경제학 석사 학위논문

Three Essays of Grocery Consumers' Channel Selection Behavior between Online and Offline Market

소비자들의 농식품 구매채널 선택행동

2016년 8월

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지도교수 문 정 훈

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Abstract

Three Essays of Grocery Consumers' Channel Selection Behavior between Online and Offline Market

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Electronic commerce has pervaded consumers' daily life since the 1990s, but online grocery is still lagging behind. This study aims to identify the hurdles online grocery faces and the ways to get over the hurdles. To accomplish the aim of study, grocery consumers' channel selection behavior is investigated using three consecutive studies. Study 1 examines the effects of consumers' food-related lifestyles on channel selection. The results show a positive determinant of online channel selection is consumers' perception regarding freshness in the case of grains, and cost performance in the case of vegetables. In study 2, factors regarding diffusion rate of online grocery is investigated, and perceived compatibility is identified as a significant determinant of online channel selection. In study 3, grocery consumers' exclusiveness of online channel usage is examined. It is shown that grain consumers use the online channel exclusively, but vegetable consumers do not. Several implications are also suggested.

Keywords: Online Grocery Shopping, Purchase Channel Selection, Product Heterogeneity, Search Costs, Food Related Lifestyle

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I. Introduction

It is commonly accepted that online shopping pervades daily life, and in some industries, online shopping providers dominate traditional shopping providers (Chakraborty et al. 2016). For example, there are stories of managers of brick and mortar bookstores deciding to shut down because of the competition with online bookstores such as Amazon.com (Brynjolfsson and Smith 2000). The grocery industry, however, has been an exception to such phenomena. Grunert and Ramus (2005) noted that most online grocers have failed to enjoy much success. Even seemingly successful online grocers have gone out of business, SimonDelivers (a previous prominent online grocer in US) being a representative example (Zhu and Semeijn 2015). Webvan and HomeGrocer are other instances of failing to sustain an online grocery business in the US. In this regard, some researchers believe that online grocery is "the Bermuda Triangle of electronic commerce," meaning that money goes but never returns (McDonald et al. 2014).

On the other hand, some researchers are optimistic about the future of the online grocery business. Specifically, Benn et al. (2015) predicted that consumers in the UK will purchase about 10% of their groceries online by 2020. In reality, Amazon Fresh shows rapid growth in the US (Gorczynski and Kooijman 2015), and US consumers have an interest in purchasing groceries online (Morganosky and Cude 2002). In Korea, B2C (business to consumer) online grocery transactions expanded from 1.76 hundred million dollars to 48.25 hundred million dollars between 2001 and 2014 (Statistics

Korea 2016). In this vein, the viability and the sustainability of the online grocery business are still controversial. Therefore, it is worthwhile to investigate factors affecting the online grocery shopping behavior of consumers.

The previous body of literature regarding online grocery shopping focused on the intention to grocery shop online, using prevalent behavioral theories such as the theory of planned behavior (TPB) and the theory of reasoned action (TRA). For example, Shim et al. (2001) proposed a behavioral model that includes attitude, subjective norms, and perceived behavioral control based on the TPB. Further, Hansen et al. (2004) applied the TPB based model proposed by Shim et al. (2001) to the context of online grocery purchasing behavior. They found that TPB is better suited than TRA for predicting online grocery buying intention. The disparity between behavioral intention and actual behavior, however, was pointed out as a limitation of such models, and thus Hansen et al. (2004) suggested that future research should address actual online grocery purchasing patterns rather than focusing on purchase intention. From another perspective, Cobb-Walgren et al. (1995) argued that attitudes, the antecedent construct of behavioral intention from the perspective of TPB, is not a highly reliable determinant of purchase behavior. In a similar vein, De Pelsmacker et al. (2005) reported a disparity between attitude and actual purchase behavior. However, literatures that analyze the grocery consumers' receipt data are limited. In this context, the current study aims to understand the purchase behavior of grocery consumers, analyzing grocery purchase data

gathered from household panels' grocery receipts, and online grocery vendors' sales records.

On the one hand, online grocery shopping can be considered from the perspective of channel selection behavior between online and offline market. As for the relevant example, Kauffman et al. (2009) investigated the price discrimination strategies of hybrid firms that retain both online and offline sales channels, and identified that consumers' channel selection behavior is determined by channel switching costs and loyalty to the firm. Further, it was noted that the portion of online channel demand among total demand determines the price level that hybrid firms select (Kauffman et al. 2009). The focus of the literature related to channel selection is not consumers' channel selection behavior, but rather firms' multi-channel management (e.g. Kauffman et al. 2009; Lam et al. 2004; Neslin et al. 2006; Stone et al. 2002). Therefore, a consumer centric view point is required when conducting a channel selection study (Dholakia et al. 2010). In this regard, the current study holds consumer centric view point to investigate the grocery consumers' channel selection behavior between online and offline. By doing so, the current study fill the current research gap: limitation in consumer centric research.

Furthermore, the grocery, a research subjects of the current study, includes various sub-categories. This study divides the grocery into two sub-categories, grains and vegetables, based on the product heterogeneous theory. The separation enables the current study to compare the differences in grocery

consumers' channel selection and purchase behavior, the comparison being another empty space of the current body of literatures.

The other focus of the current study is the exclusiveness of channel selection behavior. Generally, consumers do not use only one channel between online and offline. For example, among US retail consumers, 63% were store-only shoppers, 12% were Internet-only shoppers, 12% were catalog-only shoppers, and 12% and 1% were dual-channel and triple-channel shoppers, respectively (Thomas and Sullivan 2005). Further, consumers continuously migrate from one channel to another (Dholakia et al. 2010). Thus, channel selection is not the end; consumers can compare online and offline channels even after they select a channel, or consumers can migrate. To capture such dynamism in channel selection, analytical model regarding consumers' search range is established based on the search cost economics. Moreover, the current study considers online and offline prices simultaneously in the empirical models, because consumers' price expectations are a factor affecting channel selection behavior in the multi-channel context (Brynjolfsson and Smith 2000).

In sum, the current study is organized as shown in Table 1 to accomplish the following aims: to identify factors affecting grocery consumers' channel selection behavior, and to understand the dynamism in grocery consumers' channel selection behavior.

Studies	Research Questions	Theoretical Background
Study 1 : Why do consumers shop online for groceries?	Does consumers' lifestyle affects to channel selection behavior?	Innovation classification scheme
	Does consumers' lifestyle affects to online grocery purchase amount?	Product heterogeneity
		Food related lifestyle
Study 2: Why are consumers reluctant to shop online for groceries?	Do innovative characteristics of online grocery shopping affects to channel selection behavior?	Innovation classification scheme
		Product heterogeneity
		Diffusion of innovation
Study 3: Do online grocery consumers care about offline channel?	Whether online channel and offline channel are competing channel?	Innovation classification scheme
	Do online grocery consumers care about corresponding offline grocery price?	Product heterogeneity
		Search costs economics

Table 1. Organization of the Current Study

As summarized in Table 1, innovation classification scheme is adopted as a theoretical lens to identify the basic characteristics of online grocery throughout three studies. In study 1, factors affecting both grocery consumers' channel selection behavior and online grocery purchase amount are identified from the perspective of consumers' lifestyle. The food-related lifestyle is applied as a theoretical background. In study 2, grocery consumers' channel selection is investigated from the technological perspective. The diffusion of innovation theory is employed as a theoretical lens. In Study 3, the current study takes a market oriented perspective to understand the dynamism in grocery consumers' channel selection behavior based on the search cost economics, and online grocery price and corresponding offline grocery

market prices. Throughout three studies, product heterogeneity theory is applied to compare different grocery categories: grains and vegetables. By comparing grains and vegetables, it is possible to identify the role of product heterogeneity in the channel selection behavior of grocery consumers.

With the series of three interdependent studies, the current study sheds light on the underlying structure of grocery consumers' channel selection behavior between online and offline, which is an important research stream regarding multichannel consumer research (Dholakia et al. 2010).

II. Theoretical Background

1. Innovation Classification Scheme

Online grocery shopping is regarded as an innovation by consumers (Lim et al. 2009). According to Robertson (1967)'s innovation classification scheme, innovation is divided into three categories, which are continuous innovation, dynamically continuous innovation, and discontinuous innovation. Continuous innovation refers to a basic extension of an existing product, so it does not drastically change the current consumption patterns of consumers (Robertson 1967). An example of continuous innovation is the plasma TV (Lim et al. 2009). A discontinuous innovation has opposite characteristics from continuous innovation; it changes the consumption patterns of consumers in a drastic manner (Robertson 1967). The mobile phone is a good

example of discontinuous innovation (Lim et al. 2009). A dynamically continuous innovation is located between continuous and discontinuous innovation, because a dynamically continuous innovation disrupts the current consumption patterns of consumers at a moderate level (Robertson 1967). According to Robertson (1967), electric toothbrushes are a suitable example of discontinuous innovation.

Within this setting, online grocery shopping is classified as a discontinuous innovation, in that it tremendously changes the purchasing patterns of grocery consumers (Robinson et al. 2007). According to Peck and Childers (2003), consumers used to be concerned with sensory trials before purchasing products. Grocery consumers are no exception; rather, it is reasonable to expect that they tend to rely heavily on sensory stimuli when purchasing groceries because grocery products are perishable. In the online setting, however, the limitation of sensory stimuli is unavoidable (Hansen 2005). For example, consumers cannot touch and smell the products that they want to purchase. Therefore, grocery consumers must change their purchasing patterns to buy grocery products via online.

2. Product Heterogeneity

De Figueiredo (2000) established the degree of product heterogeneity continuum in the context of online commerce as shown in Figure 1.

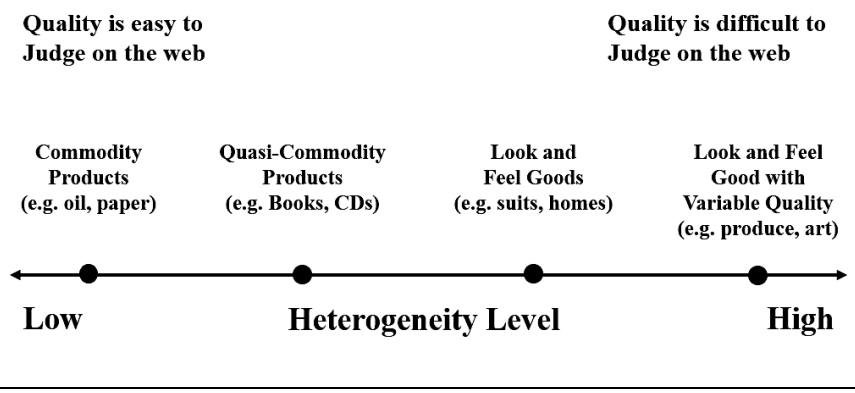

Figure 1. Level of Product Heterogeneity in Online Setting (De Figueiredo 2000)

The standard of determining the level of product heterogeneity is how easily one can grasp the quality of a product in an online setting. Similarly, Chung et al. (2006) contended that it is easier to grasp the quality of homogeneous products than heterogeneous products. The level of product heterogeneity affects the purchasing patterns of online consumers. For example, online consumers showed different purchasing patterns when comparing cases of purchasing a Beatles CD (homogeneous product) and purchasing a pack of abalone (heterogeneous product) (Chung et al. 2006).

