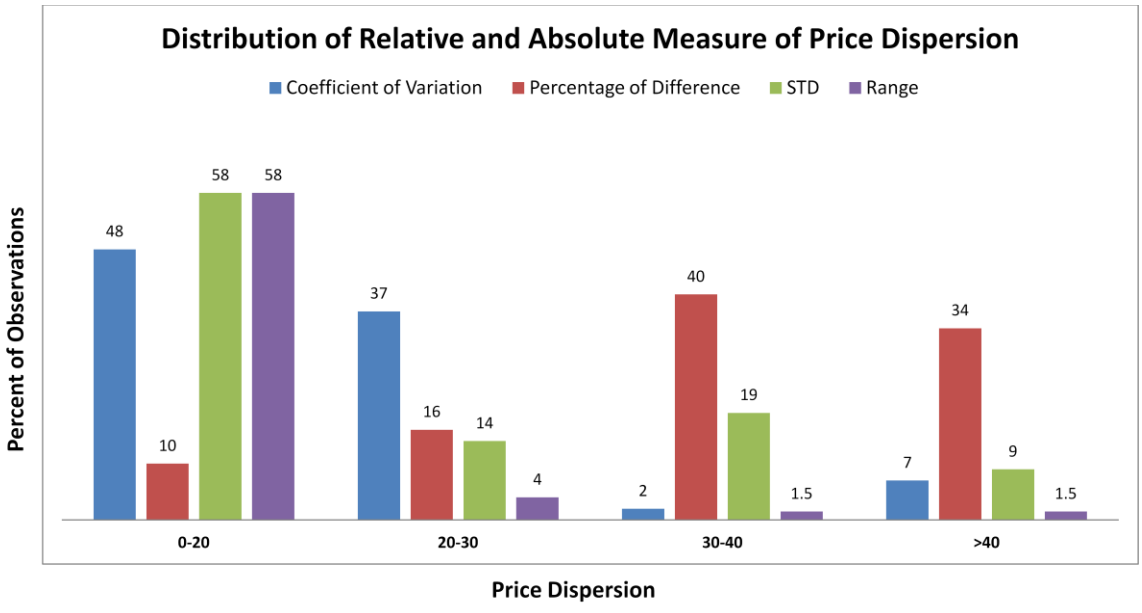

Figure 2. Frequency Distribution of Price Dispersion

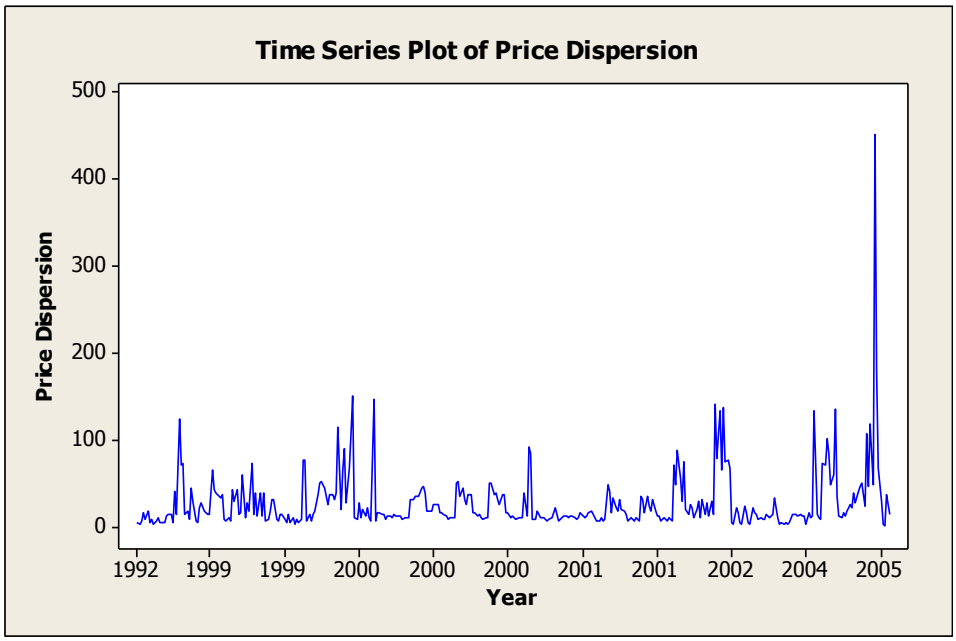

Figure 3. Time Series Plot of Price Dispersion

Table 1. 34 literatures included in Meta-Analysis on price dispersion

Paper	Title	Authors	Year	Product
1	Intermediation and electronic markets: Aggregation and pricing in Internet commerce	Bailey	1998	Books, CDs, Software
2	Modeling price dispersion as an outcome of competition in the Irish grocery market	Walsh, Whelan	1999	Chocolate Counts, Carbonate- Cans, Carbonate-Standard, Crisps/Snacks, Mineral Water, Chocolate Multi-Packs, Carbonate-Large, Soup, Sausages, Bacon, Sugar, RTE Cereals-Small, RTE Cereals-Standard, RTE Cereals-Large, Coffee, Cat Food, Dog Food, Tea
3	Frictionless commerce? A comparison of Internet and conventional retailers	Brynjolfsson, Smith	2000	Books, CDs
4	Equilibrium Price Dispersion in Retail Markets for Prescription Drugs	Sorensen	2000	Prescription Drugs
5	Prices and Price Dispersion on the Web: Evidence from the Online Book Industry	Clay, Krishnan, Wolff	2001	Books
6	Will the growth of multi-channel retailing diminish the pricing efficiency of the Web	Tang, Xing	2001	DVDs
7	Why Aren't the Prices of the Same Item the Same at Me.com and You.com?: Drivers of Price Dispersion Among E-tailers	Pan, Ratchford , Shankar	2002	Books, CDs, DVDs, Desktop, Laptop, PDAs, Software, Electronics
8	Price Dispersion and Differentiation in Online Travel: An empirical Investigation	Clemons, Hann, Hitt	2002	airline ticket offerings of Online Travel Agents (OTA)
9	Price Dispersion on the Internet: Good Firms and Bad Firms	Baylis, Perloff	2002	Digital Camera, Scanner
10	Online Pricing and the Euro Changeover: Cross-Country Comparisons	Baye, Gatti, Kattuman, Morgan	2002	Games, Games Consoles, Music CDs, PDAs, Printers, Scanners
11	Retail Strategies on the Web: Price and Non–price Competition in the Online Book Industry	Clay, Krishnan, Wolff, Fernandes	2002	Books
12	Price dispersion then and now: Evidence from retail and e-tail markets	Sholten, Smith	2002	1-pound-Potatoes, Lettuce, Stalk Celery, Tea, Deodorant, Dozen Lemons, Batteries, Hair Spray, Antacids, Auto Polish, Film, Aspirin, Hand cream, Razor Blades, Male contraceptives, Contact, Thermometer, Inexpensive camera, Dozen, Expensive camera, Deodorant, Hair, Batteries, Antacids, Aspirin, Hand Cream, Male Contraceptives, Razor Blades, Thermometer, Dozen Roses, Expensive camera
13	Can price dispersion in online markets be explained by differences in E-tailer service quality?	Pan, Ratchford , Shankar	2002	Book, CD, DVD, Desktop, Laptop, PDA, Software, Electronics
14	Price Competition Between Pure Play vs. Bricks-and-Clicks E-tailers: Analytical model and empirical analysis	Pan, Shankar, Ratchford	2002	Apparel, Gifts and Flowers, Health and Beauty, Home and Garden, Sports and Outdoors, Computer Hardware, Consumer Electronics, Office Supply
15	Price Dispersion in Online Markets: The case of College textbooks	Arnold, Saliba	2002	Textbook

Paper	Title	Authors	Year	Product
16	Pricing Behavior on the WEB: Evidence from Online Travel Agencies	Lehmann	2003	airline ticket offerings of Online Travel Agents (OTA)
17	The evolution of price dispersion in Internet retail markets	Pan, Shankar, Ratchford	2003 b	Book, CD, DVD, Desktop, Laptop, PDA, Software, Consumer Electronics
18	On the Efficiency of Internet Markets for Consumer Goods	Ratchford, Pan, Shankar	2003	Book, CD, DVD, Desktop, Laptop, PDA, Software, Consumer Electronics
19	Price Levels and Price Dispersion Within and Across Multiple Retailer Types: Further Evidence and Extension	Ancarani, Shankar	2004	Books, CDs
20	Temporal price dispersion: Evidence from an online consumer electronics market	Baye, Morgan, Scholten	2004 b	software, peripherals, accessories
21	Price dispersion in the lab and on the Internet: theory and evidence	Baye, Morgan	2004	Electronics such as camera, CD player, MP3, etc.
22	Price dispersion in the small and in the large: Evidence from an internet price comparison site	Baye, Morgan, Scholten	2004 (a)	electronics products
23	Using Price Distribution to estimate search costs	Hong, Shum	2006	Textbook
124	Persistent price dispersion in online markets	Baye, Morgan, Scholten	2006	software, peripherals, accessories
25	The Sources of On-Line Price Dispersion Across Product Types: An Integrative View of On-Line Search Costs and Price Premiums	Walter, Gupta, Su	2006	PDA, grocery, hotel rooms, airline, flowers, Book, Music CD, toys, videotapes, shoes, furniture, online trading services, fragrances, wine
26	Imperfect Information: The Persistence of Price Dispersion on the Web	Lindsey-Mullikin, Grewal	2006	VCR, TV, PDA, Laptop, MP3
27	Consumer Search, Price Dispersion, and Asymmetric Pricing	Tappata	2006	gas price from gas station
28	The Dark Side of Information and Market Efficiency in E-Markets	Grover, Lim, Ayyagari	2006	DC, Camcorder, Camera, TV, DVD Player, PDA, MP3 Player, CD Player, Printer, Monitor, Hard Drives, DVD/VCR Combo, Bridge and Routers, NIC, Graphic Cards
29	Do market characteristics impact the relationship between retailer characteristics and online prices?	Venkatesan, Mehta, Bapna	2007	Books, Camcorder, DVD, DVD Player, PDA, Printer, Scanner, Video
30	A Comparison of Prices in Electronic Markets and Traditional Markets of China	Lu, Zhou, Wang	2007	Books, CDs
31	Drivers of Price Dispersion among E-tailers during the Boom, Shakeout, Restructuring, and Mature Periods of e-Commerce	Pan, Ratchford, Shankar	2007	Books, CDs, DVDs, Electronics, Desktop, Laptop, PDAs, Software
32	Cross-country analysis of price levels and dispersion in online and offline environments: an empirical analysis in France and Germany	Ancarani, Jacob, Jallat	2009	CD
33	A Study of Price Evolution in Online Toy Market	Yang, Gan, Tang	2010	Toy
34	Country-of-Origin Premiums for Retailers in International Trades: Evidence from eBay' s International Markets	Hu, Wang	2010	SONY Memory stick, iPod Nano, WoW, Phone Unlocking

Table 2 Coding scheme of meta-analysis

Variables	Description	Coding Scheme
Dependent Variable		
Price Dispersion (relative)	Include two relative measures of price dispersion	Continuous
	1. % of diff. b/w prices (range/mean)	
	2. Coefficient of price variation (std/mean)	
Price Dispersion (absolute)	Include two absolute measures of price dispersion	Continuous
	3. Price Range	
	4. Price std.	
Market Characteristics		
Mean Price	Capture the average price level of the market examined in a certain study	Continuous
Product Category	Capture which category the product belongs to	0 Fast-moving Consumer Goods;
		1 Durable;
		2 Electronic/Computer;
		3 Services;
# of categories	Capture how many categories is examined	Continuous
Product Rank /Popularity	Capture whether product rank/popularity is involved in the study (e.g.,bestsellers)	1 Product Rank Used
		0 otherwise
Geo Scope	The geographic scope covered by the products examined in the study	0 wider than 1 country
		1 country wide
		2 several cities
		3 1 city
Search Effort	Capture whether search effort is involved in the study	1 Search Effort involved
		0 otherwise
Change Over Time	Capture whether lagged effects are considered in the study	1 Product price change over time
		0 otherwise
Year of Data	Capture the effect of when the data is collected in the study	0 Before 2000 Dec (Boom)
		1 2001 -2003 (Shakeout, Reconstruction)
		2 2004 till now (Mature)

Variables	Description	Coding Scheme	
Country	Capture the effect of where the data originates from in the study	1 US (US, Canada)	
		0 Other area including Europe (UK, France, Germany, Italy, etc.) and Asia (China, Singapore)	
# of Re/E-tailers	How many Retailers and E-tailers are examined in the study (total #)	Continuous	
Retailer Characteristics			
Multi Channel	Capture whether multi channel effect is examined in the study	1 Multi channels are considered	
		0 Otherwise	
Service (shipping, handling)	Capture whether service effect is examined in the study	1 Services are considered	
		0 Otherwise	
Research Characteristics			
Price Dispersion Measure	Capture effect of measure of price dispersion	For relative measure group:	For absolute measure group:
		1 Coefficient of price variation (std/mean)	1 Price standard deviation
		0 % of diff. b/w prices (range/mean)	0 Price range
Price Definition	Capture the effect of price definition options	1 Average unit/posted/quoted price/listed/store price/price quotes	
		0 Other prices(e.g., normalized price, weighted price, price perception, price discount)	
Customer Heterogeneity	Capture the effect of whether taking care of heterogeneity or not in the study	1 considered	
		0 otherwise	
Sample Size	Capture the effect of sample size used in the study	Continuous (# of observations)	
Manuscript Status	Capture whether the paper has appeared in an academic publications, or is an unpublished working paper	1 Published Academic Paper	
		0 Unpublished Paper	
Price Data Source	Capture whether the data is obtained from price comparison website (such as Bizrate.com) or from multiple e-tailer website	1 From Price Comparison Website	
		0 Otherwise	

Table 3 Descriptive statistics of continuous variables (DV: relative measures, N = 432)

	Mean	SD	Min	Max	1	2	3	4
1. LNPD	1.15	0.37	0.23	2.18				
2. LNMEAN	2.15	0.75	0.24	3.40	-0.19			
3. LNCATEGORY	0.09	0.25	0	1.30	0.04	0.07		
4. LNNOALL	1.17	0.68	2	2.29	0.23	0.13	-0.27	
5. LNSAMPLEN	2.46	1.03	0	5.81	0.49	-0.21	0.38	0.01

Table 4 Effects of Determinants on Price Dispersion (DV: relative measures, 432 obs.)

Number	Determinant	Level	Mean(SD) /Frequency	Hierarchical Linear Model Estimate
0	Intercept	-	-	.04(.35)
Market Characteristics				
1	Mean Price	Continuous	434.3(613.6)	-.34(.15)**
	Mean Price Squared			.07(.03)**
2	Product Category	0 Fast-moving Consumer Goods; 1 Electronic/Computer; 2 Services;	155 235 10	 -.08(.05) .83(.18)***
3	# of categories	Continuous	1.6(1.9)	.60(.30)*
4	Product Popularity	1 Product Popularity Considered 0 otherwise	155 277	-.02(.07)
5	Search Effort	1 Search Effort involved 0 otherwise	201 231	.02(.07)
Retailer/E-tailer Characteristics				
6	# of Re/E-tailers	Continuous	53.3(160.5)	.47(.09)***
	# of Re/E-tailers Squared			.16(.12)
7	Multi Channel	1 multi channels are considered 0 otherwise	66 366	-1.52(.62)**
	Multi Channel × # of Re/E-tailers			.56(.19)***
	Multi Channel × Year of Data (2001 – 2003)			.87(.31)**
	Multi Channel × Sample Size			.46(.16)***
8	Service (shipping, handling)	1 services are considered 0 otherwise	258 174	-.02(.04)
Research/Study Characteristics				
9	PD Type	1 Coefficient of price variation 0 Percentage of price difference	350 82	.42(.14)***
	PD Type × # of Re/E-tailers			-.46(.08)***
	PD Type × Multi Channel			-.43(.11)***
10	Price Definition	1 Average unit/posted/quoted price/listed/store price/price quotes 0 Other price (e.g., Normalized price, Price perception, Weighted price, Price discount, average of mean)	253 75	-.11(.18)
11	Year of Data	0 Before 2000 Dec (Boom) 1 2001 -2003 (Shakeout, Reconstruction) 2 2004 till now (Mature)	179 226 37	 -.16(.05)*** .46(.36)

Number	Determinant	Level	Mean(SD) /Frequency	Hierarchical Linear Model Estimate
12	Customer Heterogeneity	1 considered	40	-.09(.32)
		0 otherwise	392	
13	Product Heterogeneity	1 considered	74	-.47(.10)***
		0 otherwise	358	
14	Sample Size	Continuous (# of observations)	2,255(6209)	-.02(.03)
15	Country	1 US (US, Canada)	367	.67(.28)**
		0 Otherwise. Europe (UK, France, Germany, Italy, etc.) or Asia (China, Singapore)	66	
16	Manuscript Status	1 Published Academic Paper	314	-.19(.09)*
		0 Unpublished Paper	118	
17	Price Comparison Site	1 Data from price-comparison website	278	.24(.07)**
		0 otherwise	154	

*** <.01

** < .05

* <.1

Table 5 Descriptive statistics of continuous variables (DV: absolute measures, N = 358)

	Mean	SD	Min	Max	1	2	3	4
1. LNPD	1.25	0.76	-0.75	3.03				
2. LNMEAN	2.07	0.76	0.09	3.40	0.87			
3. LNCATEGORY	0.01	0.58	0	0.85	0.15	0.08		
4. LNNOALL	1.25	0.08	0	3.29	0.24	0.14	0.09	
5. LNSAMPLEN	2.46	1.10	0	4.81	0.05	-0.26	0.18	0.19

Table 6 Effects of Determinants on Price Dispersion (DV: absolute measures, 358 obs.)