However, groceries have not yet been classified based on the level of heterogeneity in the context of online shopping, though it is possible to apply De Pelsmacker et al. (2005)'s level of product heterogeneity to groceries. When considering how easily consumers can judge the quality of products online, the level of heterogeneity of vegetables is much higher than that of grains for the following reasons. At brick and mortar stores, many grocery products are sold unpackaged, but grains are sold as packaged units. Also,

vegetables are more likely to perish than grains. Thus, consumers more heavily rely on sensory stimuli to fully grasp the quality of grocery products, which is a common tendency of grocery consumers (Lim et al. 2009) when they purchase vegetables. In this regard, a huge gap exists between online and offline vegetable purchases in terms of the availability of sensory stimuli, but such a gap is relatively trivial in the case of grain purchases.

Based on this perspective, the current study considers two grocery product categories, vegetables and grains, as a unit of analysis. Thus, all empirical models and analytical models contained in the current study compares the channel selections and purchasing patterns of grocery consumers along with two product categories (i.e. grains and vegetables).

III. Study 1: Why Do Consumers Shop Online for Groceries?

Study 1 takes a consumer centric perspective. That is, factors strongly related to the daily life of consumers are identified and addressed to uncover the reason why grocery consumers select the online channel. Specifically, accessibility to offline grocery stores and consumers' food-related lifestyle are considered.

1. Hypotheses Development

The main stream of literature related to consumer behavior in multi-channel environments is two-fold: investigating factors that can be used to segment and profile consumers regarding to multi-channel preference, and identifying channel selection and migration process (Dholakia et al. 2010). Referring to the first stream of the literature, segmenting and profiling consumers, food-related lifestyle (FRL) was selected as a segmentation variable. In the area of food consumption literature, various segmentation variables have been identified and applied (Wycherley et al. 2008). Frequently used segmentation variables are socio-demographic variables (Verbeke and Poquiviqui López 2005), motives and attitudes to research perceived risk in food choice (McCarthy and Henson 2005), and food-related lifestyle (Wycherley et al. 2008). According to Wycherley et al. (2008), FRL is the most extremely elaborated segmentation tool among them.

The foundation of FRL are the psychological and behavioral aspects of humans (Reid et al. 2001), and there are five aspects of consumers' cognitive structure in the FRL, which are purchasing motive, quality aspects, consumption situations, ways of shopping, and cooking methods (Scholderer et al. 2004). According to Scholderer et al. (2004), individual differences related to the importance of food are reflected in the purchasing motives, and the food quality evaluation schema of each individual is captured by quality aspects in the FRL model. Ways of shopping, cooking methods, and consumption situations capture the differences between individuals in the perpetual use of scripts and skills (Scholderer et al. 2004). From the

macroscopic viewpoint, the FRL model addresses the consumers' assessment, preparation, and actual consumption of food (Hoek et al. 2004). Further, Grunert et al. (1993) explain that the FRL model addresses the value of food, which is perceived by consumers to the extent that its consumption will lead to self-relevant consequences. The FRL variables are related to the differences of each individual grocery consumer, but the valence of FRL variables in the online setting is still unclear (Grunert and Ramus 2005). In this regard, following hypotheses are proposed.

H1-1: FRL variables will influence the probability of online channel selection

H1-2: FRL variables will influence the online grocery purchase amount

The previous body of literature has pointed out that convenience is an important factor affecting the online grocery shopping intention (Grunert and Ramus 2005; Morganosky and Cude 2000). Specifically, Grunert and Ramus (2005) contended that convenience is the crucial factor in terms of online grocery shopping, in that the requirement of mental and physical energy is reduced in the online setting compared with the offline setting. In a similar vein, Morganosky and Cude (2000) proposed that convenience and time saving together are the most important motivation of online grocery shopping. As illustrated in this article's theoretical background, online grocery shopping is a discontinuous innovation (Robinson et al. 2007), and thus the online grocery purchasing process is tremendously different from that of shopping

offline. The biggest reason for this difference is the limited sensory stimuli in the online setting (Hansen 2005). Therefore, grocery consumers hesitate to select the online channel unless appropriate marketing strategies are enlisted to generate new consumption patterns (Anderson and Ortinau 1988). Given the biggest motivations of online grocery consumers, convenience and time saving (Grunert and Ramus 2005; Morganosky and Cude 2000), the current study considers convenience variables. In terms of consumers' lifestyle, car possession is relevant to the convenience of offline grocery shopping. The number of cars possessed is linked to the availability of a car, because the unit of analysis is the individual household. The time requirement to access the offline grocery market is related to time saving. Therefore, the following hypotheses are proposed

H2-1: Car ownership will decrease the probability of selecting the online channel.

H2-2: Car ownership will decrease the online grocery purchase amount.

H3-1: The number of cars possessed will decrease the probability of selecting the online channel.

H3-2: The number of cars will decrease the online grocery purchase amount.

H4-1: Time required to access the offline grocery market will increase the probability of selecting the online channel.

H4-2: Time required to access the offline grocery market will increase the online grocery purchase amount.

Lastly, the product heterogeneity is considered. As explained in the theoretical background section, it is clear that vegetables are more heterogeneous product then the grains in the online grocery shopping context. Further, it was identified that product heterogeneity affects to the online purchase behavior (Chung et al. 2006; Grunert and Ramus 2005). Therefore, following hypothesis is proposed.

H5: The product types (grains vs. vegetables) will moderate the effects of FRL and convenience variables.

Figure 2 represents the research model of study 1 based on the proposed hypotheses.

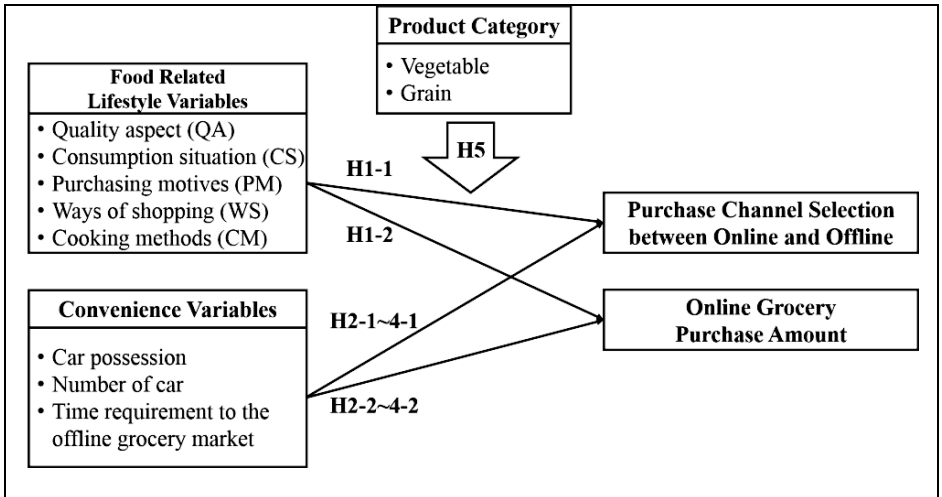

Figure 2. Research Model and Hypotheses of Study 1

As shown in the Figure 2, established research model includes convenience variables, which are whether the consumer possesses car, the number of possessed car, and the time required to access offline grocery market as independent variable. The food related lifestyle variables are also included as independent variable. As for the moderator, product categories are consided in the model. The dependent variables are two-folded; the first one is the consumers' grocery purchase channel selection between online and offline, and the second one is the online grocery purchase amount. The binary logit regression is conducted to identify the effects of independent variables on the channel selection between online and offline, and the linear regression is conducted to assess the effects of independent variables on the online grocery purchase amount.

2. Methodology

2.1 Data Collection

The current study analyzed grocery purchase records of household panels gathered by the Rural Development Administration (RDA) of Korea. The RDA collected all of the 732 household panels' grocery purchase records during 2013. The respondents within the household panels are housewives who live in the Seoul metropolitan area. The current study identified 811 online grocery purchases among 152,767 total purchases of grains and vegetables.

Table 2 shows descriptive statistics of household panel data. The mean value of the monthly income was $3,900, and this value is comparable to the mean value of monthly income of Korean households in 2013, $3,700 (Statistics Korea 2013). The ratio of the online to offline purchase amount of grains was 38.6%, and that of vegetables was 9.8%. Though the ratio of online to offline purchase amounts is a descriptive statistic, the figures intuitively show differences in grocery purchasing behavior between grains and vegetables.

Variables	Mean	Count	Median
Monthly income	$3,900	-	$4,000
Number of cars	1.07	-	1
Car possession	-	626	-
Time required to access offline grocery stores	12 minutes		10 minutes
Online grain shopping experienced consumer	-	65	-
Online vegetable shopping experienced consumer	-	72	-
Online grain purchase amount	$68		$42
Online vegetable purchase amount	$67		$32
Offline grain purchase amount	$176		$145
Offline vegetable purchase amount	$681		$520

Table 2. Descriptive Statistics of Panel Samples

2.2 Operationalization of Food Related Lifestyle

The FRL model has been applied in various European countries, such as the UK, Denmark, France, Germany, and Spain (Scholderer et al. 2004). Further, the validity of FRL measurement was verified in diverse European countries (Brunsø et al. 2004; Scholderer et al. 2002), and the cross-cultural validity

was also ensured (Grunert et al. 1993). The researchers also successfully applied the FRL in Asian countries such as Singapore (Askegaard and Bruns⊘ 1999; Grunert et al. 1993).

Dimension	Construct	Description
Ways of shopping	Information(WS Info)	Importance of product information in food consumption
	Price(WS Price)	Importance of price criteria in food consumption
Quality aspect	Health(QA Health)	Importance of healthiness in food consumption
	Fresh(QA Fresh)	Importance of freshness in food consumption
	Taste(QA Taste)	Importance of taste in food consumption
	Price(QA Price)	Importance of cost performance in food consumption
Cooking method	New(CM New)	Propensity to seek new cooking method
	Whole (CM Whole)	Propensity to cook with whole family
	Plan (CM Plan)	Propensity to cook with plan
Purchasing motivation	Self (PM Self)	Propensity to seek self-fulfillment in food consumption
	Secure (PM Secure)	Degree of conservatism in food consumption
	Social (PM Social)	Propensity to seek social relationship in food consumption
Consumption situation	Consumption situation (CS)	Importance of eating out

Table 3. FRL Constructs and Descriptions

Table 3 summarizes the constructs and descriptions included in the questionnaire. The current study applied Grunert et al. (2011)'s measure, which was validated in the urban areas of China. The measurement items were translated into Korean in a careful manner. Five measurement items were dropped, due to cultural discrepancies. The final version of the questionnaire includes 34 questions, and each question uses the 5-point Likert scale. The

questionnaires were administered to the 732 household panel respondents. Detailed survey items were presented in Appendix A.

3. Results

3.1 Measurement Model Validation

Following Chin (1998)'s recommendation, the reliability of each survey item was assessed to ensure the convergent validity. All except three of the 34 items showed a factor loading value more than 0.7, but as these three items were significant at the 0.001 significance level, these items were retained following Ke et al. (2009). The composite reliability (CR) and average variance extracted (AVE) of each construct was also higher than 0.7 and 0.5 respectively, and thus all of the measurement items were reliable. Discriminant validity of FRL measurement items was also assessed. The square root of the AVE of each construct was higher than its correlations with the other constructs, so the discriminant validity was also ensured (Chin 1998). The detailed tables show factor loading of each measurement item, AVE and CR of each construct, and correlation among constructs were presented in Appendix B.

3.2 Hypotheses Testing

To test the effects of convenience variables and FRL variables on the channel selection behavior of grocery consumers, logit regression was conducted with the following specification.

$$\log\left(\frac{\mathrm{p}(S=1)}{1-\mathrm{p}(S=0)}\right) = \beta_0 + \beta_1 Income + \beta_2 Convenience\ variables + \beta_3 FRL\ variables + e$$

S in the equation refers the online channel selection, and convenience variables denote the time required to access the offline grocery market (time), number of cars, and car possession. As for the control variable, monthly income was included in the model, because previous literature demonstrated the significant effect of income on online grocery purchase behavior (Ramus and Asger Nielsen 2005). The specified model was applied both to grains and vegetables, and the estimation results are summarized in Table 4 and Table 5.

Grains Model (McFadden R^2 = 0.278)				
Variables	**β**	**exp(β)**	**z-value**	**p-value**
Constant	-3.791**	0.022	-5.320	0.000
Income	0.000	1.000	1.316	0.188
Time	-0.001	0.998	-0.092	0.926
Number of cars	-0.335	0.715	-0.847	0.397
Car possession	1.361	3.900	1.737	0.082
WS Info	0.290	1.337	1.279	0.201
WS Price	-0.155	0.855	-0.650	0.515
QA Health	0.112	1.119	0.533	0.593
QA Fresh	0.534*	1.707	2.079	0.037
QA Taste	-0.060	0.941	-0.329	0.742
QA Price	-0.319	0.926	-1.533	0.125
CM New	0.189	1.209	0.963	1.335
CM Whole	-0.305	0.736	-1.770	0.076
CM Plan	0.126	1.134	0.648	0.516
PM Self	0.068	1.071	0.370	0.711
PM Secure	0.061	1.063	0.379	0.704

PM Social	-0.249	0.779	-1.524	0.127
CS	0.058	1.060	0.365	0.715
*Significance levels: **: p<0.01, *: p<0.05* *Note: Time denotes time required to access the offline grocery market*				

Table 4. The Results of Logit Regression for Grain Consumers' Purchase Channel Selection Behavior

	Vegetables Model (McFadden R^2 = 0.329)			
Variables	β	exp(β)	z-value	p-value
Constant	-3.549**	0.028	-5.361	0.000
Income	0.001	1.001	1.493	0.135
Time	0.002	0.002	0.179	0.857
Number of cars	-0.795	0.451	-1.718	0.085
Car possession	1.502	4.491	1.955	0.051
WS Info	0.395	1.484	1.865	0.62
WS Price	-0.327	0.967	-0.164	0.869
QA Health	-0.661**	0.516	-2.950	0.031
QA Fresh	-0.002	0.979	-0.097	0.922
QA Taste	-0.410*	0.663	-2.292	0.021
QA Price	0.564*	1.758	2.302	0.021
CM New	-0.041	0.958	-0.215	0.829
CM Whole	-0.091	0.912	-0.529	0.597
CM Plan	0.226	1.125	1.180	0.237
PM Self	0.096	1.101	0.529	0.596
PM Secure	0.215	1.240	1.352	0.176
PM Social	-0.134	0.874	-0.782	0.434
CS	-0.045	0.955	-0.290	0.772
*Significance levels: **: p<0.01, *: p<0.05* *Note: Time denotes time required to access the offline grocery market*				

Table 5. The Results of Logit Regression for Vegetable Consumers' Purchase Channel Selection Behavior

According to the estimation results illustrated in Table 4 and Table 5, the effects of convenience variables were not significant in both grains and vegetables model. Among FRL variables, QA Fresh is the only significant variable in the grains model. Whereas, in the vegetables model, QA Health,

and QA Taste showed a negative effect on the online channel selection of grocery consumers, but QA Price showed a positive effect.

Consumers who purchased grains or vegetables via online more than once were selected from the whole sample and analyzed further with a following linear regression model. Box-Cox transformation was applied to stabilize the variance (Box and Cox 1964)

$$Y = \beta_0 + \beta_1 Income + \beta_2 Convenience\ variables + \beta_3 FRL\ constructs + \varepsilon$$

Y, a regressand, denotes transformed online purchase amount using Box-Cox transformation method.

Grains Model (adjusted R^2 = 0.240)			
Variables	**β**	**t-value**	**p-value**
Constant	8.039**	7.753	0.000
Income	-0.00008	-0.078	0.938
Time	0.05325**	3.223	0.002
Number of cars	-1.907	-1.701	0.098
Car possession	0.3527	0.726	0.473
WS Info	0.0778	0.231	0.818
WS Price	0.7756	1.878	0.069
QA Health	0.4806	1.346	0.187
QA Fresh	-0.3730	-1.074	0.290
QA Taste	-0.4755	-1.845	0.073
QA Price	-0.4874	-1.656	0.107
CM New	-0.0559	-0.231	0.818
CM Whole	0.4253	1.699	0.098
CM Plan	-0.5016	-1.705	0.097
PM Self	-0.1103	-0.463	0.646
PM Secure	0.5328*	2.190	0.035
PM Social	0.0572	0.244	0.809
CS	-0.2206	-1.002	0.323
*Significance levels: **: p<0.01, *: p<0.05* *Note: Time denotes time required to access the offline grocery market*			

Table 6. The Results of Linear Regression for Grain Consumers' Online Grocery Purchase Amount

Variables	Vegetables Model (adjusted R^2 = 0.279) β	t-value	p-value
Constant	0.8195**	61.390	0.000
Income	-0.00003*	-2.524	0.016
Time	-0.00046	-1.541	0.132
Number of cars	-0.00577	-0.654	0.517
Car possession	0.01611	1.053	0.299
WS Info	0.00141	0.361	0.720
WS Price	0.00411	0.767	0.448
QA Health	-0.01139*	-2.055	0.047
QA Fresh	0.00656	1.378	0.177
QA Taste	-0.00016	-0.040	0.968
QA Price	0.00048	0.094	0.925
CM New	-0.00050	-0.141	0.888
CM Whole	0.00137	0.346	0.731
CM Plan	0.00425	1.086	0.285
PM Self	-0.00587	-1.835	0.075
PM Secure	-0.00149	-0.480	0.634
PM Social	-0.00255	-1.002	0.323
CS	-0.004	-1.501	0.142

*Significance levels: **: p<0.01, *: p<0.05*
Note: Time denotes time required to access the offline grocery market

Table 7. The Results of Linear Regression for Vegetable Consumers' Online Grocery Purchase Amount

Results are listed in Table 6 and Table 7. Among convenience variables, the time required to access the offline grocery market showed a significant effect on the online purchase amount of grains, but any convenience variable showed significant effect in the vegetables model. Among FRL variables, PM Secure showed a positive effect on the online purchase amount of grains, and QA Health showed a negative effect on that of vegetables.

4. Discussion

When grocery consumers select the purchase channel, food related lifestyle affects to the probability to select the online channel. In the case of grains, consumers' perception regarding freshness is a significant factor affecting to the online channel selection among 13 food related lifestyle variables. That is, consumers who think freshness is important when purchasing grains have more chance to select these from the online channel. Grains are normally sold in standardized packages and less perishable, so the only way to evaluate the freshness of grains is to check the harvested date, rather utilizing sensory stimuli even in an offline setting. Referring that the search cost of online market is low (Bakos 1998), consumers can easily compare the harvested date in the online setting. Therefore, the results are consistent with reality.

On the other hand, consumers' perceptions related to health, taste, and cost performance are a significant factor in selecting online channel when consumers purchase vegetables. Specifically, negative perceptions of health and taste are consistent with the previous literature. For example, Raijas (2002) identified that limited sensory stimuli in an online setting is a primary barrier for grocery consumers' online channel selection. Referring to the fact that the healthiness and the taste of vegetables are hard to confirm without sensory stimuli, the negative effect of health and taste is reasonable. On the other hand, cost performance shows a positive effect. Relatively low switching and search costs of the online channel (Bakos 1998) may be the reason for this result. Thus, consumers who regard cost performance as

important have more chance to select an online channel to purchase vegetables.

After selecting the online channel, online grain consumers who want to consume familiar products spend more money to purchase grains online. As stated before, grains are homogeneous product, so the consumers can expect similar quality whenever they purchase grains online. In this regard, this result is also justifiable. The interesting point of post-selection (online grocery purchase amount) analysis is the effect of the time required to access the offline grocery store. The effect of time requirement is not significant in the context of channel selection, but its effect is significant in the post-selection analysis. Referring to the mean value of the time requirement of the sample, consumers do not think 12 minutes are inconvenient in the context of channel selection, but once they have selected the online channel, 12 minutes are perceived as inconvenient.

In the case of vegetables, consumers' perceptions regarding health shows a negative effect on the online vegetables purchase amount. Therefore, consumers who think that the healthiness of vegetables is important not only have less chance to select an online channel, but also they spend less money to purchase vegetables online, even though they have selected the online channel.

IV. Study 2: Why Are Consumers Reluctant to Shop Online for Groceries?

Study 2 focused on the innovative characteristics of online grocery shopping. As articulated before, it is possible to view grocery consumers' online channel selection as a new transaction systems adoption, referring to the infancy of online grocery businesses (Lim and Dubinsky 2004; Lim et al. 2009). Diffusion of innovation (DOI) theory offers a comprehensive understanding from the perspective of new systems adoption. In this regard, the current study investigates the effects of factors drawn from DOI theory on grocery consumers' channel selection behavior.

1. Hypotheses Development

Rogers (2010) identified the five factors affecting the diffusion rate of an innovation. The five factors, which are the most cited regarding the characteristics of innovation (Moore and Benbasat 1991), are relative advantage, compatibility, complexity, observability, and trialability (Rogers 2010).

Relative advantage is the degree to which an innovation is better than the other alternatives as perceived by potential adopters (Jo Black et al. 2001). If users fail to identify relative advantages of an innovation, that innovation will not be considered further as one of the users' alternatives (Greenhalgh et al. 2004). Compatibility is defined as the degree of consistency with potential

adopters' current values, needs and past experiences (Moore and Benbasat 1991). The more compatible the innovation, the more readily adopted will it be by potential adopters (Aubert and Hamel 2001; Rogers 2010). Complexity is the degree of potential adopters' perceptions regarding the ease of use (Moore and Benbasat 1991). In opposition to compatibility, if the innovation is more complex to use, potential adopters are less likely to adopt it (Marshall 1990; Meyers et al. 1999). Observability is the degree of visibility of benefits resulting from adoption of an innovation (Greenhalgh et al. 2004), and trialability indicates how easily potential adopters can experiment an innovation prior to its adoption (Moore and Benbasat 1991).