Number	Determinant	Level	Mean(SD) /Frequency	Hierarchical Linear Model Estimate
0	Intercept	-	-	-2.12(.33)***
Market Characteristics				
1	Mean Price	Continuous	395.3(594.6)	.97(.03)***
	Mean Price Squared			.10(.04)***
2	Product Category	0 Fast-moving Consumer Goods;	156	
		1 Electronic/Computer;	188	-.04(.06)
		2 Services;	8	1.32(.60)**
3	# of categories	Continuous	1.1(.5)	.66(.30)**
4	Product Popularity	1 Product Popularity Considered	177	-.05(.08)
		0 otherwise	181	
5	Search Effort	1 Search Effort involved	198	-.04(.07)
		0 otherwise	160	
Retailer/E-tailer Characteristics				
6	# of Re/E-tailers	Continuous	40.0(112.8)	.54 (.10)***
	# of Re/E-tailers squared			.13(.13)
7	Multi Channel	1 multi channels are considered	80	.63(.22)***
		0 otherwise	278	
	Multi Channel × Mean Price			-.18(.09)*
	Multi Channel × Year of Data (2001-2003)			1.37(.08)***
8	Service (shipping, handling)	1 services are considered	248	-.001(.04)
		0 otherwise	109	
Research Characteristics				
9	PD Type	1 Price Standard Deviation	283	.53(.15)***
		0 Price Range	75	
	PD Type × # of Re/E-tailers			-.5(.08)***
	PD Type × Multi Channel			-.57(.09)***
10	Price Definition	1 Average unit/posted/quoted price/listed/store price/price quotes	350	-.58(.34)
		0 Other price (e.g., Normalized price, Price perception, Weighted price, Price discount, average of mean)	8	
11	Year of Data	0 Before 2000 Dec (Boom)	135	
		1 2001 -2003 (Shakeout, Reconstruction)	188	-.16(.05)***
		2 2004 till now (Mature)	35	1.08(.28)***
12	Customer Heterogeneity	1 considered	23	-.63(.29)*
		0 otherwise	335	
13	Product Heterogeneity	1 considered	53	-.54(.10)***
		0 otherwise	305	

Number	Determinant	Level	Mean(SD) /Frequency	Hierarchical Linear Model Estimate
14	Sample Size	Continuous (# of observations)	3324(8942)	-.01(.03)
15	Country	1 US (US, Canada)	326	.88(.27)**
		0 Otherwise. Europe (UK, France, Germany, Italy, etc.) or Asia (China, Singapore)	30	
16	Manuscript Status	1 Published Academic Paper	291	-.23(.09)**
		0 Unpublished Paper	67	
17	Price Comparison Site	1 Data from price-comparison website	236	.24(.08)**
		0 otherwise	121	

*** < 01

** < .05

* <.1

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ESSAY III

HOW CUSTOMERS MANAGE PURCHASE WHEN THEY LOSE OR GAIN? EFFECTS OF PRICE SURCHARGES AND SAVINGS ON EXPENDITURES

Digitization allows firms to set product prices with more flexibility and apply a multi-dimensional price strategy (e.g., shipping costs shown separately in partitioned prices, price discounts and savings in promotions). It also allows consumers to learn different components of price offers and helps them make purchase decisions. Although previous research works have examined the effects of shipping and handling fees (as a form of price partitioning) on consumer's expenditures and shopping pattern (e.g., Xia and Monroe 2004, Lewis, Singh and Fay 2006), and some studies investigate how price based promotion strategies influence customers' decisions (e.g., Lam, Vandenbosch, Hulland and Pearce 2001), little work has empirically applied price surcharges and discounts from the real-business panel data jointly to investigate purchase decisions or has associated them with gains and losses judgments (Inman, Dyer and Jia 1997, Russell and Carroll 1999).

To fill this gap, we employ a Gain-and-Loss Utility model incorporating different levels of price gains and losses presented to customers in the transactions to model online purchase behaviors in a strategic pricing framework. The current study incorporates both positive and negative price differences between product prices (how much customers spend on products, without considering any type of surcharges or discounts) and basket prices (how much customers pay at the end of transaction) simultaneously to capture the effects of the price gaps, either price surcharges or price savings. Using a hierarchical piecewise linear model, we find significant asymmetry in the effects of price surcharges

and price discounts on purchase quantity as well as on how customers organize their shopping baskets. We conclude that when customers lose by paying extra surcharge, it will not hurt the purchase but will encourage customers to buy more, select products with more variations in both prices and categories in the basket.

1. Introduction

Pricing is one of the most difficult decisions for retailers. Prices vary in different situations due to the variances in demand, competition, seasonality, costs of operations, and so forth (Grewal, Levy 2007). Retailers increase adoption of mixed pricing strategy and provide proliferation of differentiated online services, as well as frequent markups/markdowns. Consumers also encounter product prices presented in different forms and structures. Sometimes, there is a large base price and a small surcharge (e,g., a $238.64 base price for a Fuji 3.2MP digital camera and a $7.94 shipping and handling fee, at Walmart.com), or a small base price with a large surcharge (e.g., a $4.99 Hello Kitty Hand Fan and a $12.41 shipping fee, at Amazon.com). Sometimes, customers encounter a bundled price with some amount of price discount. For example, a $178.94 Canon PowerShot A75 3.2MP digital camera bundled with a $5.95 camera case at Ebay.com. The e-tailer offers a $150 saving and charges eventually $34.89 in the basket when customers check out. How would buyers respond to these price offers and presentations?

Digitization allows firms to set product prices with more flexibility and apply multi-dimensional price strategy (e.g., shipping costs showed separately in partitioned prices, price discount and savings after promotions). It also allows consumers to learn different

components of price offers with extensive online search efforts and helps them make better purchase decisions. Such search efforts are limited since customers need to balance the money they save from the searching with the potential search costs in time and search efforts (Ratchford 2009).

Although previous research works have examined the effects of shipping and handling fees on consumer's expenditures (e.g., Lewis 2006, Lewis, Singh and Fay 2006, Koukova, Srivastava and Steul-Fischer 2012) or price partitioning (e.g., Morwitz, Greenleaf and Johnson 1998, Xia and Monroe 2004, Burman and Biswas 2007), and some studies investigate how price based promotion strategies influence customers' decisions (e.g., Lam, Vandenbosch, Hulland and Pearce 2001), little work has empirically applied price surcharges and discounts from the real-business panel data jointly to investigate purchase decisions and patterns or has associated them with gains and losses judgments (Inman, Dyer and Jia 1997, Russell and Carroll 1999).

To fill this gap, we employ a Gain-and-Loss Utility model incorporating different levels of price gains and losses presented to customers in the transactions to model online purchase behaviors in a strategic pricing framework. The current study incorporates both positive and negative price differences between product prices (how much customers spend on products, without considering any type of surcharges or discounts) and basket prices (how much customers pay at the end of transaction) simultaneously to capture the effects of the gaps, either price surcharges or price savings. In addition, types of retailers, contexts of purchasing and transaction, and the demographic characteristics of customers are considered in the model. Using a hierarchical piecewise linear model, we find significant asymmetries in the effects of price surcharges and price discounts on purchase

quantity as well as how customers organize their shopping basket. We conclude that when customers lose by paying extra surcharge, it will not hurt the purchase but will encourage customers to buy more, and select products with more variations in both prices and categories in the basket.

In the following elaboration, we begin by discussing the concept and framework of Multi-dimensional prices with both price partitioning and price promotion, as well as the literature reviews on Shipping & Handling fees and the price dispersion. Then, we use a Gain-and-Loss Utility Model to explain factors that influence consumers' purchasing behaviors. Finally, we discuss the results and implications from the study.

2. Literature Review

Multi-dimensional prices

According to Bolton and Shankar (2003), prior research has focused exclusively on a single dimension - price variation (i.e., ELDP vs. Hi-Lo pricing) - implying a single pricing continuum. By examining a broader set of measures, this study shows that the retailer pricing strategy reflects a richer set of dimensions that underlie retail pricing/promotion decisions - including relative price, deal intensity, and deal support. Each of these dimensions is continuous, and can be combined with any level of another dimension. Depending on the combination of the levels of these dimensions, retailers can utilize diverse pricing strategies at the brand-store level - i.e., an undifferentiated strategy such as Moderately Promotional pricing, niche strategies such as Exclusive or Aggressive pricing, or mass-customized strategies such as Hi-Lo and EDLP pricing.

Conceptually, Kim and Kachersky (2006) propose that the attention paid to a component of a multi-dimensional price, such as a surcharge, is affected by that component's salience relative to other price components. They proposed that semantic factors, such as describing the surcharge using particular language, for example "tax," "fee," "additional charges", will influence a price component's relative salience. Computational factors, where the salience of the price component decreases as it becomes more complex to calculate total cost (both calculation for a percentage surcharge and a dollar surcharge) is also discussed. In addition, the surcharge's magnitude relative to the base price is considered as another important factor. These studies provide us conceptual foundations for the current study and the possible empirical evidence we can explore.

Price Partitioning

An important pricing decision that many firms face is whether to use a partitioned price, which divides a product's price into two or more parts, or to charge one all-inclusive price. Several research studies have examined the trends of applying partitioned pricing strategy in the marketplace. Results show that the widespread use of partitioned pricing by marketers may be the result of perceptions that it enhances the perceived value of the offer.

First, such partitioned prices are ubiquitous in catalogs (Morwitz, Greenleaf, and Johnson 1998) and on the Internet (Xia and Monroe 2004), because products have to be delivered to the buyer, and the price of this type of transportation service is added as a surcharge to the purchase price.

Second, the presentations of the price partitioning matter. The study by Morwitz et al.'s (1998) investigate how consumers process surcharges presented as a dollar amount (e.g., $5.00) or as a percentage of the base price (e.g., 10% of $50.00). The latter presentation, being more effortful to process, influences purchase likelihood less than the former. The authors speculate that surcharges affect purchase less than the base price because buyers fail to process the surcharge, or anchor on the base price and adjust insufficiently for the surcharge. Therefore, sellers who divide the total price into a base price and a surcharge could prosper when buyers ignore the surcharge.

However, recent research suggests that consumers may pay more attention to surcharges than was previously thought. Chakravarti et al. (2002) experimentally study the effects of partitioned prices within a bundle of products that is offered to buyers as a whole (e.g., a refrigerator, an ice maker, and a warranty). In this setting, buyers considering a surcharge for the warranty tend more to product reliability, while those considering a surcharge for the ice maker tend more to the benefits of the ice maker. Thus, buyers pay more attention to the surcharge (and its implications) than to the base price. Consistent with this conclusion, Smith and Brynjolfsson (2001) find the magnitude of the effect of surcharges (e.g., shipping costs, taxes) on clickthrough rates to be twice that of the base price. This analysis uses customer clickstream data from a book retailing website. The authors label higher sensitivity to surcharges "puzzling" and call for confirmatory studies of consumer sensitivity to partitioned prices.

Burman and Biswas (2007) identifies boundary conditions for the effectiveness of partitioned pricing by examining the role of the reasonableness of a surcharge and the individual characteristics such as the need for cognition (NFC, "the tendency of

individuals to engage in and enjoy thinking") in consumers' processing of pricing information. They find that for high need-for-cognition consumers, partitioned pricing has a more favorable effect than combined pricing when the surcharges are reasonable (effects reverse for unreasonable surcharges). No differences for low need-for-cognition consumers.

Morwitz, Greenleaf, Shalev, and Johnson (2009) review these findings on partitioned pricing and propose the psychological explanations for why partitioned pricing affect consumers. They explain that in some cases, partitioned price does not affect demand or reduce it and they propose factors including consumers' attitude toward the firm, search behavior, and the attention or importance consumers give to different product components and attributes.

Types of surcharges

What the surcharge is for is also a key driver of purchase decisions. Taxes, Shipping & Handling services, and gift certificates or wrapping services are common types of surcharges (Morwitz, Greenleaf, Shalev, and Johnson 2009). Researchers have examined surcharges for taxes (e.g., Ott and Andrus 2000), and shipping & handling fee (e.g., Dinlersoz and Li 2006, Burman and Biswas 2007, Bolton, Grewal and Levy 2007, Sheng, Bao and Pan 2007, etc.).

Tax. Usually, tax includes national and regional taxes, product-based taxes, customer-based (e.g. wholesale) taxes and firms can set Include/Exclude tax on products in the online channel. Ott and Andrus (2000) examined how consumers react to personal property taxes on vehicles (VPPT). Some states impose these taxes on real property such

as automobiles and real estate. VPPTs are typically assessed annually, based on a vehicle's fair market value, and paid when registering the vehicle. Authors test the hypothesis that consumers will not consider VPPT when making vehicle purchase decisions by analyzing survey data from over 200 consumers in states in the condition of either high or low VPPTs. The results show that although consumers, especially those in high VPPT states, consider that the VPPT is too high, its magnitude has little impact on their vehicle purchase decisions. Neither consumers in high or low VPPT situation state that VPPT is important in their purchasing decision. The authors conclude that "consumers are not including VPPT in their total vehicle purchase price," and speculate that this occurs because consumers view VPPT to be a "customary expense."

Shipping and Handling Services. The growth of the e-commerce has highlighted the importance of shipping fees, as one type of price surcharges. Lewis (2006) considers shipping fees as a spatial separation between customers and retailers in the business models. This physical separation creates order assembly and transportation costs that are not available in traditional offline markets.

Managing customers' perceptions of the service value proposition is considered as one of the key service strategies in an editorial by Bolton, Grewal and Levy (2007). Grewal and Levy (2007) propose that the role of self-service technology and Websites in shaping every aspect of the consumer decision process, from need recognition to post-purchase. Burman and Biswas (2007) consider customers' perceived reasonableness of shipping and handling surcharge as: 1) percentage of base price, 2) function of weight/size, 3) function of delivery time.

Some researchers investigate multiple types of surcharge in one study. For example, Xia and Monroe (2004) examine how consumers' self-reported sensitivity to shipping and handling charges, and to sales tax, influenced their purchase intentions. They examine a combined price condition and two conditions where the surcharge for a desktop computer was either for shipping or tax. While the authors do not find a main effect for type of surcharge, they do find that participants' shipping and handling sensitivity influence their purchase intentions, but their sales tax sensitivity does not. They propose that since taxes are controlled by government, and retailers cannot control and do not profit from them, they do not prevent consumers from purchasing.

Measure and Magnitude of Surcharge

From previous discussions, we so far conclude that shipping and handling fees prove to influence purchase mainly instead of taxes since the latter is found to be not affective on purchasing (Ott and Andrus 2000, Xia and Monroe 2004). By investigating how the magnitude of the surcharge, especially shipping and handling fee and its effect on consumers' purchase behaviors, several researchers have reached to further understanding of price surcharges.

For instance, Xia and Monroe (2004) take the interaction of the surcharge's magnitude with its format into consideration. The surcharge was measured by both absolute (dollar) and relative value (percent). Authors find the purchase intention is higher in all partitioned prices than the combined all-inclusive price, while the highest is the situation when surcharge magnitude is low and presented as a percentage.

Similarly, when Sheng, Bao and Pan (2007) examine the perceived fairness of the surcharge, they investigate the impacts of both absolute and relative measures of surcharge on customers' purchase decision. In one study, they set the context in buying a CD player with base price $49.95, three levels of absolute shipping and handling fee, which are low ($5), moderate ($15) and high ($25). In the other study, authors set constant $9 surcharge for both low base price ($7.9 digital watch) and high base price ($49.90 digital watch), resulting 114% and 18% of the base price as the surcharges. In both studies, respondents are asked to show their purchase intentions and the relative surcharge measures indicate significantly lower intention.

Price Discount and Promotions

There are various price discounts and promotion in the marketplace, such as Trackable coupon codes (obtained online and offline), Time-limited promotional campaigns, Multi-tiered pricing with bulk discount with quantity purchase, Discount prices for a certain customer groups (e.g., subscribed members), Rule-based promotions like buy 2, get 1 free.

The benefit of sales promotions is that they induce choice and purchase. However, DelVecchio, Henard, and Freling (2006) argue that this benefit may be offset by undermining preference for the brand when it is no longer promoted. Authors examine the effects of sales promotions on brand preference by integrating results from 51 studies on the subject. Their meta-analysis suggests that, on average, sales promotions do not affect post-promotion brand preference. However, depending upon characteristic of the sales promotion and the promoted product, promotions can either increase or decrease

preference for a brand. Kim and Kramer (2006) propose that final purchase prices following discounts are sometimes explicitly stated, requiring little or no cognitive effort from consumers to arrive at the net final purchase price. Often, however, firms state the regular price and the discount separately, either in absolute or relative terms. Processing both absolute discounts requires more cognitive effort to calculate final prices. In particular, to arrive at the final purchase price, consumers need to do subtractive arithmetic operations following absolute discounts and sub-multiplicative arithmetic operations following relative discounts (Estelami, 2003). Estelami demonstrates that subtractive operations require less cognitive effort than sub-multiplicative ones. Furthermore, consumers make more accurate choices in the former than the latter case, suggesting that accurate processing of discount information is a key to the effectiveness of price discounts.

Joint effects of Surcharge and Discount: Loss and Gain

Previous studies have reported that partitioned (vs. consolidated) pricing of bundle components can influence evaluations and choices (Chakravarti, Krish, Paul and Srivastava 2002). Reference price concepts central to the prospect theory value function (Kahneman and Tversky 1979) and mental accounting propositions on segregating gains and integrating losses (Thaler 1985, Thaler and Johnson 1990) have been used to theorize these effects. However, empirical studies have often observed conflicting results and the findings suggest that consumers code the presented prices and benefits quite flexibly and often edit the frames that are presented (Thaler and Johnson 1990). Moreover, the effort and accuracy characteristics of the judgmental heuristic used (e.g., anchoring and adjustment) (Chakravarti, Krish, Paul and Srivastava 2002) may influence decision

outcomes (Morwitz, Greenleaf and Johnson 1998). There, a more complex setting of both price surcharges and discounts representing gains and losses would capture the price judgments of customers, and how they evaluate and choose among partitioned or consolidated presentations of alternative bundles. Asymmetry of gains and losses are also expected to be captured.

Shipping & Handling Fee and Price Dispersion

Previous researches mostly focus on the basket order size as the result of price strategies. Less work has done on examining the effects of price formats with both surcharges and discounts on the variations of product item prices, described by price dispersion. Prices with and without shipping and handling costs across online and offline types of retailers might result in various price dispersions based on full prices and this is also managerially important. Previous empirical analyses have examined prices both with and without adjustments for retailer services. It is possible that E-tailers offer more of the service if it could obtain a large enough price increase to cover its cost. Therefore service differentiation is considered as one reason for price dispersion.

Empirical studies define a set of measures for E-tailer services and examine effects of those components on price dispersions, such as ease of ordering, product selection, online delivery, tracking, shipping and handling (Pan, Ratchford , Shankar 2002), E-tailer website's reliability, shopping convenience, and certification (Ratchford, Pan, and Shankar 2003). They find that the proportion of online price dispersion for both pure-play E-tailers and bricks-and-clicks does can be explained by the E-tailer characteristic (service quality); however the effect is small. Baylis, Perloff (2002) take E-tailers'

rankings into account and find high priced stores remained high-priced with superior service and low-priced ones remained low priced with poor service. They examine whether firms charge a higher price to consumers who desire services or to those who are ignorant. Their service premium model gets empirical evidence from digital camera and scanner market.

Empirical studies on Shipping and Handling strategy

In additional to conducting experiments on Shipping and Handling strategy to evaluate consumers reactions (e.g., Xia and Monroe 2004, Schindler, Morrin and Bechwati 2005, Bertini and Wathieu 2008, etc.), several researchers investigate the marketplace by empirical studies involving surcharge such as shipping & handling fee, and taxes (e.g., Dinlersoz, Li 2006, Lewis 2006, Lewis, Singh and Fay 2006, Yao and Zhang 2012).

Dinlersoz and Li (2006) conduct both theoretical and empirical analysis, in the context of online book industry. Considering the use of shipping policies to create or enhance differentiation for homogeneous products, authors propose a plausible scenario for Internet retail markets, that firms choose different levels of quality, as measured by average delivery time, by serving different consumer segments with different level of sensitivities for delay. They argue that theoretically, as base price increases, keeping service quality constant, the surcharge of shipping and handling fee would decrease, since firms must compensate their customers by offering lower surcharges. From the empirical data, they observe the opposite result, that low base-price sellers offer higher shipping quality in the form of lower average delivery time, and they tend to charge low shipping fee, controlling for shipping quality and other seller characteristics. When observing

positive relationship between base price and shipping fees, Dinlersoz, Li (2006) propose two reasons. The first reason is the imperfect consumer information. Second, the navigation and purchase process designed by website. Consumers do not learn about shipping options until they complete the purchase selection and account settings. They think such strategies aim at price sensitivity of consumers by hiding or delaying valuable but important information during shipping sessions, or to fight against the increased price transparency in the online channel. Overall speaking, extra search costs are considered as one of the main reason why large price dispersions widely exist in the digital marketplace (Bay and Morgan 2001, Baye, Morgan and Scholten 2004, Ellison and Ellison 2009).

Lewis (2006) empirically studies the effects of shipping fees and marketing activities on customer acquisition, customer retention, and average expenditures using data from an online grocery store. Using a three-stage squares (3SLS) empirical model, the author finds that shipping fee greatly affects order incidence rates and the graduated shipping fee significantly affects average expenditures. The analysis indicates that customer acquisition is more sensitive to order size incentives while retention is more influenced by base shipping fee levels. Furthermore, a profitability analysis suggests that shipping policies that provide incentives for larger order sizes may outperform free shipping promotions and standard increasing fees structures.

Yao and Zhang (2012) find that Internet retailers will increase base prices when they offer free shipping. Similarly, Lewis, Singh and Fay (2006) conduct an empirical study of the impact of nonlinear shipping and handling fees on purchase incidence and expenditure decisions, such as order size, using a database from an online retailer which has greatly experienced a wide variety of shipping fee schedules. Results show that consumers are

very sensitive to shipping charges and that shipping fees influence average basket size, especially free shipping for orders that exceed some size threshold. Furthermore, they conclude that the lost revenues from shipping and the lack of response of several segments are significantly large and thus render such promotions unprofitable to the retailer.

3. Theoretical Framework and Hypothesis

In summary, we have reviewed literatures on shipping and handling fees as price surcharges, on price dispersion, and multi-dimensional prices. However, there is a lack of empirical study on consumers' behavioral responses (e.g., purchase quantity or item variation in the basket) to both price surcharge and discount, based on the panel data from market. We expect to discover the joint effects of surcharge pricing and discount pricing strategies across different online retailers and different transactional and demographic background.

To contribute to further understanding in the current topic, we associate price surcharge with "Loss" and price discount with "Gain" and show that price surcharges and price discounts in an online purchase session have significant effects on consumers' purchase behaviors. We expect to find the asymmetry in the effects of "Gain" and "Loss". In this way, we introduce a new way of looking at multi-dimensional prices that combines the literature on price partitioning, loss and gain in prospect theory, as well as works in numerical representations of prices. We contribute to this topic by jointly examining the effects of Loss and Gain on consumers' purchase decisions, which include total basket size and expenditure, as well as how purchased items disperse across product category

and base price levels. The following are hypotheses we establish from discussions upon previous theoretical and empirical works for our study.

As Kopalle et al. (2009) have stated, from consumers' perspective, sensitivity to the surcharge such as shipping fee varies across purchase scenarios. For instance, Lewis, Singh, and Fay (2006) find consumers are very sensitive to shipping charges and the surcharge affect order incidence and basket size. Promotions such as free shipping for orders that exceed some size threshold are found to be very effective in generating additional sales. However, the lost revenues from shipping and the lack of response by several segments are substantial enough to render such promotions unprofitable to the retailer.

Shipping fees can also impact order size by providing incentives or penalties for different order quantities. For example, a common practice is to waive shipping fees for orders that reach some dollar amount threshold. These policies can induce larger orders by creating circumstances where the marginal cost of an incremental item to a basket can be low or negative. Another common practice is graduated fee schedules that discontinuously increase fees as order size increases. These schedules can lead to reduced order quantities by penalizing larger baskets

When explaining effects of shipping fees on order size, Lewis (2006) states that, by imposing extra fees for shipping based on order size thresholds, shipping fees can change the marginal price of incremental units of merchandise. Furthermore, while non-linear pricing plays as a common practice and has been extensively studied, their study emphasizes the implication that, shipping fee schedules which provides penalties (or

benefits) for larger order will cause consumers to shift from smaller (larger) order sizes. The study empirically shows that shipping fee greatly affects order incidence rates and graduated shipping fee significantly affects average expenditures.

In addition, a study by Manning and Sprott (2007) finds that the effect of multiple unit price promotion on purchase intentions is moderated by consumption volume (positive effect for high and no effect for low). The firm would offer a discount for quantity purchase, where consumers buy a large quantity of goods at one time in an online purchase session.

> *H_1. Purchase Decisions of Basket size.* We propose that both price surcharge and price discount simultaneously affect purchase decisions in basket size. Due to the differences in the nature of measures of basket size, effects will be different among Basket Price (total product expenditure), Product Total Price (order size), and Purchase Quantity. In addition, effects of price surcharge and price discount will be asymmetric.

As we've stated, Shipping and handling fee is one important characteristic that a traditional retailer does not have as a form of price partitioning. Some studies get consistent price presentations by examining the prices including or excluding shipping fee. For example, Ancarani, Jacob and Jallat (2009) find higher degree of online price dispersion than offline, with or without shipping costs. Similarly, Baye, Morgan, Scholten (2004a) find that after controlling for shipping costs and firm heterogeneities, the prices do not converge, although the average range in prices falls when the number of competing firms decreases. To further evaluate its effect, some studies focus on shipping

and handling fee as representative of retailer service quality and take it into account to compare price dispersion with and without it. Ancarani and Shankar (2004) find the absolute price dispersion (range) from Internet retailer to be higher than the traditional retailer, while it becomes lower after accounting for shipping fees in two formats (single shipping fee, and shipping fee divided among 3 items).

> *H_2. Purchase Decisions of Basket composition.* Following Ancarani and Shankar (2004), we consider shipping and handling fee as the representative of channel service provided, and propose that including or not including it in product prices will have an effect on the magnitude of price dispersion, which measures the composition of customer basket items. We hypothesize that the surcharge of shipping and handling fee will increase the tendency of price dispersion in the basket than price discount situations.

Free shipping or other type of surcharge online is considered as an effective incentive for consumers to buy products without paying extra fees, while saving transportation charges to the physical store. When retailers charge nothing by subsidizing the shipping cost, they might share some of the costs with customers by charging higher base price. Many well-known e-tailers have been practicing a free-shipping policy with a minimum order amount (such as Amazon.com, BN.com, Macys.com), while there is a trend of free-shipping policy for any order without any threshold value (e.g., Nordstrom.com, NeimanMarcus.com) or for a limited group of buyers (e,g, Prime membership subscribers in Amazon.com). When firms subsidize this cost by themselves, consumers would consider free shipping as gaining some benefits, if they consider transportation service as a separate charge, and they save this amount of fees in this situation.

If consumers take service fees as part of the product costs for online channel, since compared with physical stores, e-tailers have saved cost of physical stores, sales force labor fees, and so on. In this situation, buyers might think free shipping or any type of surcharges as no gain, no loss. Given this option, customers tend to purchase more and do not consider how to save the transportation fees. This would probably encourage them to mix different products in a basket or purchase more frequently without considering maximizing the purchase quantity.

Therefore, the relevance of shipping fees is also highlighted by the frequent use of "free shipping" and other shipping related promotions. However, reports are mixed regarding the profitability of shipping promotions (Lewis, Singh and Fay 2006). Authors state that the shipping-free schedule design is a relatively complex task that requires balancing the desire to recover shipping costs with the need to attract and retain a substantial customer base. In their empirical study, authors use a database from an online grocer that includes transaction histories for individual customers and information on marketing activity related to pricing and promotions. They find shipping fee surcharge significantly affect both order-incidence rates and expenditure levels, and the customers are more responsive to shipping fees than to merchandise prices.

> *H_3. Free-shipping, No discount.* In the No Loss, No gain situation, companys do not charge the transportation costs on customers. Consumers tend to maximize the utility of marketing mix and will buy more items, with larger basket size. However, more items in the basket tend to decrease price dispersion among purchased items.

In the digital world, because competition can meet price offers so easily, any price advantage can quickly evaporate, and margins can deteriorate into a price war. However, retailers such as Wal-Mart, Amazon and others successfully have developed low price strategies (Grewal, Levy 2007), while taking a tactical perspective to pricing, by using practices such as reasonable surcharge and temporary price reductions.

Lewis (2006) also emphasizes on the relative or percentage impact of shipping fees on consumer expenditures. In contract to the notion that consumers optimize by minimizing the percentage impact, there is research that suggests consumers often behave sub-optimally in this type of situation. Specifically, Capon and Kuhn (1982) has proved that consumers have difficulty with proportionality calculations, especially when they are dealing with nonlinear pricing schedules (Nunes 2000). We expect to find moderate impact of relative shipping fee to the base total expenditures on order amount and purchase quantity.

A special case is when the firms seek different margins on specific items that exploit these differences among consumers, where loss-leader promotion might be an example (Kopalle et al. 2009). Loss leaders are products temporarily priced at or below retailer cost. Selling such deeply discounted items can be effective because the losses are made up on the sale of complementary items to current customers or because they bring incremental traffic to the website or the store. When it is in the context of online channel, firms set a significantly higher S&H fee on the deeply discounted product price, leading relative percentage of surcharge to the base price extremely large.

For example, Amazon.com reduced the product price at very low level (e.g., a 1$ Italy-design Moleskine Notebook) while setting the surcharge at $9.0 which is 9 times of the base price. Customers would accept the unreasonable surcharge since they observe a deep discount and combined price ($10) is acceptable, compared with $12.5 base price with free-shipping in a another retailer's website.

> *H_4. Absolute vs. Relative Measures of Surcharge and Discount.* Two types of measures will result in different effects on purchase decisions. Without considering special cases such as loss-leader promotion tactic, relative measure would provide more helpful information to customers, resulting significant effects on purchase decisions.

The pricing task differs for fashion (e.g., brand apparel) and staple goods (perishables and packaged, e.g., food, home supplies). Ideally, fashion merchandise holds zero inventory at the end of a fashion season. To accomplish this objective, retailers use markdowns and promotions to stimulate demand. But the size and timing of markdowns is critical—too small a markdown too late in the season, and the retailer has leftover merchandise; too high a markdown too early in the season, and the retailer sacrifices gross margins. For retailers pricing staple goods, the challenge changes, because they do not have to worry about a zero end-of-season inventory position. Instead, they must determine how to employ the frequent extra discounts and deals provided by vendors (Grewal, Levy 2007).