Hansen (2005) conducted discriminant analysis based on the five factors regarding the diffusion rate of an innovation. With these considerations, grocery consumers were categorized into three segments: non-adopters of online shopping, online shopping adopters and online shopping & online grocery shopping adopters. Hansen (2005) retained relative advantage, compatibility, and complexity, but dropped observability and trialability, including social norm and online grocery risk. Social norm connotes communicability (Hansen 2005), a degree of social acceptance, which is disseminated among consumers (Weick and Walchli 2002). Online grocery risk is a multi-dimensional concept that includes perceived product risk, perceived social risk, perceived vendor risk, and perceived technology risk (Hansen 2005). Therefore, revised DOI factors are perceived social norm

(PSN), perceived complexity (PCL), perceived compatibility (PCA), perceived relative advantage (PRA), and perceived online grocery risk (POR).

Considering the discontinuity of online grocery in terms of compatibility with the traditional way of grocery shopping (i.e. offline grocery shopping), and the infancy of online grocery business (Lim and Dubinsky 2004; Lim et al. 2009) simultaneously, it is reasonable to consider consumers' online channel selection from the perspective of new transaction system adoption. In this regard, this study proposes the following hypotheses based on the DOI theory and Hansen's (2005) revised DOI factors.

H1: Perceived social norms will increase the probability of adopting the online grocery.

H2: Perceived complexity will decrease the probability of adopting the online grocery.

H3: Perceived compatibility will increase the probability of adopting the online grocery.

H4: Perceived relative advantage will increase the probability of adopting the online grocery.

H5: Perceived online grocery risk will decrease the probability of adopting the online grocery.

Further, as same with the study 1, the product categories (grains and vegetables) are incorporated as a moderator.

H6: The product types (grains vs. vegetables) will moderate the effects of revised DOI factors.

Based on the proposed hypotheses, research model is illustrated in Figure 3.

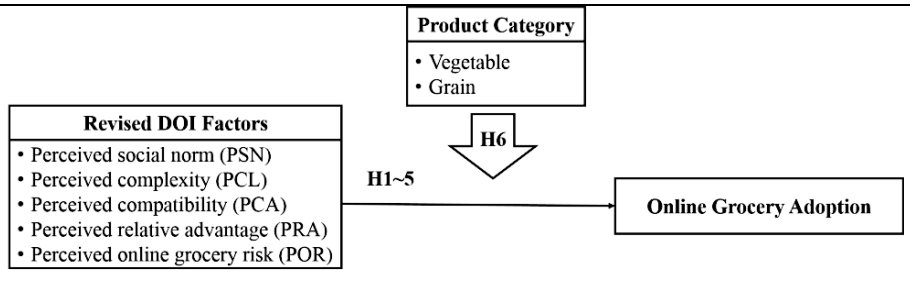

Figure 3. Research Model and Hypotheses of Study 2

As shown in Figure 3, the revised DOI factors are incorporated in the model as predictors, and the product categories are included as a moderator. Different from the study 1, the dependent variable is not grocery consumers' purchase channel selection, but online grocery adoption. From the perspective of DOI, online channel selection is online grocery transaction systems adoption, because online grocery is still infancy (Lim and Dubinsky 2004; Lim et al. 2009).

2. Methodology

In Study 2, household panel data analyzed in Study 1 was further analyzed with revised DOI variables. In the following section, the development of revised DOI measurement items will be explained.

2.1 Development Revised DOI Factors Measurement Items

To measure the perceived social norm, the current study follows Thomson et al. (1994) measurement items. The measures of perceived complexity and perceived compatibility follow Verhoef and Langerak (2001). Perceived relative advantage was measured by Hansen (2005) measurement items, which were created by multiple sources (Anckar et al. 2002; Kaufman-Scarborough and Lindquist 2002; Verhoef and Langerak 2001). The measure of perceived online grocery risk also follows Hansen (2005) measure, and it was also created by multiple sources (Lim 2003; McKnight et al. 2002). The measurement items were carefully translated into Korean. Each question uses a 7-point Likert scale from "strongly agree" to "strongly disagree." The questionnaires were administered to the 732 household panel respondents. Each survey item was presented in Appendix C.

3. Results

3.1 Validity and Reliability of Revised DOI Factors Measurement Items

The convergent and discriminant validity of survey items was assessed following Chin (1998), and Fornell and Larcker (1981) recommendations. The first survey item measuring PCL and POR were dropped in the further analysis, because these did not meet the .7 criterion of factor loading (Chin 1998). After removing them, all the survey items' factor loading were higher than .7, and all the composite reliability and AVE values were higher than .7 and .5, respectively. Therefore, convergent validity was ensured. Also, all five constructs showed sufficient discriminant validity because the square root of the AVE of each construct was higher than its correlations with the other constructs (Chin 1998). The detailed tables show factor loading of each measurement item, AVE and CR of each construct, and correlation among constructs were presented in Appendix D.

3.2 Hypotheses Testing

In order to identify the effects of revised DOI factors on the online channel selection, the following logit regression model was specified.

$$\log\left(\frac{\mathrm{p}(S=1)}{1-\mathrm{p}(S=0)}\right) = \beta_0 + \beta_1 age + \beta_2 income + \beta_3 revised\ DOI\ factors + \varepsilon$$

S in the model denotes online channel selection. Monthly income and age were also included in the model as a control variable. The specified model was applied to two product categories, grain and vegetables. The estimation results are listed in Table 8 and Table 9.

Grains Model(McFadden R^2 = 0.431)				
Variables	**β**	**exp(β)**	**z-value**	**p-value**
Constant	-2.700**	0.067	-2.235	0.011
Age	-0.001	0.999	-0.063	0.949
Income	0.000	1.000	0.368	0.713
PSN	0.404	1.497	1.747	0.081
PCL	-0.229	0.796	-1.116	0.264
PCA	0.992**	2.670	3.731	0.000
PRA	-0.215	0.806	-0.895	0.370
POR	0.253	1.288	1.337	0.181
*Significance levels: **: p<0.01, *: p<0.05*				

Table 8. The Results of Logit Regression for Grain Consumers' Online Channel Adoption

Vegetables Model(McFadden R^2 = 0.492)				
Variables	**β**	**exp(β)**	**z-value**	**p-value**
Constant	-3.924**	0.020	-3.538	0.000
Age	0.003	1.028	1.230	0.219
Income	0.000	0.999	-0.007	0.995
PSN	-0.019	0.980	-0.085	0.933
PCL	-0.414*	0.661	-1.965	0.049
PCA	1.161**	3.194	4.238	0.000
PRA	-0.384	0.681	-1.615	0.106
POR	0.088	1.091	0.468	0.640
*Significance levels: **: p<0.01, *: p<0.05*				

Table 9. The Results of Logit Regression for Vegetable Consumers' Online Channel Adoption

As summarized in Table 8 and 9, perceived compatibility is a significant factor in both models. In the grains model, perceived compatibility is the sole significant factor among the five factors, but in the vegetables model, perceived complexity is also a significant factor, in addition to perceived compatibility.

4. Discussion

In both grain and vegetable cases, perceived compatibility plays an important role in determining online grocery shopping adoption; consumers who perceive online grocery shopping as being compatible with their lifestyle are more likely to adopt online grocery shopping. Perceived complexity has an effect only on online vegetable shopping adoption; consumers who perceive online vegetable shopping as complex have a lower probability of adopting this practice.

Considering the exponential value of the estimated coefficient of perceived compatibility (2.670 in the case of grain and 3.194 in the case of vegetable), perceived compatibility is most imperative factor for online grocery shopping adoption, regardless of the product categories. The positive effect of perceived compatibility accords with the previous body of literature (Rogers 2010; Verhoef and Langerak 2001). This result is also resonant with the suggestion of Grunert and Ramus (2005) that convenience is a major factor in the adoption of online grocery shopping because online grocery shopping does not require additional energy, if online grocery shopping is compatible with consumers' lifestyle.

The negative effect of perceived complexity in the vegetables model may derive from the heterogeneous characteristic of vegetables. Specifically, the level of heterogeneity of vegetables is much higher than the grains because of the difficulty of grasping the quality of products online. In the similar vein,

it is hard to compare various vegetable products, because consumers do not delicately assess the quality of vegetables in online setting.

In this regard, with the same system configuration, online grain consumers do not suffer from confusion in assessing the quality of grocery products, but online vegetable consumers may have a hard time to grasp the quality of grocery products and compare the quality among various products. Referring current online grocery shopping systems do not divide the user interface or web configuration along with the product categories, it is highly likely that online vegetable consumers perceive the online grocery more complex than the online grain consumers. From this perspective the significant negative effect of perceived complexity in the vegetable model is justifiable.

Lastly, insignificant effect of perceived relative advantage in both grains and vegetables model connote important implications. The previous literatures contend that relative advantage, specifically time saving is primary motivation of online grocery shopping (Morganosky and Cude 2000). However, the results of study 2 shows that perceived relative advantage is insignificant factor in the adoption stage. Therefore, given infancy stage of online grocery shopping, perceived compatibility is significant factor rather than perceived relative advantage, such as time saving.

V. Study 3: Do Online Grocery Consumers Compare Online Channel and Offline Channel?

Study 3 focuses on the dynamism in the channel selection behavior of grocery consumers. In Studies 1 and 2, the current study sheds light on the factors affecting the online channel selection of grocery consumers from the perspective of lifestyle and diffusion of innovation. However, it is still unclear whether grocery consumers who select the online channel use this exclusively or not. Said differently, grocery consumers may compare the offline grocery channel and online grocery channel, and then migrate from one channel to the other. Alternatively, consumers may not care about the offline channel once they select the online channel. To address the research questions, not only analytical model based on the search cost in online markets, but also empirical model and hypotheses that support the analytical model are established in study 3.

1. Analytical Model

1.1 Basic Model

Based on the product heterogeneity theory, this study develop analytical model to capture the effect of product heterogeneity on the optimal search range of grocery consumers. Several basic assumptions on the product heterogeneity and the search range of grocery consumers are introduced as follow (among five assumptions, assumption 5 and assumption 4 can be

relaxed, and the analytical models without assumption 5 and assumption 4 are presented in the Appendix E and Appendix F, respectively).

A1. The product quality is uniformly distributed from minimum quality (Q_{min}) to maximum quality (Q_{max}). The distribution of the product quality is regarded as a common knowledge (i.e. consumers know the minimum quality, maximum quality, and their distribution)

A2. The consumers have an initial quality expectation (Q_E). In other words, each consumer expects the quality of heterogeneous product before they purchase the product. Further, each consumer is assumed as a totally risk aversion.

A3. The probability to purchase "bad product" (i.e. Pr(actual quality is less than the initial quality expectation)) decreases with the search range (S).

A4. Search costs (C) increase with search range. That is, C(S)=cS, and total search cost (TSC) is cS×S=cS^2.

A5. Consumers' quality perception is discrete (i.e. good or bad).

With these setting, the following expected utility function of consumers is suggested.

$$EU = R - P + (Q - Q_E)\Pr(Q \geq Q_E) - (Q_E - Q)Pr(Q < Q_E) - cS^2$$

Where, R denote the reservation price of consumers, P refers the market price, and the Q indicates the actual quality of the product. By assumption 5

(discrete quality perception of consumers), the expected utility function is given by

$$EU = R - P + (Q_{max} - Q_E)\Pr(Q \geq Q_E) - (Q_E - Q_{min})Pr(Q < Q_E) - cS^2$$

According to the assumption 1 (uniform distribution of the product quality), the expected utility function can be expanded as follow.

$$EU = R - P + (Q_{max} - Q_E)\int_{Q_E}^{Q_{max}} f_Q(Q)dQ - (Q_E - Q_{min})\int_{Q_{min}}^{Q_E} f_Q(Q)dq - cS^2$$

$$= R - P + (Q_{max} - Q_E)\frac{Q_{max} - Q_E}{Q_{max} - Q_{min}} - (Q_E - Q_{min})\frac{Q_E - Q_{min}}{Q_{max} - Q_{min}} - cS^2$$

According to Kwon et al. (2009), the structure of risk aversion can be reflected by applying convex combination. Let α be the coefficient of risk aversion ($0 \leq \alpha \leq 1$), then the expected utility function is as follow.

$$EU = R - P + \alpha(Q_{max} - Q_E)\frac{Q_{max} - Q_E}{Q_{max} - Q_{min}} - (1 - \alpha)(Q_E - Q_{min})\frac{Q_E - Q_{min}}{Q_{max} - Q_{min}} - cS^2$$

By assumption 2 (totally risk aversion consumers), $\alpha = 0$, and thus,

$$EU = R - P - (Q_E - Q_{min})\frac{Q_E - Q_{min}}{Q_{max} - Q_{min}} - cS^2$$

Finally, the assumption 3 (decrease of probability to purchase bad product with search range) is included to the model as follow.

$$EU = R - P - (Q_E - Q_{min})\frac{Q_E - Q_{min}}{S(Q_{max} - Q_{min})} - cS^2$$

Therefore, the optimal search range (S*) is

$$\max_S EU = \frac{\partial EU}{\partial S} = \frac{(Q_E - Q_{min})^2}{S^2(Q_{max} - Q_{min})} - 2cS = 0$$

$$S^3 = \frac{(Q_E - Q_{min})^2}{2c\,(Q_{max} - Q_{min})}$$

$$\boldsymbol{S^* = \frac{(Q_E - Q_{min})^{\frac{2}{3}}}{2^{\frac{1}{3}}c^{\frac{1}{3}}(Q_{max} - Q_{min})^{\frac{1}{3}}} \geq 0}$$

The optimal search range is non-negative, because c>0, $(Q_{max} - Q_{min})^{\frac{1}{3}}$>0, and $(Q_E - Q_{min})^{\frac{2}{3}} \geq 0$. If the consumers' initial quality expectation is exactly same with the minimum quality, then the optimal search range is zero, which means that consumers purchase the product without search. Otherwise, the optimal search range is strictly positive. In other words, consumers always search to the extent of some degree before they purchase heterogeneous products via online. Therefore, the following proposition is proposed.

Proposition 1. Online grocery consumers always search the other product before they purchase the product, unless they expect the minimum product quality.

1.2 Comparative Statics

To verify the effect of unit search cost (c), maximum quality (Q_{max}), minimum quality (Q_{min}), and initial quality expectation (Q_E) on the optimal search range (S*) this study conducts comparative statics. Firstly, the effect of unit search cost is examined as follow.

$$\frac{\partial S^*}{\partial c} = \left(-\frac{1}{3}\right)\frac{(Q_E - Q_{min})^{\frac{2}{3}}}{2^{\frac{1}{3}}c^{\frac{4}{3}}(Q_{max} - Q_{min})^{\frac{1}{3}}} \leq \mathbf{0}$$

As shown in the above first-order differential equation, the effect of unit search cost is non-positive. Further, if the consumers' initial quality expectation is higher than minimum quality, the effect of unit search cost is always negative. Therefore, the increase in the unit search cost causes the decrease in the optimal search range. In this regard, the following proposition is proposed.

Proposition 2. The grocery consumers' search range decreases with the unit search costs, unless they expect the minimum product quality.

Secondly, the effect of changes in the maximum quality and the minimum quality are examined.

$$\frac{\partial S^*}{\partial Q_{min}}$$

$$= \frac{-\frac{2}{3}(Q_E - Q_{min})^{-\frac{1}{3}}(Q_{max} - Q_{min})^{\frac{1}{3}} + \frac{1}{3}(Q_E - Q_{min})^{\frac{2}{3}}(Q_{max} - Q_{min})^{-\frac{2}{3}}}{2^{\frac{1}{3}}c^{\frac{1}{3}}(Q_{max} - Q_{min})^{\frac{2}{3}}}$$

$$= \frac{\frac{1}{3}(Q_E - Q_{min})^{\frac{2}{3}}(Q_{max} - Q_{min})^{-\frac{2}{3}}(1 - 2\frac{Q_{max}-Q_{min}}{Q_E-Q_{min}})}{2^{\frac{1}{3}}c^{\frac{1}{3}}(Q_{max} - Q_{min})^{\frac{2}{3}}}$$

$$\leq \mathbf{0} \left(\because \min\left(\frac{Q_{max} - Q_{min}}{Q_E - Q_{min}}\right) = 1\right)$$

$$\frac{\boldsymbol{\partial S^*}}{\boldsymbol{\partial Q_{max}}} = \left(-\frac{1}{3}\right)\frac{(Q_E - Q_{min})^{\frac{2}{3}}}{2^{\frac{1}{3}}c^{\frac{1}{3}}(Q_{max} - Q_{min})^{\frac{4}{3}}} \leq \mathbf{0}$$

The partial derivative of optimal search range (S*) with regard to the minimum quality (Q_{min}) is always negative, unless the consumers' initial quality expectation is exactly same with the minimum quality. In other words, the heterogeneity derived from the decrease of minimum quality increase the optimal search range, ceteris paribus. On the other hand, $\frac{\partial S^*}{\partial Q_{max}}$ is non positive, which denotes that the optimal search range is not increase with the maximum quality. If the consumers' initial quality expectation is higher than the minimum quality, $\frac{\partial S^*}{\partial Q_{max}}$ is strictly negative, and thus the optimal search range is decrease with the maximum quality. The effects of minimum quality and maximum quality on the optimal search range is summarized in Figure 4.

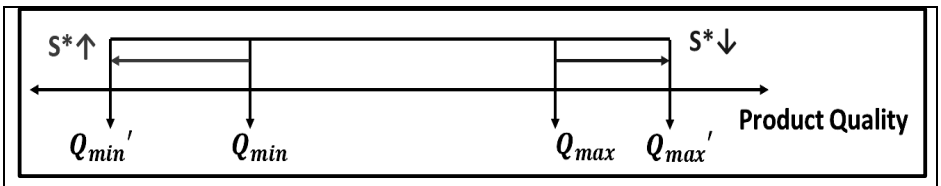

Figure 4. The Effects of Minimum and Maximum Quality

As shown in Figure 4, the heterogeneity generated by the decrease of minimum quality increases the optimal search range, but the heterogeneity generated by the increase of maximum quality decreases the optimal search range. In this regard, the following proposition is proposed.

Proposition 3. The direction of product heterogeneity is matter. Specifically, product heterogeneity derived from decrease in minimum quality increase the optimal search range, but product heterogeneity derived from increase in maximum quality decrease the optimal search range.

Further, the absolute value of the $\frac{\partial S^*}{\partial Q_{min}}$ is determined by the relative size between $Q_E - Q_{min}$. More specifically, the closer the consumers' initial quality expectation is, the higher the value of $\frac{\partial S^*}{\partial Q_{min}}$. Thus, the gap between consumers' initial quality expectation and minimum product quality determines the absolute value of $\frac{\partial S^*}{\partial Q_{min}}$, the response rate of optimal search range regarding the changes in the minimum product quality. Therefore, the following proposition is proposed.

Proposition 4. The closer the consumers' initial quality expectation with minimum product quality, the faster consumers' optimal search range along with the decrease of minimum product quality.

Figure 5 illustrate the proposition 4 graphically. As demonstrated, the response rate of optimal search range (i.e. $\frac{\partial S^*}{\partial Q_{min}}$) with regard to the negative

heterogeneity (i.e. decrease of minimum quality) exponentially diminishes with the distance between initial quality expectation and minimum quality.

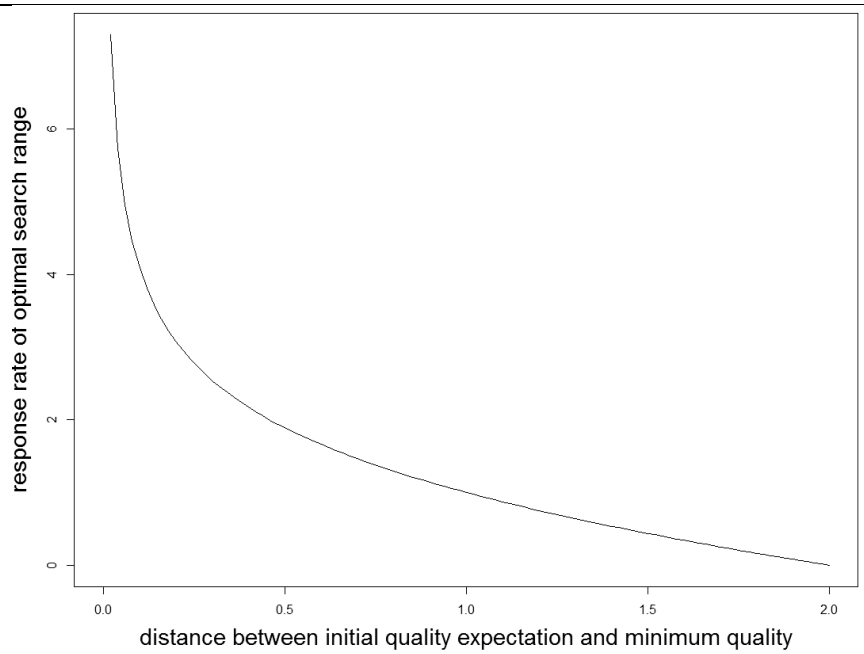

Figure 5. Graphical Illustration of Proposition 4

Finally, the effect of changes in the consumers' initial quality expectation is assessed.

$$\frac{\partial S^*}{\partial Q_E} = \frac{\frac{2}{3}(Q_E - Q_{min})^{-\frac{1}{3}}}{2^{\frac{1}{3}}c^{\frac{1}{3}}(Q_{max} - Q_{min})^{\frac{1}{3}}} \geq 0$$

According to the above equation, the increase of consumers' initial quality expectation expands the optimal search range, unless the initial quality expectation is exactly equal to the minimum product quality. Thus, the following proposition is proposed.