Internet Book and CD retailing is a popular research area in the current studies, due to the ease of data access and product homogeneity. Several studies (e.g., Dinlersoz, Li 2006) have examined the shipping strategies from the evidence from this industry. In addition,

previous studies cover a single product category (e.g., perishable grocery and drugstore items in Lewis, Singh and Fay, 2006; Lewis 2006; digital cameras and video games in Yao and Zhang 2012).

> *H_5. Product Category.* Different Product category will have different base prices and purchase quantity, as well as price dispersions, which would moderate the effects of price surcharge and discount on decisions. For example, Fast-moving consumer goods have the smaller basket size and price dispersion with larger order size, and electronic/Computer have larger basket size and price dispersion, but smaller order size, while the service product has a moderate level of purchase results.

While consumers' heightened perceived risks in online markets and their aversions to dealing with unknown sellers have resulted in the dominance of well-known sellers, there are potentially other factors behind this phenomenon (Biswas and Biswas 2004).

As (Kopalle et al. 2009) mention, empirical evidence on price elasticity in online markets shows that online markets are far from being perfectly competitive, and different firms are adopting various pricing strategies. For example, Chevalier and Goolsbee (2003) find that the online price elasticity of demand for books is about -3.5 for BarnesandNoble.com and -.45 for Amazon.com. The result for Amazon implies negative marginal revenue, indicating that Amazon prices are below the short-run profit-maximization level, with a penetration pricing strategy. Besides, Singh, Hansen and Blattberg (2006) conduct analysis on market entry and consumer behavior from Wal-Mart Supercenter.

With the emergence of Internet as a significant channel, more traditional brick-and-mortar retailers go beyond their traditional channel and establish an on-line branch channel. Therefore, types of channel examined in the current study include 1) multichannel with both online and offline branches, 2) physical store which is called bricks-and-clicks retailer, and 3) the pure play E-tailer.

One question is that whether multichannel retailers with both online and offline channels charge price differently from pure-play E-tailers with a single online channel, and whether the type of transaction channel is the reason for the price dispersion. By comparing basket price and price dispersion among retailers with multichannel and single Internet channel, we could examine a strong empirical confirmation or disconfirmation for the frictionless commerce and price convergence hypothesis; this would signal that it might be possible to design and implement consumer value-based pricing strategy by different types of retailers (Ancarani and Shankar, 2004). Multichannel retailers combine online and offline channels, with prices likely reflecting the variability in prices of all the retailers in both channels, and therefore will likely have greater basket price and price dispersions than other types of retailers (Ancarani and Shankar, 2004). If the brick-and-click channel has a wide geographic scope, those retailers can provide value added services such as the ability to order products online and pick up or return offline, or return by mail at no charge. This kind of offer helps customers save time and provides ease of using the online channel to check product attributes and reviews without going to the store. For pure-play E-tailers, a lower price dispersion is predicted to be lower due to the lower inventory costs of the single distribution (Venkatesan, Mehta, Bapna 2007).

H_6. Retailer differences. Pure-play E-tailers and Retailers with multichannel differ in the cost strategy and pricing strategy. Different types of retailer will have different base prices and purchase quantity, as well as price dispersions, which would moderate the effects of price surcharge and discount on decisions. For example, retailers without physical store have smaller basket size and price dispersion with larger order size, and retailers with physical store have larger basket size and price dispersion, but smaller order size.

4. Empirical Study and Results

Data and Observed Expenditure Pattern

Our data is from a random sample of multiple major online retailers, with detailed transaction information within one year in the United States. Since it is from online channel of brick-and-mortar retailer or pure-play e-tailer, there is no geographic limit to the purchase. All transactions made are from the websites and recorded in the website server of each retailer.

When a consumer makes transaction online, she/he could complete the whole session, which starts when the customer enters the website, and ends when the consumer completes the transaction and closes the web page. The whole transaction process is called “purchase session” in the digital marketplace. The data in our current empirical study includes 18715 unique purchase sessions, and covers totally 43556 different items purchased by 7696 unique customers (identified by household machine ID), from 8 well-known online retailers (Amazon, Ebay, Walmart, Yahoo, BN, Office Depot, GAP and

VS). The time of the observed transaction is one year long, starting on January 1 to December 31.

A sample of the original data is shown in ***Table 1***.

----------Insert Table 1 about here----------

For each purchase session, the data records details about customers' each expenditure, including retailer domain name, customer machine ID, duration time (by minutes), pages viewed in the session, purchase date and time, names and categories of each items purchased in the session, purchase quantity of each item, price of each item, and total basket price (how much consumers pay at the end of session).

To empirically study the effects of price surcharges and discounts on purchase decision, we also develop a few variables based on the original data shown in ***Table 1***. The new variables we have developed include Product total price, Gap between total basket price and total product price, Total number of items purchased, Average expenditure per item (Unit price), Total number of unique items purchased, Prices of all items in one purchase and its price variation, Mode of category distribution (the most commonly purchased category in one session) and Total number of unique categories purchased.

Given original transaction data and the variables we develop from the sample, we have determined the main variables used in our empirical study. Main price information related variable are described in ***Table 2***.

----------Insert Table 2 about here----------

In addition to price related purchase decision variables, our data has captured purchase situational information and consumer's demographic information, such as session duration, consumer's education level, and so on. These are considered as covariate variables in the current study, and detailed descriptions are shown in ***Table 3*** and ***Table 4***. Most demographic variables are recoded into dichotomous variables, including Household size (dummy 1: larger household size; dummy 0: smaller household size), Education level (dummy 1: higher level; dummy 0: lower level), Family Oldest Age (dummy 1: older; dummy 0: younger), Household income (dummy 1: higher income; dummy 0: lower income).

----------Insert Table 3 about here----------

----------Insert Table 4 about here----------

The summary statistics of main variables is described by ***Table 5***. Of all 18715 purchase sessions, we find significant gap between total purchased product price and basket price, resulting three possible situations. First, if the total product price is equal to basket price, consumers do not pay extra money or gain any discount upon the product price for the items they've purchased. With zero gaps between basket price and total product price, what customers pay finally is exactly the same amount of money of what they buy. We consider it as "No Gain No Loss" situation. In our data, we have 4408 sessions with zero gaps. Second, if the total product price is smaller than basket price, consumers pay extra money beyond the product price. There at 13100 purchase sessions with the negative gaps GAP^- (M=11.56, SD = 34.88), meaning a certain amount of surcharge consumers have paid in this purchase situation, and they "Loss". Third, we find 1207 purchase sessions with positive gaps GAP^+ (M=-20.55, SD = 30.30) between total product price

and the basket price, meaning that consumers gain some discounts and savings at the checkout point in their basket. In this "Gain" situation, what buyers pay finally is less than the sum of product item prices.

----------Insert Table 5 about here----------

In addition, given positive and negative gap value, we have obtained relative positive gap (M=0.39, SD = 0.38) and negative gap (M=-2.74, SD = 29.31) to the total product price. By looking at the mean value, we could confirm that average relative GAP^+ is smaller than 1, representing price discounts and savings could not exceed the total product price, while average relative GAP^- is -2.74, meaning that the price surcharges could be even higher than the product price itself.

Further, from our data summary statistics results, we observe that 18715 unique purchase sessions made by 7696 unique customers on these 8 websites from January 1 to December 31 result in average expenditure $57.58 (Basket Size M=2.53, SD=4.32), with 3 items purchased on average from 2 unique categories (Number of Unique Category M=1.21, SD=0.54). On average, consumers have browsed in the website for about 33 minutes (M = 32.45, SD = 31.40) and have viewed about 44 web pages (M=44.19, SD=49.48).

Considering price surcharges as losses and price discounts as gains in our study, how to measure gains and losses is an important step. We use both categorical measures and quantitative measures to explicitly examine their effects on purchase decisions. When there is any discount, promotion, benefit and so on in the purchase session, we call it "Gain" situation, with positive gap between Product Total Price and Basket Price. If the

positive gap value is higher than its average level, we categorize the situation into “High Gain” case, and if the positive gap value is lower than its average level, we categorize the situation into “Low Gain” case. Continuous value of the positive gap (GAP^{+}) is used as the quantitative measure. Similarly, when there is any surcharge fees such as Tax, shipping and handling fee charged in the purchase session, we call it “Loss”, with negative gap between Product Total Price and Basket Price. If the negative gap value is lower than its average level, we categorize the situation into “High Loss” case, and if the negative gap value is higher than its average level, we categorize the situation into “Low Loss” case. Continuous value of the negative gap (GAP-) is used as the quantitative measure. See ***Table 6***. The distribution of four Gain and Loss categories is shown in ***Table 7***.

----------Insert Table 6 about here----------

----------Insert Table 7 about here----------

The distribution of purchase sessions across eight websites is described by ***Table 8***. We observe that Amazon purchase sessions take up 65.44% of sample data with 12248 out of 18715 purchase sessions. The average total basket price is the highest for Office Depot, with the average $135.66 total dollar amount. Ebay carries wide range of products, resulting in the lowest average total basket price (M=16.77) and lowest average expenditure per item (M=8.52). The average GAP is as high as $10 for Walmart and $12 for VictoriasSecret website, indicating that these two retailers charge a significant amount of shipping and handling fee, even after considering possible price promotions and price discounts simultaneously.

----------Insert Table 8 about here----------

In the original data, each transaction is categorized into a sub-category of purchase goods, ranging from Apparel, home furniture, Books, music, to consumer electronic product and services such as tickets, photo printing, and so on. There are in total 60 sub-categories and among these categories, Books & Magazines, Movies & Videos, Apparel, Music, Toys and Games are top five most popular sub-categories. For the convenience of analysis, we re-categorized them into six main domains. See ***Table 9*** for details of categorization and relevant summary statistics.

----------Insert Table 9 about here----------

Model and Estimation Results

Dependent measures. Following several empirical studies (e.g., Dinlersoz and Li 2006, Chintagunta, Chu and Cebollada 2012) on price partitioning and transaction cost, we use multiple measures to explain consumers' purchase decisions and shopping pattern, which includes:

1) Total Product Price
2) Number of Unique Items (Purchase Quantity)
3) Unit Price (Average Expenditure per Item)
4) Purchase Item Price Dispersion measure 1: Coefficient of Price Variation
5) Purchase Item Price Dispersion measure 2: Percentage of Price Difference
6) Purchase Category Dispersion: Number of Unique Product Category

See ***Table 2*** for detailed explanation of these six variables. Each of these six measures of purchase decision can imply some information about customers' purchase behavior and

shopping pattern. Total Product Price[34], Number of Unique Items and Unit Price (Average Expenditure per Item) indicate the size of the order, which will directly affect firms' profitability. Price dispersion is important in explaining customers' search costs, selection of products as well as the perception of price variations in the digital marketplace. More researchers examine formats of price dispersion and its effects on customers' satisfaction, purchase intention, market competition, and so on (e.g., Pan, Ratchford and Shankar 2003, 2007, Baye, Morgan, Scholten 2004). We use two popularly used relative measures of price dispersion to investigate how price surcharge and price discount affect the components in customers' baskets within one purchase session.

Basket Size Of all six dependent measures of purchase decision, three variables indicate information about the basket size, such as how much product price do customers put in their basket explained by Total Product Price, how many unique items do customers put in the basket described by Purchase Quantity, and how much money do they pay for each item, which is the Unit price.

Variations in the Basket Other three dependent measures describe more about how customers organize their basket, when offering a certain amount of extra surcharge or price savings. The coefficient of variation of the price distribution, defined as price standard deviation divided by mean price of the price distribution, and the percentage difference of the highest and lowest price, defined as price range divided by mean price are two popularly used relative measurements of price dispersion (e.g., Baye, Gatti, Kattuman, and Morgan 2002), Pan, Ratchford and Shankar 2002).

[34] When considering surcharges or discounts, the total basket price is highly correlated with the total product price (r = .94). Therefore, we retain total product price as one of the dependent variables.

Previous researches also find differences in absolute and relative measures in describing price variations. Pan, Ratchford and Shankar (2001) find increase in absolute price dispersion (price range and standard deviation) with price level or involvement while relative price dispersion (percentage of price difference and the coefficient of variation of price) declines with price and high involvement products exhibit less relative price dispersion. Baylis, Perloff (2002) find high priced stores remained high priced and superior service, while low-priced remained low priced and poor service.

These measures are not only indicating purchase decision independently, but are also jointly explaining customers' online purchase behavior and are also correlated with each other. For example, if the price surcharge is a proportion of the base price of product, Total Product Price is closely related with Basket Price, which will be (1+proportion) times of Total Product Price. If customer buys more variety of products, which results in larger number of unique items and number of unique product category, as well as the order size. See ***Table 10*** for correlation between these measures in our data.

----------Insert Table 10 about here----------

Following Inman, Dyer and Jia (1997)'s generalized utility model, which incorporates intuitively appealing notions of disappointment and regret jointly, we model consumers' losses and gains on price when they observe the differences between product total price (the total dollar amount of all items they purchase in a session) and basket price (the total expenditure they need to pay in a session). Both positive and negative gaps are captured in the panel data, and thus we apply a simple linear model and a piecewise linear model

to incorporate the effects of losses and gains, operationalized by the positive and negative gaps.

Model1 is a simple Linear Model, with categorical measure of Gain and Loss. We first decompose the outcomes into two to reflect the asymmetric of people's happiness and unhappiness from gains and losses. When the gap is positive, i.e., when the customer pay lower than the total product prices with a certain level of savings, it results in positive emotion such as happiness. When the gap is negative, i.e., when the customer pay extra charge in addition to the total product prices with a certain level of surcharges, it results in negative emotion such as unhappiness.

We then incorporate four dummy variables to describe the nature of the gap (See ***Table 2*** for detailed information). Some customers may not accurately evaluate the magnitude of the gaps, however they make decisions based on their precious shopping experience, knowledge about the product and price, and so on. Then they judge where the surcharge or saving is fair or not fair, which will immediately help them make purchase decisions. Thus, we develop four dummy variables to describe when it is a Gain with larger (High Gain) or smaller benefit (Low Gain), and when it is a Loss with larger (High Loss) or smaller loss (Low loss). These four dummy variables are introduced in Model1, see formula *(1)*.

$$Purchase\ Decision_i = \beta_0 + \beta_{1\text{-}\beta_8} Website_i + \beta_9\, Purchase\ Quantity_i + \beta_{10}\,(Purchase\ Quantity_i)^2 + \beta_{11}\, Unit\ Price_i + \beta_{12}\,(Unit\ Price_i)^2 + \beta_{13}\, High\ Gain_i + \beta_{14}\, Low\ Gain_i + \beta_{15}\, High\ Loss_i + \beta_{16}\, Low\ Loss_i + \beta_{17\text{-}21}\, Product\ Category_i + \beta_{22}\, Seasonality_i + \beta_{23}\, Duration\ Time_i + \beta_{24}\, Pages\ Viewed_i + \beta_{25}\, Education_i + \beta_{26\text{-}28}\, Region_i + \beta_{29}\, Household\ Size_i + \beta_{30}\, Oldest\ Age_i + \beta_{31} Household\ Income_i + \beta_{32}\, Child_i + \beta_{33}\, Connection\ Speed_i + \beta_{34}\, Country\ of\ Origin_i + \varepsilon_i \quad (1)$$

Using subscript i to denote each purchase session observation, the model structure we use to explain the variations in the purchase decisions at individual transaction level. This applies to Model1, Model2 and Model3.

We now report the coefficient estimates (β) from the model 1 for each determinant and covariates in ***Table 11***. In summary, we find 24 (DV1: Total Product Price), 28 (DV2: Purchase Quantity), 22 (DV3: Unit Price) and 26 (DV4: Coefficient of Variation, DV5: Percentage of Difference, DV6: Number of unique Category) out of 34 independent variables including two quadratic terms are statistically significant at least $p<.10$. The overall model fit (R^2) ranges from 15.69% to 79.65% for six dependent variables, indicating that predictors explained about 15.69% to 79.65% of the variation of purchase decisions, covering information such as transaction order size, average unit price and variations of item prices in the basket.

----------Insert Table 11 about here----------

Retailer. We observe that two multi-channel retailers selling products with large variety obtain the largest basket size (Office Depot β_6 = .069, p<.01 and Walmart β_3 = .049, p<.01), while pure-play e-tailer obtains smaller basket size (Ebay β_2 = -.051, p<.01, Amazon β_1 = -.108, p<.01) however Amazon and Walmart have higher average unit price. Customers tend to choose various unique categories at Walmart (β_3 = .239, p<.01,), BarnesandNoble.com (β_5 = .222, p<.01,), as well as Amazon.com (Amazon β_1 = .175, p<.01). Yao and Zhang (2012) also examined the characteristics of retailer and conclude that retailers with physical channel tend to charge less surcharge and the public firms have higher base price settings.

Empirical evidences show contradictory results to the theoretical prediction of price convergence. A few studies find larger price difference for pure-play E-tailers (pure click) than multichannel while some findings point in the opposite direction. Xing, Tang and Tang (2006) find that multichannel retailer has much higher price dispersion measured by price standard deviation than that among pure-play one, however as time elapses, the price dispersion among pure-play becomes larger. Yang, Gan and Tang (2010) studies evolution of toy price dispersion over two periods of time and find price dispersion of multichannel is higher than that of pure-play ones at the beginning and does not change much over time.

Similar results and explanation apply to other three models explained in the following part of the study.

Related Marketing Mix Decisions. When examining effects on a certain purchase decision measure, we also include two other related decision variables and its quadratic terms. For example, when we use Total Product Price as dependent variable, we also include Purchase quantity and Unit price as its predictors, to account for variations in the components of items purchased. Similarly, when we use Purchase quantity as dependent variable, we also include Total Product Price and Unit price as its predictors, and when we predict Unit Price, Total Product Price and Purchase quantity are included. As expected, we find "U-shaped" relationships between Purchase quantity and other two purchase variables, and between Unit Price and other two purchase variables. We also find "inverted U-shaped" relationships between Total Product Price / Number of Unique Category and other two purchase decision related variables. For example, as unit price increases, we first observe an increase in the basket size (measured by Product Total Price

with estimated β_{12} = .861, p<.01), however when unit price continues increasing and reaches a critical point, basket size tends to decrease (Product Total Price with estimated β_{12} = -.069, p<.01). This is consistent with previous empirical studies (e.g., Lewis, Singh and Fay 2006), which examine various segments given different shipping structures and find their effects on basket size and average order size preferences.

In terms of basket variations, we observed "inverted U-shaped" relationships with basket size and number of unique items. For example, as number of unique items increases, we first observe an increase in the price variation (measured by Coefficient of Variation with estimated β_9 = .846, p<.01, Percentage of Difference with estimated β_9 = .923, p<.01), however when purchase quantity continues increasing and reaches a critical point, price variation tends to decrease (Coefficient of Variation with estimated β_{10} = .846, p<.01, Percentage of Difference with estimated β_{10} = .923, p<.01). We could understand it since Coefficient of Variation and Percentage of Difference are two relative measures of price dispersion, which is the percentage of standard deviation and price range out of the average unit price. Therefore, as basket size increases, the variation get larger than the purchase session with single items purchased, indicating zero variation. However, when basket size increases to a critical size, prices are getting closer among purchased items, even though there are more unique items purchases, the price variation will be smaller than the situation with less unique items.

Similar results and explanation apply to other three models explained in the following part of the study.

Gain and Loss Dummy. In Model1, we use four levels of gain and less to predict purchase outcomes and have reached interesting results. The four levels of gain and loss represent a relatively gradual change in customers' fairness evaluations and emotional outcomes on purchases (Campbell 1999, Xia, Monroe and Cox 2004). Consumers will feel very happy when there is High Gain, being happy to see there is Low Gain, a little disappointed seeing Low Loss, and finally very disappointed finding High Loss. Commonly, we expect to see gradual effects on purchase decision from these four situations, however, the result is consistent with our previous hypotheses that, even loss would encourage customers to buy more and even gain will result in smaller purchase size.

From the estimation result, we find that High Gain is positively related with all purchase outcomes, that people who obtained price discount higher than the average level, tend to make more expenditures for their total purchase products (β_{13} = .088, p<.01), tend to buy more items (β_{13}= .059, p<.01), spend on more expensive product with higher unit price (β_{13} = .032, p<.01), with larger price dispersions (Coefficient of Variation β_{13}= .062, p<.01, Percentage of Difference β_{13} = .063, p<.01) and more variations in the category (β_{13} = .054, p<.01). The estimate for the effect on the whole basket including the possible surcharge and discount is positive but not significant (β_{13} = .001, p>.5).

Opposite result occurs when customer face Low Loss situation, where they pay a certain amount of extra surcharge (such as shipping and handling fee, taxes) and the dollar amount of the surcharge is lower than the average level. In this situation, customers loss some money but not too high, which results negative outcomes in all seven purchase

decisions. Specifically, people who pay the surcharge lower than the average level, tend to make less expenditures for their total purchase products (β_{16} = -.159, p<.01), tend to buy less items (β_{16}= -.133, p<.01), spend on less expensive product with lower unit price (β_{16} = -.090, p<.01), with smaller price dispersions (Coefficient of Variation β_{16}= -.063, p<.01, Percentage of Difference β_{16} = -.059, p<.01) and less variations in the category (β_{16} = -.083, p<.01).

More interestingly, in Low Gain situation, customers obtain a price saving but lower than the average saving level, result in less expenditures for their total purchase products (β_{14} = -.016, p<.5), spend on less expensive product with lower unit price (β_{14} = -.028, p<.01), However, they tend to buy more items (β_{14} = .042, p<.01), with larger price dispersions (Coefficient of Variation β_{14}= .070, p<.01, Percentage of Difference β_{14} = .077, p<.01) and more variations in the category (β_{14} = .054, p<.01).

On the contrary to the common sense, High Loss situation with extra surcharge that customers have paid, which is even larger than the average level, results show positive effect on all purchase decisions. Customers who face High Loss situation, tend to make more expenditures for their total purchase products (β_{15} = .061, p<.01), tend to buy more items (β_{15}= .101, p<.01), buy products with larger price dispersions (Coefficient of Variation β_{15}= .128, p<.01, Percentage of Difference β_{15} = .167, p<.01) and more variations in the category (β_{15} = .058, p<.01). The estimate for the effect on the average expenditure per item is positive but not significant (β_{15} = .017, p>.5).

The results are consistent with previous findings by Lewis, Singh and Fay (2006) but also provide some extensions. We conclude that charging extra surcharge encourage customers to buy more to meet the requirement of the threshold to get free-shipping promotion, while given smaller surcharge for smaller order ($0 to $50), customers favor small baskets and order relatively infrequently. As observed by the results, the "free-large" policy has a smaller impact on order incidence (Lewis, Singh and Fay, 2006) but leads to the largest average expenditure.

Product Category purchased. Different from previous studies covering a single product category (e.g., perishable grocery and drugstore items in Lewis, Singh and Fay, 2006; Lewis 2006; books in Dinlersoz and Li 2006; digital cameras and video games in Yao and Zhang 2012), we incorporate six main product categories in our model, including 1)Apparel, Shoes, Jewelry; 2)Home & Food; 3) Books, Music, Videos; 4) Computers, Electronics; 5) Business and Office Supplies and 6)Services. We observe higher Basket size for category of Computers and Electronics (Product Total Price β_{20} = .438, p<.01) and more expensive product with higher unit price (β_{20} = .411, p<.01). Customer tend to buy more in category of Books, Music, Videos (β_{19}= .275, p<.01), and Large price dispersion exist in Computers and Electronics category (Coefficient of Variation β_{20}= .286, p<.01, Percentage of Difference β_{20} = .279, p<.01), while customers choose more sub-categories in Apparel, Shoes and Jewelry product (β_{17} = .329, p<.01).

Purchase Situational Variables. We observe a significant effect of seasonality only on number of items purchased during holidays (β_{22} = .014, p<.5), indicating that on average customers spend similar amount of money across the eight retailer websites in one year.

By looking into the detailed search efforts on the website, we find significant effects of both time duration and number of web pages viewed during the transaction. For example, one more minute customers spend on the website, they will buy more in the basket (β_{23} = .061, p<.01) with larger variations in product categories (β_{23} = .052, p<.01). Similarly, one more page they viewed, they will buy more in the basket (β_{24} = .059, p<.01) with larger variations in product categories (β_{24} = .102, p<.01), however they may buy less expensive items (β_{24} = -.64, p<.01), with more search efforts and costs. In addition, network connection speed at which customers make transactions does not have significant impact on purchase decisions.

Demographic Background. Education level, Census Region, Family Size, Income, Country of Origin are significant factors on purchase decisions. Specifically, Education level has significantly positive effect on purchase decision making, that customers with higher education level tend to spend on products of higher price dispersions (Coefficient of Variation β_{25}= .022, p<.01, Percentage of Difference β_{25} = .017, p<.01). This is understandable since we also observe a significant positive effect from income on all measures of price decision, that buyers who have higher income, tend to make bigger size transactions (β_{31}= .034, p<.01), buy more items (β_{31}= .033, p<.01), spend on more expensive product with higher unit price (β_{31} = .024, p<.01), with larger price dispersions (Coefficient of Variation β_{31}= .028, p<.01, Percentage of Difference β_{31} = .038, p<.01) and more variations in the category (β_{31} = .024, p<.01). In addition, we find slightly different pattern for customers from different census regions, that customers from South tend to put more items in the basket (β_{28} = .030, p<.01), which results higher price

variations (Coefficient of Variation β_{28}= .029, p<.01, Percentage of Difference β_{28} = .027, p<.01), and people from East have more variety in product category (β_{28} = .032, p<.01). However, age, child being present in the family or not do not significantly influence buyers' purchase patterns and decisions.

How large is the magnitude of the gap, purchase situation, marketplace characteristics, etc. will also play a moderate role and affects consumers' expenditure patterns. We incorporate the continuous measure of gap in Model 2, which is a Piece-wise Linear Model, with continuous absolute measure of Gain and Loss, see formula *(2)*.

$$\textit{Purchase Decision}_i = \beta_0 + \beta_{1\text{-}\beta_8}\textit{Website}_i + \beta_9\,\textit{Purchase Quantity}_i + \beta_{10}\,(\textit{Purchase Quantity}_i)^2 + \beta_{11}\,\textit{Unit Price}_i + \beta_{12}\,(\textit{Unit Price}_i)^2 + \beta_{13}\,GAP_i \bullet I\,(GAP_i>0) + \beta_{14}\,GAP_i \bullet I\,(GAP_i<0) + \beta_{15}\,I(GAP_i=0) + \beta_{16\text{-}20}\,\textit{Product Category}_i + \beta_{21}\,\textit{Seasonality}_i + \beta_{22}\,\textit{Duration Time}_i + \beta_{23}\,\textit{Pages Viewed}_i + \beta_{24}\textit{Education}_i + \beta_{25\text{-}27}\,\textit{Region}_i + \beta_{28}\,\textit{Household Size}_i + \beta_{29}\,\textit{Oldest Age}_i + \beta_{30}\textit{Household Income}_i + \beta_{31}\,\textit{Child}_i + \beta_{32}\,\textit{Connection Speed}_i + \beta_{33}\,\textit{Country of Origin}_i + \varepsilon_i \quad (2)$$

Where Indicator Variables are:

$$I\,(GAP>0) = \begin{cases} 1; GAP > 0 \\ 0; GAP \leq 0 \end{cases}$$

$$I\,(GAP=0) = \begin{cases} 1; GAP = 0 \\ 0; GAP \neq 0 \end{cases}$$

We now report the coefficient estimates (β) from the model2 for each determinant and covariates in ***Table 12.***

----------Insert Table 12 about here----------

Effects of Magnitude of Gain and Loss. By incorporating continuous measures of gains and losses, while taking free shipping cases with no gains, no losses value, Model 2 provides more information about purchase pattern given price surcharge and discounts. As expected, we find significant positive effect of positive gap representing price savings

in the basket on all measures of price decisions. Specifically, given one dollar amount customers save in the basket, they tend to make more expenditures for their total purchase products (β_8 = .134, p<.01), tend to buy more items (β_8= .081, p<.01), spend more on the average expenditure per item (β_8 =.059, p<.01), buy products with larger price dispersions (Coefficient of Variation β_8= .128, p<.01, Percentage of Difference β_8 = .050, p<.01) and more variations in the category (β_8 = .062, p<.01).

On the contrary, the dollar amount customers lose in the basket results in smaller basket size, however the components of product items in the basket show more variations. Specifically, given one extra dollar amount customers pay in the basket, they tend to make less expenditures for their total purchase products (β_9 = -.072, p<.01), spend on less average expenditure per item (β_9 =-.083, p<.01), however, they tend to buy more unique items (β_9= .081, p<.01), buy products with larger price dispersions (Coefficient of Variation β_9= .015, p<.01, Percentage of Difference β_9 = .010, p<.01) and more variations in the category (β_9 = .018, p<.01).

The results provide insights that customers tend to maximize the benefits they've gained from the price savings in the basket, while they try to minimize the loss they face given a certain level of price surcharge at the check out by putting more dissimilar product with larger variations in prices and categories.

We also observe interesting pattern given there is neither price surcharge nor price savings. In the situation of No gains, no losses, customers tend to spend more in their total purchase products (β_{10} = .101, p<.01), spend on higher average expenditure per item

(β_9 =.053, p<.01), buy more unique items (β_{10}= .028, p<.01), however, they will buy products with more similarity in prices with smaller percentage of price differences (β_{10} = -.016, p<.01).

Further, the absolute gap plays differently from the relative gap (where the gap is presented as a percentage of total product prices, indicating how much is the surcharge or saving relative to the total spending on the merchandise). We also use percentage of the gap to the base product total price, as a measure of the level of surcharge and savings relatively in Model 3 which is a Piece-wise Linear Model, with continuous relative measure of Gain and Loss. See Model 3 in formula *(3).*

$$Purchase\ Behavior_i = \beta_0 + \beta_{1\text{-}\beta_8} Website_i + \beta_9\, Purchase\ Quantity_i + \beta_{10}\,(Purchase\ Quantity_i)^2 + \beta_{11}\, Unit\ Price_i + \beta_{12}\,(Unit\ Price_i)^2 + \beta_{13}\, RelativeGAP_i \bullet I\,(GAP_i>0) + \beta_{14}\, RelativeGAP_i \bullet I\,(GAP_i<0) + \beta_{15}\, I(Relative\ GAP_i=0) + \beta_{16\text{-}20}\, Product\ Category_i + \beta_{21}\, Seasonality_i + \beta_{22}\, Duration\ Time_i + \beta_{23}\, Pages\ Viewed_i + \beta_{24} Education_i + \beta_{25\text{-}27}\, Census\ Region_i + \beta_{28}\, Household\ Size_i + \beta_{29}\, Oldest\ Age_i + \beta_{30} Household\ Income_i + \beta_{31}\, Child\ Present_i + \beta_{32}\, Connection\ Speed_i + \beta_{33}\, Country\ of\ Origin_i + \varepsilon_i \qquad (3)$$

Where Indicator Variables are:

$$I\,(GAP>0) = \begin{cases} 1; GAP > 0 \\ 0; GAP \leq 0 \end{cases}$$

$$I\,(GAP=0) = \begin{cases} 1; GAP = 0 \\ 0; GAP \neq 0 \end{cases}$$

We now report the coefficient estimates (β) from the model3 for each determinant and covariates in ***Table 13.***

----------Insert Table 13 about here----------

After taking percentage of gains and losses over its total product price in the model, the effects of relative measures of gaps are different from these of absolute value reported in

Model2 results. Given one more percent of product price as savings, customers significantly decrease the total spending on the products (β_8 = -.006, p<.01) and basket (β_8 = -.094, p<.01), but they favor more variety of product categories in the basket (β_8 = .024, p<.01). Given one more percent of product price as surcharges, customers significantly increase the total spending on the products (β_9 = .024, p<.01) and they buy more product (β_9 = .029, p<.01) and favor more variety of product prices (Coefficient of Variation β_9= .034, p<.01, Percentage of Difference β_9 = .035, p<.01) as well as categories in the basket (β_9 = .024, p<.01).