Proposition 5. The higher the consumers' initial quality expectation, the larger the optimal search range.

2. Empirical Model

To empirically validate the proposed analytical model, empirical analysis is also conducted. Among the five propositions, the focus of the empirical model is the third proposition, because the third proposition is directly linked to the product heterogeneity, a primary focus of the current study.

2.1 Hypotheses Development

It is a well-known fact that information technology (IT) provides accessibility to information about products and prices for consumers, and thus IT ultimately has increased market transparency (Bakos 1997; Granados et al. 2006). It is market transparency that has been regarded as one of the fundamental factors that has a positive effect on price discovery and on the fairness and competitiveness of the market (Bloomfield and O'Hara 1999). In this regard, the general perception regarding online grocery markets is that they offer cheaper prices. For example, Ramus and Asger Nielsen (2005) showed that grocery prices in online markets are generally believed to be cheaper than those at brick and mortar stores.

In this regard, online grocery consumers may not compare the online grocery price with that of offline, because cheaper price in online market is the general belief (Ramus and Asger Nielsen 2005). Despite this general belief, low grocery prices and delivery services are simply incompatible in reality

(Delaney-Klinger et al. 2003). Thus, it is uncertain whether online grocery consumers compare the online channel and offline channel in terms of price.

To capture whether the online grocery consumers care about offline channel, the grocery price of offline channel is identified as an independent variable of the empirical model. The online grocery price also included in the empirical model as an independent variable. Intuitively, it is likely that online grocery price negatively affects to the online grocery vendors' sales performance, because it is a "law of demand". In this regard, the following hypothesis is proposed.

H1: online grocery price will influence to the sales performance of online grocers in negative way

The offline grocery price, however, has a negative effect if the online channel and the offline channel are competing channel. If the offline channel and the online channel are not competing channel, the offline grocery price may not have a significant effect on the sales performance of online grocery vendors.

This study expect that online grains consumer do not care about the offline channel, but the online vegetables consumer do care about the offline channel. In other words, it is expected that online grains market and the offline grains market are not competing channel, but the online vegetables market and the offline vegetables market are competing channel.

The product heterogeneity is the underlying logic behind the expectation: consumers perceives more risk while they shopping heterogeneous product

than homogeneous product in online setting (Choe et al. 2007), because it is hard to assess the quality of heterogeneous product. Further, it is empirically validated that higher perceived risk causes intensive information search (Gemünden 1985). Therefore, the following hypotheses are proposed.

H2: in the case of grains, offline grocery price will not influence to the sales performance of online grocers

H3: in the case of vegetables, offline grocery price will influence to the sales performance of online grocers in positive way

Even more, the analytical model established in the previous section also indicates that the search range of online vegetable consumers is larger than that of online grain consumers (proposition 3). In reality, it is reasonable to posit that the direction of heterogeneity is negative, and thus the proposition 3 is another evidence supports the proposed hypotheses, H2, and H3.

Based on the proposed hypotheses, research model and hypotheses were proposed as shown in Figure 6.

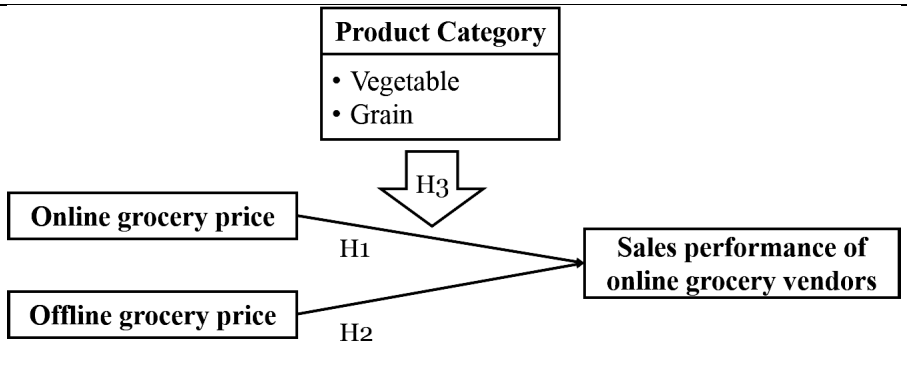

Figure 6. Research Model and Hypotheses of Study 3

As shown in the Figure 6, the established model includes two independent variables: online grocery price and offline grocery price. Dependent variable is the sales performance of online grocery vendors. The product category is also incorporated in the model as same with the study 1 and study 2.

2.2 Methodology

2.2.1 Data Collection

To verify the proposed research model and hypotheses, consumers' online grocery purchase data was gathered from one of the prominent online agro-product e-commerce sites, namely KG Farm (http://kgfarm.gg.go.kr). KG Farm was established by a Korean local government (Gyeonggi-Do local government). The manager of KG Farm agreed to provide transaction records from January 2010 to July 2015 with the understanding that the records would be used for research only. Among various products sold by KG Farm, Pyeong-teak rice and tomatoes were selected and analyzed.

Pyeong-teak is a representative rice cultivation area in the Gyeonggi-Do province of Korea, and thus most sales data was for Pyeong-teak rice. Also, rice is the staple food of Korea, so Pyeong-teak rice was selected as a representative product of grains. The reason why the tomato was selected is the stability of its supply. Most vegetables show huge fluctuation in availability along with the seasons. Tomatoes, however, are commonly cultivated in a greenhouse complex, so seasonality is not a concern. Further, the tomato is a frequently consumed grocery product. Therefore, the tomato was selected as a representative product of vegetables. The corresponding offline retail price was gathered from AT center (Agro-Fisheries & Food Trade center) of Korea (http://www.kamis.co.kr). All the price information was transformed as unit price per kg (kilogram). The descriptive statistics for rice and tomato sales records for KG Farm and offline retail are summarized in Table 10.

Variables	Min	Max	Count	Mean	SD	Median
Online price per kg (rice)	$1.46	$4.47		$2.56	$0.55	$2.40
Offline price per kg (rice)	$1.75	$2.04		$1.92	$0.09	$1.92
Online price per kg (tomato)	$1.86	$5.94		$3.25	$1.00	$2.94
Offline price per kg (tomato)	$2.35	$7.22		$3.70	$0.97	$3.60
Number of transactions (rice)			15,865			
Number of seller (rice)			9			
Number of transactions (tomato)			2,490			
Number of seller (tomato)			6			

Table 10. Descriptive Statistics of Dataset

2.2.2 Estimation Model Specification

To address the research model and hypotheses, the following panel regression model was established.

$$\mathrm{Y}_{it} = X_{it}\beta + a_i + e_{it} \ (\mathrm{i} = 1 \cdots 9\,, \mathrm{t} = 1, \cdots 67)$$

$\mathrm{Y}_{it} = sales\ performance\ (number\ of\ transaction)$

$\mathrm{X}_{it} = constant\ and\ independent\ variables$

$\mathrm{a}_i = \text{time constant error}$, $\mathrm{e}_{it} = \text{idiosyncratic error}$

Subscription i denotes each online grocery vendor in the KG Farm site (there are 9 rice vendors and 6 tomato vendors), and t denotes the time period (i.e.

67 different months). For an estimation strategy, a fixed effect model and a random effect model were considered following Wooldridge (2012) recommendation. The fixed effect model is regarded as appropriate because of concern for the endogeneity problem. According to Gan et al. (2008), online grocery vendors establish their price strategy based on their brand names. Further, consumers who have positive prior experience have less price sensitivity in the online setting (Shankar et al. 1998). Thus, each vendors' brand name, an unobserved time constant error, is likely to affect to the online price. In this regard, the current study considers a fixed effect model more appropriate to prevent any potential endogeneity problem between the online price and the unobserved error.

2.3 Results

2.3.1 Rice Model

The Lagrange multiplier test shows that a panel regression model is more appropriate than pooled OLS (χ^2 =8699.8, df=1, p-value<0.01). The Wooldridge test shows that there is an autocorrelation problem (χ^2=75.075, df=1, p-value<0.01), and the Breush-Pagan test shows that there is a heteroscedasticity problem (BP=50.539, df=2, p-value<0.01). To deal with these problems, this study calculates the robust standard error following Wooldridge (2012). Finally, the Hausman test was conducted to identify whether a fixed effect model is appropriate. The result shows that the random effect model is more appropriate than the fixed effect model (χ^2=0.13022,

df=2, p-value=0.937). The result contradicts the theory based expectation of this study when it comes to the endogeneity between online price and the time constant error (i.e. online vendor's brand name). Based on the result of the Hausman test, the random effect model was estimated. The fixed effect model, however, was also estimated in order to compare the results of the random effect model with the fixed effect model. The estimation results are listed in Table 11 and Table 12 (random effect model), and Table 13 and Table 14 (fixed effect model).

Random Effect Model / Biased Standard Error (adjusted R^2 = **0.021)**				
Variables	**β**	**SE**	**t-value**	**p-value**
Constant	107.11*	42.142	-5.320	0.000
Offline price	-0.020	0.019	-1.044	0.297
Online Price	-0.011*	0.004	-2.268	0.024
*Significance levels: **: p<0.01, *: p<0.05*				

Table 11. The Results of Panel Regression for Online Rice Consumers' Exclusiveness in Using Online Channel (RE & Biased SE)

Random Effect Model / Robust Standard Error (adjusted R^2 = **0.021)**				
Variables	**β**	**SE**	**t-value**	**p-value**
Constant	107.11**	34.856	3.073	0.002
Offline price	-0.020	0.018	-1.135	0.257
Online Price	-0.011*	0.005	-2.207	0.043
*Significance levels: **: p<0.01, *: p<0.05*				

Table 12. The Results of Panel Regression for Online Rice Consumers' Exclusiveness in Using Online Channel (RE & Robust SE)

Fixed Effect Model / Biased Standard Error (adjusted R^2 = 0.021)				
Variables	β	SE	t-value	p-value
Offline price	-0.222	0.019	-1.094	0.274
Online Price	-0.010*	0.005	-2.051	0.041
*Significance levels: **: p<0.01, *: p<0.05*				

Table 13. The Results of Panel Regression for Online Rice Consumers' Exclusiveness in Using Online Channel (FE & Biased SE)

Fixed Effect Model / Robust Standard Error (adjusted R^2 = 0.021)				
Variables	β	SE	t-value	p-value
Offline price	-0.022	0.018	-1.200	0.230
Online Price	-0.010*	0.005	-1.960	0.050
*Significance levels: **: p<0.01, *: p<0.05*				

Table 14. The Results of Panel Regression for Online Rice Consumers' Exclusiveness in Using Online Channel (FE & Robust SE)

As shown in Table 11, while online price has a significant negative effect on the sales performance of online vendors, offline price has no significant effect on the sales performance of online vendors. The robust version of estimation applying Driscoll and Kraay (1998) method also shows the same results (Table 12). Driscoll and Kraay (1998)'s method is appropriate in this model, because the data analyzed in this study includes a larger number of time periods than individuals (i.e. t>n). The estimation results of the fixed effect model, listed in Table 13 and Table 14, also similar results with the random effect model.