Xia and Monroe (2004) state that, in the case of partitioned prices (e.g., shipping costs showed separated), consumers tend to make price-related judgments that do not adequately adjust for the add-on pricing component in a transaction.

Inconsistent with Morwitz et al.'s (1998) results, relative measures of surcharge and discount do not prove to be more effortful to process, affected purchase likelihood less than the former. On the contrary, they show strong relationship with purchase decisions, given the empirical study results. As argued by Sheng, Bao and Pan (2007), when the surcharge is relatively small compared to the base price, partitioned pricing can increase demand. However, as the relative magnitude of the surcharge to the base price increases, consumers will likely pay more attention to the surcharge and the effect of partitioned pricing on demand diminishes. If the surcharge is too large relative to the base price, partitioned pricing can reduce demand compared to combined pricing. Compared to absolute measure, percentage measure of price surcharge is more valuable, since the percentage number is a more reasonable measure. For example, given different

merchandise, it is hard to evaluate whether $5 or $9 is a more reasonable S&H surcharge. Given the base price, $5 with the base price $7.9 would be less reasonable than $9 with the base price $49.90.Thus, relative measure of surcharge is expected to affect purchase decision differently and more effectively. When Bolton and Shankar (2003) identify four pricing dimensions that underlie retail pricing/promotion decisions, they use relative price instead of absolute price.

Model 4 is a Hierarchical piecewise linear development based on the results of Model3, using relative gap in the model, as suggested by Bijmolt and Pieters (2001) and Raudenbush and Bryk (2002). Since we have observed multiple purchase sessions from the same consumers in our data, we need to control for the dependence of multiple purchases within one customer. 7696 customers with the unique machine ID have made 18715 transactions, and each customer has bought 2.43 times on average. Therefore, we apply a hierarchical structure in the piecewise linear model. To account for the lack of independence across purchase sessions for the same customer, we allow random effects in both intercept and slopes across each independent customer and control for the within-subject error correlation between purchase decisions. In model 4 with hierarchy, there are two levels: the collected 18715 purchase sessions are at the first level. These observations are nested in 7696 customers that we set as the second level, who share demographic information such as household size, education level, and so on. See Model 4 in Formula *(4)*.

$$Purchase\ Behavior_{ij} = \beta_0 + \beta_{1\text{-}}\beta_8 Website_{ij} + \beta_9\, Purchase\ Quantity_{ij} + \beta_{10\,(}Purchase\ Quantity_{ij})^2 + \beta_{11}\, Unit\ Price_{ij} + \beta_{12}\,(Unit\ Price_{ij})^2 + \beta_{13}\, RelativeGAP_{ij} \bullet I\,(GAP_{ij}>0) + \beta_{14}\, RelativeGAP_{ij} \bullet I\,(GAP_{ij}<0) + \beta_{15}\, I(Relative\ GAP_{ij}=0) + \beta_{16\text{-}20}\, Product\ Category_{ij} + \beta_{21}\, Seasonality_{ij} + \beta_{22}\, Duration\ Time_{ij} + \beta_{23}\, Pages\ Viewed_{ij} + \beta_{24} Education_{ij} + \beta_{25\text{-}27}\, Census\ Region_{ij} + \beta_{28}\, Household\ Size_{ij} + \beta_{29}\, Oldest\ Age_{ij} + \beta_{30} Household\ Income_{ij} + \beta_{31}\, Child\ Present_{ij} + \beta_{32}\, Connection\ Speed_{ij} + \beta_{33}\, Country\ of\ Origin_{ij} + e_j + \varepsilon_{ij} \quad (4)$$

Where Indicator Variables are:

$$I\,(GAP>0) = \begin{cases} 1; GAP > 0 \\ 0; GAP \leq 0 \end{cases}$$

$$I\,(GAP=0) = \begin{cases} 1; GAP = 0 \\ 0; GAP \neq 0 \end{cases}$$

Using subscript i to denote each purchase session observation, j to denote an independent customer with unique Machine Id, the model structure we use to explain the variations in the purchase decisions at two levels.

We now report the coefficient estimates (β) from the model4 for each determinant and covariates in ***Table 14.***

----------Insert Table 14 about here----------

After controlling for dependence within customer purchase, we observe similar results for relative gains, however given relative loss situation, customers' purchase decision are more positive. Given one more percent of product price as surcharges, after controlling for the correlations of purchase sessions made by the same person, customers significantly increase the total spending on the products (β_9 = .155, p<.01), they spend on more expensive product with higher unit price (β_9 = .015, p<.01), and they buy more product (β_9 = .032, p<.01) and favor more variety of product prices (Coefficient of Variation β_9= .043, p<.01, Percentage of Difference β_9 = .041, p<.01).

4. Discussion and Implications

In sum, we propose a Gain-and-Loss Utility model incorporating both price surcharges and price savings developed from price partitioning, price promotion as well as prospect theory. By decomposing positive and negative gap between purchased product total prices and transaction basket price, we include both positive and negative gaps and examine "Gain" and "Loss" simultaneously in the price strategy framework. Our theoretical framework includes price partitioning, promotion strategy, price presentation, loss and gain theory, as well as price surcharges and price savings as the key stimuli of customers' expenditure behaviors. We have derived three sets of hypotheses from reviewed previous research and theory and we provide substantial evidence to support our hypotheses. Empirical results show asymmetry in the effects of (both absolute and relative) price surcharge and price discount, which implies that customers are managing their purchases differently when they lose or gain. Specifically, we discover that when customers lose by paying extra surcharges, it does not necessarily hurt the purchase however it encourages customers to buy more, buy products in the basket with more variations in both prices and category selections.

First, hypotheses regarding consumers' purchase behavior and expenditure pattern affected by price surcharges and discounts are supported. From model estimation results predicting basket size and basket items price dispersion, we find significant evidence to support hypotheses H_1 and H_2. Four situations of "High Gain", "Low Gain", "High Loss" and "Low Loss" induce consumers' significantly different responses in the basket price, purchase quantity, unit price and price dispersion measured by coefficient of variation and percentage of difference. Specifically (see ***Table 11***), customers tend to spend more

on the total expenditure when they encounter “High Gain”, following by “High Loss”, “Low Gain” and “Low Loss” situations. Only “Low Loss” situation will result in smaller purchase quantity, while in “High Loss”, “High Gain” and “Low Gain” cases, customers put more items in the basket from more different categories. In addition, the continuously measured “Gain” significantly has a positive effect on purchase decision, while one dollar amount “Loss” significantly negatively impacts customers’ total expenditures however customers look for the opportunity to maximize their benefits by putting products with more variety in prices and categories in the basket (see ***Table 12, Table 13, Table 14***).

As Kopalle et al. (2009) have summarized, a key component of the output of retailing is a set of services, such as location, information, assortment, delivery, and ambience. Because these services lower transportation and search costs, and possibly provide other benefits, customers are willing to pay for them. Retailers normally do not charge separately for the services such as location and ambience, however since transportation and other costs of shopping that consumer incur are specific to the trip and independent of the items bought, consumers seek to minimize the cost of obtaining product items. Further, retail pricing is a matter of setting prices on individual items to recover the cost of providing various services. As stated by Venkatesan, Mehta and Bapna (2007), high service quality retailers charge significantly more than the low service quality retailer when the level of competition and scope for differentiation are high and when both level of competition and scope for service differentiation are low. Therefore, our study provides managerial suggestions that, customer do not refuse and reject the potentially

higher surcharge fees, since they've obtained benefits of faster delivery and better service, given proliferation of differentiated online services offered by retailers.

The second group of hypotheses (H_3 and H_4) is regarding zero gaps in the "No Gain, No Loss" situation with free shipping and no discounts in the purchase sessions, as well as absolute or relative gap measures of the magnitude of the surcharges and discounts. We also find significant evidence to support our expectations that free shipping and no discounts is a trend that firms adopt in the pricing strategy and they subsidize the shipping cost by offering the benefits to customers to encourage them buy more. Since trust in online seller and whether people can obtain enough information on the website influence consumer's judgment on prices. The more trust people have in E-tailer given free shipping benefits, or the more information provided by E-tailer, the higher expenditure they will make in the transactions (see ***Table 12***). In addition, in the free shipping situation, customers do not take risks in paying any extra fee, therefore they do put product items with lower price variations (see ***Table 12***).

Moreover, when we use relative measure of price surcharges and discounts to the base total product price, different results regarding effects on the total basket size are obtained (see **Table 13**) compared with absolute measures reported in ***Table 12***, indicating that the "Loss" does not always hurt customers however it encourage them to spend more in the product expenditure and buy different items. The hypotheses are supported even after controlling for the correlation of purchases within the same customer, by a hierarchical model (see ***Table 14***). Consistent with Morwitz et al.'s (1998), Kim and Kachersky (2006)'s conclusion, computational factors, where the salience of the price component decreases as it becomes more complex to calculate total cost (both calculation for a

percentage surcharge and a dollar surcharge) affects purchase decisions. Compared with absolute measure of the surcharges and discounts, relative measure to the base price is more reasonable and helpful in explaining customers' responses in different price components in the basket.

The third group of hypotheses focuses on the purchase situational (H_5) and retailer characteristics (H_6). We contribute in the area by capturing significant effects across different product categories and retailers. We hypothesize that different product categories will have different base prices and purchase quantity, as well as price dispersions, which would moderate the effects of price surcharge and discount on decisions. As an extension to previous studies covering a single product category (e.g., Lewis, Singh and Fay, 2006; Lewis 2006; Dinlersoz and Li 2006; Yao and Zhang 2012), we find differences in six main product categories in our model, that higher Basket size for category of Computers and Electronics and more expensive product with higher unit price; customer tend to buy more in category of Books, Music, Videos and large price dispersion exist in Computers and Electronics category, while customers choose more sub-categories in Apparel, Shoes and Jewelry product. In addition, two situational factors including time duration and web pages viewed show significant effects on purchase decisions, indicating that search costs representing customers' involvement in purchasing are ubiquitous on the Internet (Walter, Gupta, Su 2006, Ellison and Ellison 2009, Ratchford 2009).

Moreover, Research studies take E-tailers' characteristics such as firm ranking, type of distribution channel, and service quality into account (e.g., Brynjolfsson and Smith 2000, Baylis and Perloff 2002, Ancarani and Shankar 2004) to investigate their effects on

online price presentations. We also find substantial evidence that two multi-channel retailers selling products with large variety obtain the largest basket size (Office Depot and Walmart, while pure-play e-tailer obtains smaller basket size (Ebay, Amazon), however Amazon and Walmart have higher average unit price. Customers tend to choose various unique categories at Walmart, BarnesandNoble.com, as well as Amazon.com.

While providing support to our theoretical framework, our results have some limitations. First, given price surcharges and price discounts, base unit price and purchase quantity still play important roles in predicting the total expenditures. If we have access to the cost information, we could predict firms' profitability by incorporating both price surcharges and discounts after controlling for costs. Second, we use price dispersion and category information to capture the variations in the basket items, however if we could look into detailed products information, we can capture the effects of the attention or importance consumers give to specific product components and attributes on purchase decisions. Third, we could not distract types of surcharges and discounts in the data, leaving some future research opportunities to decompose the components of both surcharge and discounts in empirical studies.

Table 1. Sample of the original purchase session data

domain	machine_id	duration	pages_v	date	event_time	prod_name	prod_ca	prod_qty	prod_totpr	basket_tot
amazon.com	303378	42	68	0618	1:37:00	PEACE, LOVE AND HEALIN	21	1	0.01	17.5
amazon.com	305673	18	19	0526	20:57:07	PHONICS GAMES KIDS CA	21	1	8.76	30.58
amazon.com	305673	18	19	0526	20:57:07	PHONICS FROM A TO Z (C	21	1	11.87	30.58
amazon.com	305673	18	19	0526	20:57:07	PERFECT POEMS FOR TEA	21	1	9.95	30.58
amazon.com	307779	35	29	0114	15:02:35	CHILDREN'S NATIVITY	99	1	29.99	60.73
amazon.com	307779	35	29	0114	15:02:35	CONAIR METROPOLIS CO	34	1	19.87	60.73
yahoo.com	2417743	17	12	0530	18:46:16	BUSHNELL 7X50 WP MAF	15	1	149.99	149.99
yahoo.com	2418208	14	7	0109	21:45:06	PINHEAD	99	1	34.95	40.9
yahoo.com	2418208	14	5	0115	0:08:09	PIONEER TS-W254DVC 10	31	1	41.99	57.74
walmart.com	5603177	9	13	1214	18:36:40	GAME BOY ADVANCE CU	37	1	30	33.5
walmart.com	5606199	25	35	0416	4:50:09	SONG DOWNLOAD	48	1	0.88	5.28
walmart.com	5606199	25	35	0416	4:50:09	SONG DOWNLOAD	22	1	0.88	5.28
walmart.com	5606199	25	35	0416	4:50:09	SONG DOWNLOAD	48	1	0.88	5.28

Table 2. Main Price Variable Descriptions

Variables	Description
Basket Price (total expenditure)	Total price in the basket; total dollar amount that customer has paid for a certain purchase session (including any price surcharge or saving); also referred to Order Size.
Total Product Price	Sum of prices of all product items in the shopping cart (without considering price surcharges or savings).
Purchase Quantity	The total number of items in the shopping cart; it is also referred to Basket Size or Consumption volume.
Number of Unique items	The total number of unique items in the shopping cart.
Average Unit Price (expenditure per Item)	Average dollar amount (total expenditure) consumers spend on each item in a order, measured by $\frac{\text{Basket Price}}{\text{Purchase Quantity}}$
GAP	The difference between Total Product Price and Basket Price: Total Product Price – Basket Price
GAP^{+}	Positive difference between Total Product Price and Basket Price
GAP^{-}	Negative difference between Total Product Price and Basket Price
GAP^{0}	Dummy Variable: 1 if there is no difference between Total Product Price and Basket Price, 0 otherwise
Relative GAP^{+}	The relative positive difference between Total Product Price and Basket Price: $\frac{GAP+}{\text{Product Total Price}}$
Relative GAP^{-}	The relative negative difference between Total Product Price and Basket Price: $\frac{GAP-}{\text{Product Total Price}}$
Purchase Item Price Dispersion (Similarity of product prices)	Variation of item prices in a certain purchase session, measured by 1) Coefficient of Variation 2) Percentage of Price Difference
Purchase Category Dispersion (Similarity of product category)	Variation of item categories in a certain purchase session, measured by 1) Mode of category distribution 2) number of unique product categories

Table 3. Covariate Variable Descriptions

Variables	Description
Purchase Timing	Timeslot of purchase event (midnight-4:00am; 4:00am-8:00am; 8:00am-12:00pm; 12:00pm-4:00pm; 4:00pm-8:00pm; 8:00pm-12:00am)
Duration Time	Time spent in a certain purchase session at site
Pages Viewed	Number of pages viewed in a certain purchase session at site
Holiday	Dummy Variable: 1 if the purchase is made in any nation holiday day, 0 otherwise

Table 4. Demographic Variable Descriptions

Census Region	Census Region 1 North East 2 North Central 3 South 4 West
Household Size	Household size 1 2 3 4 5 6+
Oldest Age	1 18-20 2 21-24 3 25-29 4 30-34 5 35-39 6 40-44 7 45-49 8 50-54 9 55-59 10 60-64 11 65 and older
Household Income	1 Less than 15k 2 15k-24.999k 3 25k-34.999k 4 35k-49.999k 5 50k-74.999k 6 75k-99.999k 7 100k+
Household Education	0 Less than a high school diploma 1 High School diploma or equivalent 2 Some college but no degree 3 Associate degree 4 Bachelor's degree 5 Graduate degree 6 Missing
Connection Speed	0 Not broadband 1 Broadbrand
Country of Origin	1 Hispanic 0 Non Hispanic
Child Present	1 Yes 0 No

Table 5. Summary Statistics

Variables	Mean	SD
GAP	6.77	31.40
GAP+	20.55	34.88
GAP-	-11.56	30.30
Relative GAP+	0.39	0.38
Relative GAP-	-2.74	29.31
Basket Price (dollar)	57.58	90.75
Total Product Price (dollar)	50.82	82.80
Basket Size (Purchase Quantity)	2.63	4.32
Number of Unique Items	2.33	2.40
Average Unit Price (dollar)	26.47	56.17
Number of Unique Category	1.21	0.54
Duration Time (minute)	32.45	31.40
Pages Viewed	44.19	49.48
Coefficient of Variation (%)	20.60	31.81
Percentage of Difference (%)	40.72	68.70

Table 6. Magnitudes of surcharges and discount/savings represent Loss and Gain

Variable	Situations	Categorical Measure	Quantitative Measure
Gain (GAP^{+})	Discount, Promotion, Membership benefit.	High Gain Low Gain	When Product Total Price > Basket Price, GAP between Product Total Price and Basket Price is positive.
Loss (GAP^{-})	Tax, Shipping and Handling, Service Surcharge (such as Airflight, Gift wrapping).	High Loss Low Loss	When Product Total Price < Basket Price, GAP b/w Total product price and Basket price is negative.
No Loss, No Gain (GAP^{0})	Free S&H, No Discount, Offset of surcharge and discount savings.	No Loss, No Gain Otherwise	When Product Total Price = Basket Price, GAP between Product Total Price and Basket Price is zero.