2.3.1 Tomato Model

The result of the Lagrange multiplier test reveals the panel regression model is more appropriate than pooled OLS (χ^2=7461.2, df=1, p-value<0.01), and

the result of the Wooldridge test ensures that there is not an autocorrelation structure (χ^2=2.6377, df=3, p-value=0.451). The result of the Breush-Pagan test, however, shows that there is also a heteroscedasticity problem (BP=33.638, df=3, p-value<0.01). To deal with this heteroscedasticity problem, this study decided to calculate the robust standard error applying White's correction (White 1984). For the last step, the Hausman test was conducted, and the result shows that the fixed effect model is appropriate, as expected (χ^2=32.141, df=2, p-value<0.01). Therefore the fixed effect model was estimated, and the results are summarized in Table 15 and Table 16.

Fixed Effect Model / Biased Standard Error (adjusted R^2 = 0.419)				
Variables	β	SE	t-value	p-value
Offline price	0.026*	0.010	2.658	0.010
Online Price	-0.082**	0.012	-6.715	0.000
*Significance levels: **: p<0.01, *: p<0.05*				

Table 15. The Results of Panel Regression for Online Tomato Consumers' Exclusiveness in Using Online Channel (FE & Biased SE)

Fixed Effect Model / Robust Standard Error (adjusted R^2 = 0.419)				
Variables	β	SE	t-value	p-value
Offline price	0.026**	0.002	12.120	0.000
Online Price	-0.082**	0.004	-21.346	0.000
*Significance levels: **: p<0.01, *: p<0.05*				

Table 16. The Results of Panel Regression for Online Tomato Consumers' Exclusiveness in Using Online Channel (FE & Robust SE)

As summarized in Table 15, offline price shows a positive effect and online price shows a negative effect on the sales performance of online vendors. White's robust standard error (White 1984) was computed and applied to the original model to correct the heteroscedasticity problem. The results of this

robust version was listed in Table 16, but the results are not different from the original estimation.

3. Discussion

Study 3 develops the analytical model regarding the optimal search range of online grocery consumers. According to the proposition 1, online grocery consumers always search alternative products unless they expect minimum product quality. Therefore, online grocers face with fierce competition when the consumers' search range is large. In this regard, it is desirable for online grocers to decrease the search range of consumers. Proposition 2 and 3 connote intuition to decrease the search range of consumers.

According to the proposition 2, optimal search range of consumers decreases with the unit search cost. Unit search cost, however, is not controllable factor, but exogenous factor from the perspective online grocers. Rather, proposition 3 connotes another intuition to reduce consumers' search range. As shown in the Figure 4, consumers' search range decreases if the level minimum quality is increased. Conversely, decrease in the maximum quality causes increase of search range of consumers. It is possible for online vendors to control the minimum quality and the maximum quality. Therefore, to increase the level of minimum quality is feasible way to decrease the search range of consumers.

In some cases, it is hard to increase the level of minimum quality, because of the characteristics of ago-products. For example, the freshness of the

vegetables largely depends on the cold chain systems during the delivery chain. In such case, online vendors try to apply alternative approach to decrease the search range of consumers: decreasing consumers' initial quality expectation. Proposition 5 shows that consumers' optimal search range decreases when consumers' initial quality expectation is decreased. The online vendors, however, should remember that lowering consumers' initial quality expectation involves risk, which is shown in proposition 4. More specifically, consumers' search range exponentially increases if online vendors fail to control minimum quality when the distance between initial quality expectation and the minimum quality is close. Therefore, online vendors should keep the minimum quality at current level when they apply the strategy that decreases the consumers' initial quality expectation.

The results of empirical model indicate that online rice consumers do not care about offline prices, once they decide to use the online channel. On the other hand, online tomato consumers care about corresponding offline prices, although they purchase tomatoes via the online channel. In this regard, the results of empirical model show that online rice market and offline rice market are not competing channel, but online tomato market and offline tomato market are competing channel.

The result of the Hausman test in each model is also interesting. In the rice model, the Hausman test shows that there is not an endogeneity problem, but an endogeneity problem is identified in the tomato model. Referring to the online price is the result of online vendors' price strategy (Gan et al. 2008),

which is affected by the vendors' characteristics, such as brand name, and consumer loyalty (Shankar et al. 1998). Characteristics of tomato vendors influence the price level of online tomato vendors, but that of rice vendors do not. These results, however, are indirect, so further research should be conducted to find more direct empirical evidence.

VI. General Discussion

The current study uncovers the underlying structure of grocery consumers' channel selection behavior between online and offline, by conducting three interrelated studies with the consumers' grocery receipt data. In study 1, it is identified that determinants of the channel selection behavior of grocery consumers vary along with the product categories. In the case of grains, freshness is a significant factor in channel selection, but in the case of vegetables, health, taste, and cost performance are significant factors in channel selection. The convenience variables, however, do not show significant effects on the channel selection, except for post-selection analysis of grains.

In study 2, online grocery shopping is investigated from the perspective of new transaction systems adoption. The results of the study 2 show that perceived compatibility is significant positive factor affecting to the online grocery shopping adoption, regardless of the product categories. In the case

of vegetable model, perceived complexity is identified as a significant negative factor affecting to the online vegetables shopping adoption.

In study 3, dynamism in channel selection behavior is examined by both analytical model and empirical model. The established analytical model identifies that consumers' optimal search range increases with the level of product heterogeneity. Therefore, it is more likely that online vegetables market competes with the offline vegetables market, but the online grains market does not compete with the offline grains market. The established analytical model is empirically validated. The results of empirical model show that online grain consumers use the online channel in an exclusive manner, but online vegetable consumers do not. That is, consumers purchase groceries via online by comparing offline price and online price simultaneously when purchasing vegetables, but grain consumers do not consider the offline channel, once they select the online channel.

Table 17 summarizes the key findings of the current study. The findings are categorized along with the context (i.e. channel selection vs. online grocery purchase) and product categories (i.e. grains vs. vegetables).

Study	Context	Factor	Product categories	
			Grains	Vegetables
Study 1	Channel selection	Positive	Freshness	Cost-performance
		Negative	-	Taste Health
	Online grocery purchase	Positive	Time	-
		Negative	Conservatism in food consumption	Health
Study 2	Channel selection (adoption)	Positive	Compatibility	Compatibility
		Negative	-	Complexity
Study 3	Online grocery purchase	Compete with offline?	Do not compete	Compete with offline
		Online price	Market price	Price strategy
Note: Time denotes time required to access the offline grocery market				

Table 17. Summary of Key Findings

The findings listed in Table 17 are interrelated. Firstly, the insignificant effect of perceived relative advantage is related to the results of study 1. More specifically, the effect of convenience variables are not significant in the context of channel selection at study 1. In this regard, consumers do not determine to shop groceries via online, based on the relative advantage of using online grocery, such as time saving. The time required to access the grocery market is, however, turned to be significant in the context of online grocery purchase only in the case of grains. Thus, the relative advantage of purchasing groceries via online becomes realized by using online channel in the case of grains, but in the case of vegetables are not.

This difference can be interpreted based on the effect of perceived complexity in study 2. In study 2, perceived complexity shows significant negative effect in the case of vegetables, but it do not show significant effect in the case of grains. As explained in the discussion section of study 2, this difference stems from the difference in the level of product heterogeneity. In other words, it is difficult to gasp the quality of vegetables in online setting, and thus online vegetables consumers do not realize the relative advantage of purchasing groceries through online, such as time saving, even after they adopt the online vegetable shopping.

The other linkage among three studies is the relationship between the results of study 1 and study 3. In study 3, it is identified that the online grain consumers do not care about the corresponding offline price, but the online vegetable consumers compare the online grocery price and the offline grocery price when they purchase groceries via online.

The difference in dynamics of channel selection behavior between rice consumers and tomato consumers are consistent with the results of Study 1. Specifically, as shown in Table 4 and Table 5, cost performance is a significant determinant of channel selection in the case of vegetables, but it is an insignificant factor of channel selection in the case of grains. Therefore, tomato consumers compare online and offline prices, because the cost performance is an important reason why they select the online channel. For rice consumers, however, cost performance is not an important factor, but freshness is the main reason why they select the online channel. These

differences are also reflected in the R-squared of each model. The R-squared of the tomato model of Study 3 is .419, but that of the rice model is .021. Thus, it is possible to say that price is an important factor in the case of online tomato consumers, and the corresponding offline price is also important. Online rice consumers, however, do not think price itself is an important factor in deciding purchase channel, but other factors, such as information related to freshness, are much more important as identified in Study 1.

1. Academic Contributions

Academically, the current study contributes to the study of the relationship between FRL variables and channel selection behavior, which was ambiguous in the previous body of literature. Furthermore, this study is conducted from the consumer's viewpoint. The previous body of literature regarding channel selection is focused on the behavior of corporations, and there was a need for consumer-centric research (Dholakia et al. 2010). Thus, the perspective of this study is another contribution to the field.

The current study identifies that the relative advantage of purchasing groceries via the online channel is an insignificant factor affecting the online channel selection. Rather, this study points out that compatibility is a factor affecting the online channel selection, and the relative advantage is realized only after selecting the online channel.

The insignificance of relative advantage is a somewhat counterintuitive finding, because the previous body of literature reports that the biggest motivations for online grocery shopping are convenience and time-saving (Grunert and Ramus 2005; Morganosky and Cude 2000). This counterintuitive finding can be justified by the classification scheme of the current study. Said differently, this study divides the context of grocery consumers' channel selection behavior into two stages: channel selection and online grocery purchase. The insignificance of relative advantage in the channel selection stage is derived from the detailed classification of channel selection behavior of grocery consumers.

Therefore, the insignificant effect of relative advantage at the channel selection stage that the current study identifies has implications for future research regarding consumer behavior in online grocery shopping.

Furthermore, the current study uncovers whether the online channel and the offline channel are competing channel or not by establishing analytical model and empirically validating the established analytical model. The previous literatures regarding analytical model based on the search costs have focused on the product differentiation, but the current research develops the analytical model based on the product heterogeneity.

Comprehensively, this study clearly divides the online grocery consumers' behavior into two context: channel selection and online grocery purchase. The product categories of grocery is also divided along with the product

heterogeneity. In this regard, the current study contribute to the body of literatures by suggesting the classification scheme of online grocery.

2. Practical Suggestions

The results of the current study have several suggestions for practitioners. First, online grocery managers should recognize that online grocery consumers do not simply want a low price. Further, online grocery vendors' strategies to attract new consumers and to retain existing consumers should be developed separately depending on the product categories.

To attract new consumers, offering a relatively cheap price is effective to make consumers select the online channel in the case of vegetables. Highlighting freshness and taste of the vegetables, however, is an inefficient strategy to draw consumers toward the online channel. Consumers who value freshness and taste are less likely to select the online channel, so emphasizing these features is a less efficient way to draw consumers. For the consumers of grains, providing ample information regarding the freshness, such as harvested date and polishing date, is helpful to attract consumers to the online channel. Additionally, attaching information regarding the polishing mill is also a possible way to give information about the freshness of grains.