Table 7. Distribution of situations

Category	Descriptions	Number of Sessions when the dummy value is 1
High Gain	Dummy variable: 1 if the GAP+ is higher than its average level (20.55), 0 otherwise (if GAP is lower than its average, and if GAP is negative, and if GAP is zero)	421
Low Gain	Dummy variable: 1 if the GAP+ is lower than its average level (20.55), 0 otherwise (if GAP is higher than its average, and if GAP is negative, and if GAP is zero)	786
High Loss	Dummy variable: 1 if the GAP- is lower than its average level (-11.56), 0 otherwise (if GAP is higher than its average, and if GAP is negative, and if GAP is zero)	3042
Low Loss	Dummy variable: 1 if the GAP- is higher than its average level (-11.56), 0 otherwise (if GAP is lower than its average, and if GAP is negative, and if GAP is zero)	10058
No Gain No Loss	Dummy variable: 1 if the GAP is zero, 0 otherwise	4408
Total	All categories	18715

Table 8. Purchases across 8 retailers

Website	Number of Purchase sessions (Percentage)	Total Basket Price	Average Purchase Quantity	Average Unit Price	Average GAP	Average Relative GAP
Amazon	12248 (65.44%)	$50.04	2.2	$24.82	-$6.11	-0.401
Ebay	333 (1.78%)	$16.77	1.6	$8.52	-$4.10	-0.805
Walmart	1767 (9.44%)	$77.02	3.4	$44.53	-$10.04	-0.548
Yahoo	808 (4.32)	$68.90	3.2	$41.30	-$6.67	-0.243
BN	1675 (8.95%)	$43.46	2.9	$17.89	-$3.92	-0.440
Office Depot	116 (0.62%)	$135.66	9.0	$20.13	-$6.81	**-2.360**[1]
GAP	372 (1.99%)	$87.41	3.7	$25.80	-$8.17	-0.174
VS	1396 (7.46%)	$104.88	4.1	$24.72	-$12.13	-0.369
Total	18715 (100%)	$57.58	2.6	$26.47	-$6.77	-0.424

1. At Office Depot website, of its 116 purchase sessions, we observe several observations with large gap and very small total product price. For example, one purchase session data shows the total product price is $1, however the total basket price is $102, which means the price surcharge is as high as $101, resulting relative GAP to be a large number.

Table 9 Product categorization and summary statistics

Categories	Sub-categories	Purchase sessions	Total Basket Price	Average Purchase Quantity	Avg. Unit Price	Average GAP
Apparel, Shoes, Jewelry	Apparel, shoes, accessories, jewelry, watches	2147	101.78	3.8	28.65	13.73
Home & Food	Home furniture, home appliances, pet supplies, food & beverage, health & beauty, home & living items, toy and game items, gifts	1805	82.12	2.2	49.84	7.93
Books, Music, Videos	Books, magazines, music, movies & videos	11680	38.94	2.4	16.57	5.41
Computers, Electronics	Desktop computers, laptop computers, mobile phones, portable devices, printers, monitors, computer software, audio & video equipment, cameras, console video games, Tvs,	2234	98.22	2.2	61.11	6.60
Business and Office Supplies	Business machines, office furniture, office supplies	110	122.54	9.0	19.75	9.06
Services	Movie tickets, event tickets, air travel, hotel reservations, car rental, travel packages, photo printings	534	15.15	5.8	6.67	4.86
missing	Missing value	205	73.8	2.2	39.37	6.69

Table10. Correlation between Dependent Variables

Variable	BASKET SIZE	TOTAL PRICE	NO. OF ITEMS	UNIT PRICE	CoeffVar.	PerDiff.	NO. OF CATE
Mean	57.58	50.82	2.33	26.47	20.60	40.72	1.21
Std.	90.75	82.80	2.40	56.17	31.81	68.90	0.54
N	18715	18715	18715	18715	18536	18536	18715
BASKET SIZE	1.00						
TOTAL PRICE	0.94	1.00					
NO. OF ITEMS	0.31	0.33	1.00				
UNIT PRICE	0.61	0.65	0.16	1.00			
CoeffVar	0.26	0.28	0.53	-0.03	1.00		
PerDiff	0.30	0.31	0.69	-0.05	0.94	1.00	
NO. OF CATE.	0.21	0.23	0.40	-0.02	0.40	0.43	1.00

Table 11. Model 1 (Linear Model with Categorical Gap measures) Estimation Results

Independent Variables	Dependent Measures					
	Basket Size			Variations in the Basket		
	1. Total Price	2. Purchase Quantity	3. Average Unit Price	4. Coefficient of Var	5. Percentage of Diff.	6. Number of Cat.
Intercept	0** (2.48)	0*** (10.91)	0*** (5.42)	0 (0.60)	0 (0.38)	0*** (10.54)
Amazon	-0.108*** (4.28)	-0.331*** (13.46)	0.121*** (4.63)	-0.136*** 5.18 ()	-0.179*** (6.98)	0.175*** (6.63)
Ebay	-0.051*** (4.67)	-0.116*** (10.93)	0.023** (2.00)	-0.062*** (5.42)	-0.073*** (6.61)	0.050*** (4.43)
Walmart	0.049*** (2.80)	0.213*** (12.39)	0.184*** (10.13)	-0.097*** (5.28)	-0.125*** (6.95)	0.239*** (13.00)
Yahoo	0.0002 (.01)	-0.108*** (8.93)	0.074*** (5.82)	-0.043*** (3.39)	-0.056*** (4.45)	0.158*** (12.31)
BN	-0.064*** (3.60)	-0.167 (9.72)	0.079*** (4.35)	-0.042** (2.27)	-0.068*** (3.77)	0.222*** (12.06)
Office	0.069*** (4.03)	0.014 (0.84)	-0.007 (0.39)	0.051*** (2.91)	0.061*** (3.57)	0.110*** (6.24)
Gap	-0.032*** (3.53)	-0.058*** (6.48)	-0.001 (0.04)	0.006 (0.60)	0.001 (0.09)	0.028*** (2.95)
UniItem[1]	0.565*** (68.53)	1.192*** (89.44)	0.831*** (107.65)	0.846*** (57.41)	0.923*** (72.73)	0.802*** (46.90)
UniItem Squared Term	-0.210*** (77.57)	-0.489*** (36.98)	0.09*** (13.53)	-0.460*** (34.59)	-0.341*** (29.55)	-0.287*** (16.98)
Unit Price[2]	0.861*** (127.46)	-1.024*** (75.98)	-0.543*** (60.13)	0.141*** (10.95)	0.127*** (11.54)	-0.674*** (39.14)
Unit Price Squared Term	-0.069*** (10.89)	0.463*** (35.44)	0.213*** (26.31)	-0.039*** (3.43)	-0.046*** (4.70)	0.265*** (15.99)
HighGain	0.088*** (10.18)	0.059*** (6.98)	0.032*** (3.59)	0.062*** (6.92)	0.063*** 7.26 ()	0.054*** (6.08)
LowGain	-0.016 (1.82)*	0.042*** (4.93)	-0.028*** (3.11)	0.070*** (7.69)	0.077*** (8.67)	0.054*** (5.86)
HighLoss	0.061*** (6.01)	0.101*** (10.24)	0.017 (1.64)	0.128*** (12.27)	0.167*** (16.40)	0.058*** (5.51)
LowLoss[3]	-0.159*** (15.43)	-0.133*** (13.23)	-0.090*** (8.49)	-0.063*** (5.89)	-0.059*** (5.70)	-0.083*** (7.76)
MAIN1	0.380*** (17.55)	0.144*** (6.84)	0.308*** (13.79)	0.195*** (8.97)	0.161*** (7.59)	0.327*** (14.54)
MAIN2	0.336*** (19.42)	0.063*** (3.74)	0.323*** (18.00)	0.132*** (7.37)	0.111*** 6.36 ()	0.234*** (13.02)
MAIN3	0.408*** (15.06)	0.275*** (10.44)	0.275*** (9.86)	0.286*** (10.28)	0.279*** (10.26)	0.346*** (12.29)
MAIN4	0.438*** (23.83)	0.118*** (6.61)	0.411*** (21.67)	0.151*** (7.91)	0.143*** (7.68)	0.220*** (11.51)
MAIN5	0.063*** (3.71)	0.055*** (3.35)	0.060*** (3.44)	0.056*** (3.22)	0.067*** (3.98)	0.024 (1.36)
HOLIDAY	0.009 (1.04)	0.014* (1.72)	0.007 (0.82)	-0.009 (1.05)	-0.004 (0.49)	-0.001 (0.11)
DURATION	0.055*** (4.51)	0.039*** (3.33)	0.028** (2.21)	0.063*** (5.02)	0.059*** (4.86)	0.052*** (4.14)
PAGES	0.013 (1.06)	0.211*** (17.61)	-0.064*** (5.03)	0.103*** (8.06)	0.151*** (12.17)	0.102*** (7.96)
EDU01	0.018** (2.16)	0.010 (1.23)	0.012 (1.39)	0.022** (2.57)	0.017** (2.01)	0.009 (0.98)

Independent Variables	Dependent Measures					
	Basket Size			Variations in the Basket		
	1. Total Price	2. Purchase Quantity	3. Average Unit Price	4. Coefficient of Var	5. Percentage of Diff.	6. Number of Cat.
East	0.013 (1.25)	0.025*** (2.56)	-0.001 (0.02)	0.023** (2.22)	0.022** (2.14)	0.032*** (3.04)
Central	0.004 (0.40)	0.020** (2.08)	-0.002 (0.15)	0.017* (1.66)	0.019* (1.86)	0.016 (1.53)
South	0.028*** (2.76)	0.030*** (2.98)	0.010 (0.15)	0.029*** (2.70)	0.027*** (2.61)	0.005 (0.43)
FSIZE01	-0.008 (0.83)	0.024** (2.56)	-0.017* (1.65)	0.013 (1.21)	0.014 (1.39)	0.035*** (3.33)
AGE01	-0.013 (1.59)	-0.002 (0.24)	-0.008 (0.95)	0.005 (0.61)	0.004 (0.43)	-0.003 (0.32)
INCOME01	0.034*** (3.93)	0.033*** (3.94)	0.024*** (2.67)	0.028*** (3.15)	0.038*** (4.45)	0.024*** (2.72)
CHILDREN	0.006 (0.55)	0.018* (1.82)	-0.001 (0.09)	0.013 (1.29)	0.014 (1.36)	0.004 (0.39)
SPEED	0.003 (0.32)	0.005 (0.63)	0.006 (0.62)	-0.001 (0.07)	-0.002 (0.22)	-0.001 (0.07)
COUNTRY	0.027*** (3.23)	0.021** (2.53)	0.019** (2.26)	0.007 (0.83)	0.009 (1.08)	-0.001 (0.10)
Observations	12444	12444	12444	12339	12339	12444
R^2	79.65%	53.80%	77.06%	36.98%	15.69%	24.63%

1. The independent variable is Product Total Price and its squared term when the dependent variable is Purchase Quantity, Unit Price, Number of Category.
2. The independent variable is Unit Price and its squared term when the dependent variable is Coefficient of variation, Percentage of Difference.
3. No Loss No Gain is the base level for four Loss and Gain dummy variables
4. West is the base level for Census Region variable

Table 12. Model 2 (Linear Piecewise Model with Continuous Gap measures) Estimation Results

Independent Variables	Dependent Measures					
	Basket Size			Variations in the Basket		
	1. Total Price	2. Purchase Quantity	3. Average Unit Price	4. Coefficient of Var	5. Percentage of Diff.	6. Number of Cat.
Intercept	0*** (3.52)	0*** (10.32)	0*** (6.24)	0 (0.82)	0 (1.21)	0*** (8.88)
Amazon	-0.160*** (6.03)	-0.388*** ()	0.099*** (3.64)	-0.143*** (5.14)	-0.196*** (7.15)	0.193*** (6.99)
Ebay	-0.073*** (6.50)	-0.145*** (13.15)	0.015 (1.31)	-0.076*** (6.45)	-0.092*** (7.94)	0.046*** (3.97)
Walmart	0.023 (1.26)	-0.246*** (13.60)	0.175*** (9.30)	-0.102*** (5.26)	-0.133*** (7.02)	0.248*** (12.99)
Yahoo	-0.029** (2.28)	-0.144*** (11.39)	0.063*** (4.81)	-0.059*** (4.35)	-0.076*** (5.75)	0.157*** (11.75)
BN	-0.089*** (4.86)	-0.189*** (10.52)	0.068*** (3.62)	-0.034* (1.78)	-0.065*** (3.44)	0.244*** (12.80)
Office	0.060*** (3.50)	0.008*** (0.46)	-0.011 (0.63)	0.053*** (3.00)	0.062*** (3.53)	0.117*** (6.55)
Gap	-0.036*** (3.93)	-0.061*** (6.71)	-0.002 (0.26)	0.002 (0.22)	-0.004*** (0.40)	0.027*** (2.80)
UniItem[1]	0.570*** (71.09)	1.229*** (91.65)	0.835*** (108.36)	0.151*** (11.75)	0.137*** (12.44)	0.826*** (48.99)
UniItem Squared Term	-0.212*** (28.33)	-0.506*** (38.07)	0.090*** (13.20)	-0.045*** (3.90)	-0.051*** (5.22)	-0.298*** (17.64)
Unit Price[2]	0.861*** (127.99)	-1.037*** (76.25)	-0.537*** (60.19)	0.857*** (58.66)	0.932*** (74,57)	-0.681*** (39.46)
Unit Price Squared Term	-0.069*** (10.88)	0.466*** (35.43)	0.209*** (25.99)	-0.465*** (35.05)	-0.346*** (30.51)	0.267*** (15.97)
Gain	0.134*** (15.75)	0.081*** (9.69)	0.059*** (6.83)	0.050*** (5.71)	0.052*** (6.03)	0.062*** (7.04)
Loss	-0.072*** (8.32)	0.016*** (1.91)	-0.083*** (9.36)	0.015* (1.70)	0.010*** (1.18)	0.018** (2.04)
No Gain No Loss	0.101*** (11.55)	0.053*** (6.19)	0.069*** (7.78)	-0.004 (0.48)	-0.016*** (1.74)	0.028*** (3.04)
MAIN1	0.371*** (16.92)	0.149*** 6.92 ()	0.295*** (13.20)	0.199*** (8.96)	0.165*** 7.54 ()	0.329*** (14.49)
MAIN2	0.336*** (19.22)	0.070*** (4.08)	0.317*** (17.79)	0.138*** (7.58)	0.117*** (6.58)	0.238*** ()13.14
MAIN3	0.379*** (13.89)	0.247*** (9.19)	0.259*** 9.30 ()	0.259*** (9.14)	0.246*** (8.86)	0.326*** (11.48)
MAIN4	0.429*** (23.07)	0.114*** (6.23)	0.404*** (21.30)	0.146*** (7.55)	0.138*** (7.23)	0.216*** (11.20)
MAIN5	0.065*** 3.79 ()	0.059*** (3.50)	0.059*** 3.42 ()	0.058*** (3.31)	0.071*** (4.08)	0.025 (1.41)
HOLIDAY	0.006 (0.69)	0.010 (1.20)	0.006 (0.75)	-0.011 (1.32)	-0.007*** (0.84)	-0.003 (0.29)
DURATION	0.066*** 5.42 ()	0.057*** (4.78)	0.030** (2.41)	0.077*** (6.00)	0.075*** (6.02)	0.061*** (4.76)
PAGES	0.019*** (1.49)	0.237*** (19.30)	-0.069*** (5.40)	0.132*** 10.12 ()	0.184*** (14.38)	0.125*** (9.66)
EDU01	0.023*** (2.70)	0.017** (2.03)	0.014 (1.57)	0.028*** (3.15)	0.024*** (2.72)	0.012 (1.37)
East	0.007 (0.70)	0.022** (2.18)	-0.004 (0.42)	0.020** (1.91)	0.018*** (1.71)	0.030*** (2.85)

Independent Variables	Dependent Measures					
	Basket Size			Variations in the Basket		
	1. Total Price	2. Purchase Quantity	3. Average Unit Price	4. Coefficient of Var	5. Percentage of Diff.	6. Number of Cat.
Central	-0.004 (0.40)	0.012 (1.17)	-0.005 (0.50)	0.012 (1.12)	0.012*** (1.16)	0.013 (1.21)
South	0.022** (2.11)	0.025** (2.49)	0.006 (0.55)	0.026** (2.41)	0.023*** (2.19)	0.004 (0.36)
FSIZE01	-0.006 (0.61)	0.024** (2.42)	-0.015 (1.49)	0.012 (1.13)	0.013*** (1.27)	0.034*** (3.23)
AGE01	-0.017** (1.96)	-0.008 (0.93)	-0.009 (1.03)	0.001 (0.14)	-0.002*** (0.21)	-0.004 (0.42)
INCOME01	0.033*** (3.80)	0.034*** (4.03)	0.022** (2.52)	0.029*** (3.16)	0.039*** (4.42)	0.024*** (2.68)
CHILDREN	0.00 (0.71)	0.020** (2.01)	0.000 (0.03)	0.015 (1.40)	0.016*** (1.52)	0.004 (0.41)
SPEED	0.006 (0.67)	0.012 (1.43)	-0.006 (0.67)	0.004 (0.48)	0.003*** (0.39)	0.003 (0.33)
COUNTRY	0.021** (2.50)	0.017** (2.00)	0.016* (1.80)	0.005 (0.58)	0.007*** (0.77)	-0.002 (0.21)
Observations	12444	12444	12444	12339	12339	12444
R^2	79.70%	53.08%	77.06%	36.89%	53.77%	24.27%

1. The independent variable is Product Total Price and its squared term when the dependent variable is Purchase Quantity, Unit Price, Number of Category.
2. The independent variable is Unit Price and its squared term when the dependent variable is Coefficient of variation, Percentage of Difference.

Table 13. Model 3 (Linear Piecewise Model with Relative Gap measures) Estimation Results

Independent Variables	Dependent Measures					
	Basket Size			Variations in the Basket		
	1. Total Price	2. Purchase Quantity	3. Average Unit Price	4. Coefficient of Var	5. Percentage of Diff.	6. Number of Cat.
Intercept	0*** (3.52)	0*** (10.72)	0*** (6.46)	0 (1.23)	0 (1.59)	0*** (9.21)
Amazon	-0.134*** (5.00)	-0.383*** (14.63)	0.121*** (4.45)	-0.141*** (5.07)	-0.191*** (6.98)	0.190*** (6.89)
Ebay	-0.072*** (6.35)	-0.146*** (13.18)	0.017 (1.44)	-0.077*** (6.52)	-0.092*** (8.00)	0.045*** (3.86)
Walmart	0.024*** (1.29)	-0.251*** (13.89)	0.181*** (9.59)	-0.106*** (5.50)	-0.138*** (7.23)	0.242*** (12.69)
Yahoo	-0.028*** (2.13)	-0.146*** (11.56)	0.067*** (5.11)	-0.061*** (4.53)	-0.078*** (5.91)	0.154*** (11.56)
BN	-0.078*** (4.18)	-0.188*** (10.41)	0.078*** (4.16)	-0.034* (1.77)	-0.064*** (3.37)	0.242*** (12.68)
Office	0.068*** (3.89)	0.010 (0.58)	-0.005 (0.31)	0.055*** (3.06)	0.064*** (3.63)	0.118*** (6.58)
Gap	-0.036*** (3.88)	-0.061*** (6.68)	-0.002 (0.24)	0.002 (0.23)	-0.003 (0.36)	0.026*** (2.72)
UniItem[1]	0.578*** (71.95)	1.224*** (93.48)	-0.539*** (60.43)	0.857*** (58.74)	0.129*** (11.94)	0.824*** (49.53)
UniItem Squared Term	-0.216** (28.59)	-0.503*** (38.01)	0.210*** (26.13)	-0.465*** (35.07)	-0.047*** (4.82)	-0.297*** (17.66)
Unit Price[2]	0.870*** (129.57)	-1.037*** (76.51)	0.830*** (108.91)	0.146*** (11.45)	0.931*** (74.59)	-0.683*** (39.69)
Unit Price Squared Term	-0.075*** (11.77)	0.467*** (35.53)	0.094*** (13.78)	-0.041 ***(3.64)	-0.346*** (30.49)	0.268*** (16.08)
Relative Gain	-0.006*** (0.70)	0.005 (0.61)	-0.015 (1.76)	0.002 (0.19)	-0.007 (0.77)	0.024*** (2.77)
Relative Loss	0.024*** (2.88)	0.029*** (3.53)	0.014 (1.62)	0.034*** (3.92)	0.035*** (4.03)	0.021** (2.37)
No Gain No Loss	0.076*** (8.65)	0.046*** (5.39)	0.050*** (5.60)	-0.009 (1.00)	-0.022** (2.49)	0.026*** (2.82)
MAIN1	0.379*** (17.05)	0.139*** (6.43)	0.307*** (13.63)	0.190*** (8.52)	0.156*** (7.14)	0.322*** (14.08)
MAIN2	0.340*** (19.19)	0.065*** ()3.74	0.323*** (17.95)	0.132*** (7.22)	0.112*** (6.23)	0.234*** (12.84)
MAIN3	0.364*** (13.11)	0.228*** (8.43)	0.254*** (9.02)	0.244*** 8.58 ()	0.231*** ()8.27	0.314*** (10.98)
MAIN4	0.430*** (22.74)	0.107*** (5.82)	0.407*** (21.21)	0.139*** (7.16)	0.131*** (6.85)	0.211*** (10.87)
MAIN5	0.063*** (3.67)	0.055*** (3.27)	0.060*** (3.46)	0.055*** (3.13)	0.068*** (3.90)	0.022 (1.26)
HOLIDAY	0.006*** (0.71)	0.011 (1.30)	0.006 (0.68)	-0.011 (1.26)	-0.007 (0.77)	-0.002 (0.24)
DURATION	0.074*** (5.98)	0.059*** (4.92)	0.036*** (2.87)	0.077*** (6.04)	0.076*** (6.09)	0.062*** (4.85)
PAGES	0.040*** (3.20)	0.240*** (19.60)	-0.050*** (3.93)	0.133*** (10.31)	0.187*** (14.71)	0.125*** (9.70)
EDU01	0.026*** (2.97)	0.018** (2.19)	0.015* (1.73)	0.029*** (3.31)	0.025*** (2.89)	0.013 (1.47)
East	0.010*** (1.01)	0.021** (2.15)	-0.001 (0.11)	0.019* (1.85)	0.017* (1.68)	0.029*** (2.79)

Independent Variables	Dependent Measures					
	Basket Size			Variations in the Basket		
	1. Total Price	2. Purchase Quantity	3. Average Unit Price	4. Coefficient of Var	5. Percentage of Diff.	6. Number of Cat.
Central	-0.002*** (0.20)	0.012 (1.22)	-0.004 (0.35)	0.011 (1.08)	0.012 (1.14)	0.013 (1.22)
South	0.025*** (2.36)	0.025** (2.45)	0.009 (0.83)	0.026** (2.40)	0.023** (2.21)	0.003 (0.30)
FSIZE01	-0.004*** (0.41)	0.027*** (2.68)	-0.01* (1.51)	0.014 (1.35)	0.016 (1.50)	0.036*** (3.39)
AGE01	-0.020*** (2.35)	-0.009 (1.08)	-0.012 (1.35)	0.001 (0.07)	-0.002 (0.28)	-0.005 (0.57)
INCOME01	0.035*** (4.02)	0.035*** (4.13)	0.024*** 2.69 ()	0.029*** (3.21)	0.040*** (4.45)	0.025*** (2.81)
CHILDREN	0.006*** (0.56)	0.020** (1.94)	-0.001 (0.10)	0.014 (1.32)	0.015 (1.45)	0.003*** (0.30)
SPEED	0.008*** (0.88)	0.011 (1.35)	-0.004 (0.43)	0.004 (0.41)	0.003 (0.37)	0.001 (0.16)
COUNTRY	0.022*** (2.52)	0.015* (1.79)	0.017** (1.99)	0.004 (0.47)	0.006 (0.65)	-0.003 (0.33)
Observations	12444	12444	12444	12339	12339	12444
R^2	79.47%	53.08%	77.01%	36.88%	53.74%	24.31%

1. The independent variable is Product Total Price and its squared term when the dependent variable is Purchase Quantity, Unit Price, Number of Category.
2. The independent variable is Unit Price and its squared term when the dependent variable is Coefficient of variation, Percentage of Difference.

Table 14. Model 4 (Hierarchical Linear Piecewise Model with Relative Gap measures)Estimation Results

Independent Variables	Dependent Measures					
	Basket Size			Variations in the Basket		
	1. Total Price	2. Purchase Quantity	3. Average Unit Price	4. Coefficient of Var	5. Percentage of Diff.	6. Number of Cat.
Intercept	-0.275*** (8.00)	0.258*** (2.86)	-0.911*** (17.02)	-0.265*** (2.85)	-0.090 (0.98)	-1.136*** (12.29)
Amazon	-0.498*** (4.55)	-0.667*** (9.49)	0.246*** (5.64)	-0.242*** (3.64)	-0.338*** (5.27)	0.372*** (5.56)
Ebay	0.004*** (6.58)	-0.883*** (9.09)	0.133** (2.56)	-0.476*** (4.75)	-0.570*** (5.81)	0.304*** (3.10)
Walmart	-0.113 (0.06)	-0.706*** (9.59)	0.509*** (10.96)	-0.288*** (4.03)	-0.389*** (5.64)	0.824*** (11.43)
Yahoo	-0.259 (1.62)	-0.521*** (6.78)	0.284*** (5.53)	-0.224*** (3.00)	-0.277*** (3.85)	0.855*** (11.21)
BN	1.486*** (4.05)	-0.574*** (7.61)	0.256*** (5.56)	-0.097 (1.32)	-0.197*** (2.78)	0.761*** (10.39)
Office	-0.217*** (4.20)	0.199 82 (0.)	0.111 (0.69)	0.604** (1.99)	0.551* (1.86)	1.570*** (4.84)
Gap	0.003*** (3.01)	-0.492*** (5.40)	0.017 (0.32)	0.043*** (0.52)	-0.024 (0.29)	0.211** (2.56)
UniItem[1]	0.476*** (80.28)	0.012*** (90.78)	-0.307*** (57.94)	0.154*** (12.56)	0.912*** (81.28)	0.864*** (50.16)
UniItem Squared Term	-0.026*** (27.91)	-0.029*** (40.74)	0.016*** (22.43)	-0.003*** (3.78)	-0.057*** (31.46)	-0.021*** (18.18)
Unit Price[2]	0.919*** (127.81)	-0.961*** (75.44)	0.560*** (86.79)	0.784*** (60.24)	0.132*** (12.56)	-0.717*** (39.29)
Unit Price Squared Term	-0.005*** (16.43)	0.020*** (33.96)	0.016*** (34.17)	-0.072*** (34.55)	-0.003*** (4.40)	0.014*** (15.48)
Relative Gain	0.022 (0.42)	0.009 (1.20)	-0.005 (1.08)	0.003*** (0.38)	-0.001 (0.11)	0.029*** (3.33)
Relative Loss	0.155*** (3.36)	0.032*** (3.90)	0.015*** (3.38)	0.043*** (3.96)	0.041*** (3.90)	0.012 (1.54)
No Gain No Loss	1.004*** (8.36)	0.073*** (4.04)	0.102*** (3.47)	-0.015*** (0.71)	-0.054*** (2.68)	0.059*** (2.77)
MAIN1	1.044*** (15.04)	0.350*** (4.41)	0.873*** (18.67)	0.547*** ()6.85	0.401*** (5.08)	0.963*** (12.01)
MAIN2	0.642*** (14.36)	0.101*** (1.82)	1.071*** (17.17)	0.336*** (5.13)	0.244*** (3.77)	0.680*** (10.07)
MAIN3	1.219*** (13.09)	0.355*** (6.48)	0.473*** (14.62)	0.448*** (7.03)	0.374*** (5.86)	0.641*** (10.06)
MAIN4	0.106*** (19.84)	0.204*** (3.67)	1.233*** (19.53)	0.352*** (5.36)	0.277*** (4.22)	0.610*** (9.11)
MAIN5	0.018 0.32 ()	0.289 (0.98)	0.506*** (3.66)	0.600*** (1.60)	0.593 (1.52)	0.107 (0.33)
HOLIDAY	0.071 (0.45)	0.019 (0.42)	-0.014 ()0.45	-0.083*** (1.83)	-0.057 (1.29)	-0.030 (0.66)
DURATION	0.073*** (5.22)	0.022*** (1.43)	0.005 (0.73)	0.094*** (5.72)	0.092*** (5.24)	0.051*** (2.89)
PAGES	0.031*** (5.09)	0.445*** (20.95)	-0.031*** (3.97)	0.214*** (11.56)	0.317*** (15.27)	0.242*** (11.07)
EDU01	-0.002*** (2.11)	0.029 (1.61)	0.012 (1.17)	0.077*** (3.74)	0.066*** (3.28)	0.023 (1.14)
East	-0.012 (0.09)	0.030 (1.13)	-0.004 (0.27)	0.018*** (0.58)	0.024 (0.80)	0.038 (1.29)

Independent Variables	Dependent Measures					
	Basket Size			Variations in the Basket		
	1. Total Price	2. Purchase Quantity	3. Average Unit Price	4. Coefficient of Var	5. Percentage of Diff.	6. Number of Cat.
Central	-0.002*** (0.56)	0.001 (0.02)	-0.007 (0.45)	-0.019*** (0.62)	-0.004 (0.14)	0.012 (0.43)
South	0.005*** (0.10)	-0.003 (0.11)	-0.006 (0.46)	-0.001*** (0.02)	0.003 (0.09)	-0.004 (0.16)
FSIZE01	-0.028 (0.25)	0.053** (2.21)	-0.016 (1.15)	0.045*** (1.67)	0.048* (1.77)	0.057** (2.13)
AGE01	0.035* (1.79)	-0.009 (0.45)	-0.013 (1.17)	-0.003*** (0.14)	-0.005 (0.25)	-0.016 (0.76)
INCOME01	0.007** (2.31)	0.042** (2.24)	0.012 (1.13)	0.032*** (1.54)	0.048* (2.33)	0.039* (1.89)
CHILDREN	0.026 (0.36)	0.028 (1.24)	-0.005 (0.39)	0.016*** (0.63)	0.025 (1.00)	0.000 (0.01)
SPEED	0.055* (1.72)	-0.011 (0.59)	0.004 (0.41)	0.008*** (0.40)	0.005 (0.22)	-0.013 (0.64)
COUNTRY	-0.275** (2.27)	0.051* (1.74)	0.025 (1.52)	0.021*** (0.62)	0.024 (0.75)	0.007 (0.23)
Observations	12444	12444	12444	12339	12339	12444

1. The independent variable is Product Total Price and its squared term when the dependent variable is Purchase Quantity, Unit Price, Number of Category.
2. The independent variable is Unit Price and its squared term when the dependent variable is Coefficient of variation, Percentage of Difference.

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