On the other hand, emphasizing the relative advantages, such as time-saving and convenience, is not helpful to make consumers select the online channel to purchase groceries. For instance, advertisements such as "no more driving"

or “around the clock operating grocery store” are not intriguing enough to make grocery consumers select the online channel. Rather, increasing compatibility with consumers’ daily life is effective to attract consumers toward the online channel. It is important for online grocers to understand grocery consumers’ lifestyles and the existing purchase patterns. As listed above, providing articulated information regarding the harvested date is a representative example.

Decreasing perceived complexity is also an important step to draw consumers in the case of vegetables. For example, introducing visualization techniques is helpful to decrease perceived complexity (Chung et al. 2009), because such techniques enable consumers to assess the quality of the product more easily in the online setting.

Though accentuating the relative advantage is inefficient for customer acquisition, it is helpful to retain existing consumers in the case of grains. Specifically, emphasizing the time-saving effect of online grocery shopping is effective to make consumers spend more money to purchase grains online. Moreover, recommending grocery products that consumers purchased previously is another available marketing strategy to increase the amount of the online grains purchase, because online grain consumers who prefer familiar products purchase more grains via the online channel.

In the case of vegetables, however, online grocery vendors should establish different strategies to hold onto existing consumers. In contrast with the

strategies for grains, emphasizing relative advantage will not work well for retaining online vegetable consumers. Further, online vegetable consumers compare the online vegetable price and the offline vegetable price, even after they select the online channel. Therefore, it is an imperative issue for online grocery vendors to prevent migration of existing consumers. To inhibit migration of online vegetable consumers, online grocery vendors should identify offline competitors and their price offerings. Since menu cost online is substantially lower than that of offline markets (Oh and Lucas Jr 2006), online grocery vendors can rapidly adjust their prices offered to match or beat the price offered by offline competitors to sustain a relatively low price level. The other possible strategy to prevent migration is promotions, such as "buy one get one free" or "three for two." If constantly retaining a relatively inexpensive price level is impossible, such promotions will be helpful to retain existing consumers.

3. Limitations and Future Research

Though the current study provides comprehensive understanding about the channel selection behavior of grocery consumers, several limitations are remained for future research. First, it is possible extension of the current study to examine the effects of online vendors' characteristics on vendors' price strategies more directly. Though the results of Hausman test indirectly show that the tomato price is the result of online vendors' pricing strategy and the rice price is market price, more elaborated study is needed. Further, future

research may more develop the proposed analytical model, including seller side and computing social welfare along with decreasing of product heterogeneity.

VII. Conclusion

The author of the current study believes that the findings of the current study contribute to the body of literature in that the current study provides comprehensive understanding regarding grocery consumers' channel selection behavior from the consumer's point of view, and classification scheme of sub-categories within the grocery market based on the product heterogeneity. It is hoped that the current study may be the starting point of establishing sustainable and profitable online grocery businesses.

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Appendix A. Survey Items for Measuring Food Related Lifestyle

Ways of Shopping: Information	
Items	Descriptions
WS_info 1	For me, food information is very important
WS_info 2	For me, food information regarding origin is very important
WS_info 3	For me, food information regarding producer is very important
WS_info 4	I want to know the ingredients in the food

Table A.1. Measurement Items for Food Related Lifestyle (Ways of shopping: Information)

Ways of Shopping: Price	
Items	Descriptions
WS_price 1	I always check price, even on small items
WS_price 2	I will notice price changes of the food I often buy

Table A.2. Measurement Items for Food Related Lifestyle (Ways of shopping: Price)

Quality Aspect: Health	
Items	Descriptions
QA_health 1	I like to buy natural food, e.g. those that do not contain preservatives
QA_health 2	For me, the naturalness of the food I buy is an important quality factor
QA_health 3	I would like to avoid eating food that contains additives

Table A.3. Measurement Items for Food Related Lifestyle (Quality Aspect: Health)

Quality Aspect: Price	
Items	Descriptions
QA_price 1	I always try to get the best quality with the best of price
QA_price 2	I compare the prices among different food to get the best economic benefit
QA_price 3	For me, it is important to know that the money I spent reserve the quality

Table A.4. Measurement Items for Food Related Lifestyle (Quality Aspect: Price)

Quality Aspect: Taste	
Items	Descriptions
QA_taste 1	I find the taste of the food is the most important
QA_taste 2	My priority in preparing meals is their taste

Table A.5. Measurement Items for Food Related Lifestyle (Quality Aspect: Taste)

Quality Aspect: Fresh	
Items	Descriptions
QA_fresh 1	I prefer fresh products to canned or frozen products
QA_fresh 2	I think it is important that food is fresh

Table A.6. Measurement Items for Food Related Lifestyle (Quality Aspect: Fresh)

Cooking Method: New	
Items	Descriptions
CM_new 1	I like to try new recipes
CM_new 2	I look for various ways to prepare uncommon meals
CM_new 3	I will try in the kitchen according to the introduction of traditional food recipes or articles about

Table A.7. Measurement Items for Food Related Lifestyle (Cooking Method: New)

Cooking Method: Whole	
Items	Descriptions
CM_whole 1	Kids or other members in the family always help in the kitchen; for instance, they peel the potatoes and cut the vegetables
CM_whole 2	My family will help do things in relation to meals, e.g. setting the table and making dishes

Table A.8. Measurement Items for Food Related Lifestyle (Cooking Method: Whole)

Cooking Method: Plan	
Items	Descriptions
CM_plan 1	Plan must be made ahead of cooking
CM_plan 2	I always plan what to eat a few days ahead

Table A.9. Measurement Items for Food Related Lifestyle (Cooking Method: Plan)

Purchasing Motives: Self	
Items	Descriptions
PM_self 1	Appreciation of my cooking will enhance my self-respect
PM_self 2	For me, eating is a matter that incorporates all senses of feeling, smell, taste and sight. This is an exciting feeling
PM_self 3	I am an outstanding cook

Table A.10. Measurement Items for Food Related Lifestyle (Purchasing Motives: Self)

Purchasing Motives: Secure	
Items	Descriptions
PM_secure 1	I dislike anything that may change my habit on food and drink
PM_secure 2	I only buy and eat those food I know well
PM_secure 3	Dishes that are familiar with give me a sense of security

Table A.11. Measurement Items for Food Related Lifestyle (Purchasing Motives: Secure)

Purchasing Motives: Social	
Items	Descriptions
PM_social 1	When I cook for friends, I find the most important thing is that we are together
PM_social 2	People may have a good chat after meal

Table A.12. Measurement Items for Food Related Lifestyle (Purchasing Motives: Social)

Consumption Situation	
Items	Descriptions
CS 1	Eating out is a regular part of our diet habits
CS 2	We often get together with friends and enjoy dinner that is simple and easy to cook
CS 3	I like to go to restaurants with my family and friends

Table A.13. Measurement Items for Food Related Lifestyle (Consumption Situation)

Appendix B. Validity and Reliability of Food Related Lifestyle Measurement Items

Constructs	Items	Factor Loading	SE	t-value	CR	AVE
WS_info	WS_Info1	.8099	.0170	47.6482	.844	.577
	WS_Info2	.8421	.0123	68.5417		
	WS_Info3	.6570	.0382	17.1991		
	WS_Info4	.7157	.0354	20.1931		
WS_price	WS_Price1	.8462	.0138	61.4425	.835	.716
	WS_Price2	.8462	.0138	61.4425		
QA_health	QA_Health1	.8672	.0157	55.3914	.866	.685
	QA_Health2	.8682	.0198	43.8106		
	QA_Health3	.7407	.0446	16.6114		
QA_fresh	QA_Fresh1	.8779	.0140	62.8428	.871	.771
	QA_Fresh2	.8779	.0140	62.8428		
QA_taste	QA_Taste1	.8468	.0149	56.9354	.835	.717
	QA_Taste2	.8468	.0149	56.9354		
QA_price	QA_Price1	.8304	.0203	40.9748	.827	.617
	QA_Price2	.8432	.0194	43.3928		
	QA_Price3	.6708	.0393	17.064		
CM_new	CM_New1	.8587	.0120	71.2715	.894	.738
	CM_New2	.8996	.0105	85.8906		
	CM_New3	.8160	.0180	45.2904		
CM_whole	CM_Whole1	.9362	.0060	57.0916	.934	.876
	CM_Whole2	.9362	.0060	57.0916		
CM_plan	CM_Plan1	.8489	.0009	94.2594	.838	.721
	CM_Plan2	.8489	.0009	94.2594		
PM_self	PM_Self1	.7921	.0225	35.1958	.822	.608
	PM_Self2	.8437	.0163	51.6646		
	PM_Self3	.6970	.0360	19.3668		

PM_secure	PM_Secure1	.6895	.0377	18.2692	.797	.567
	PM_Secure2	.8171	.0203	40.1616		
	PM_Secure3	.7477	.0269	27.7639		
PM_social	PM_Social1	.8321	.0146	57.0743	.818	.692
	PM_Social2	.8321	.0146	57.0743		
CS	CS1	.8016	.0187	42.8348	.839	.635
	CS2	.7406	.0264	28.0254		
	CS3	.8444	.0132	63.8120		

Table B.1. Loadings of Measurement Items for Food Related Lifestyle

	WS_ Info	WS_ Price	QA_ Health	QA_ Fresh	QA_ Taste	QA_ Price	CM_ New	CM_ Whole	CM_ Plan	PM_ Self	PM_ Secure	PM_ Social	CS
WS_Info	.760												
WS_Price	.366	.846											
QA_Health	.593	.254	.828										
QA_Fresh	.503	.235	.615	.878									
QA_Taste	.291	.266	.302	.438	.847								
QA_Price	.411	.541	.489	.390	.417	.785							
CM_New	.329	.357	.383	.343	.317	.350	.859						
CM_Whole	.159	.110	.182	.153	.167	.129	.357	.936					
CM_Plan	.336	.307	.331	.298	.264	.274	.537	.399	.849				
PM_Self	.299	.306	.313	.268	.305	.342	.414	.237	.330	.780			
PM_Secure	.085	.112	.082	.121	.216	.195	-.022	-.012	-.007	.209	.753		
PM_Social	.286	.244	.289	.311	.248	.307	.286	.192	.253	.366	.187	.832	
CS	.126	.012	.060	.070	.120	.038	.104	.109	.103	.018	.155	.199	.797
Note: The diagonal elements are square roots of AVE													

Table B.2. Correlation among Food Related Lifestyle Constructs

Appendix C. Survey Items for Measuring Revised DOI Factors

Perceived Social Norm	
Items	Descriptions
PSN1	Members of my family think that it is a good idea to buy groceries via the internet
PSN2	Most of my friends and acquaintances think that shopping groceries via the internet is a good idea

Table C.1. Measurement Items for Revised DOI Factors (Perceived Social Norm)

Perceived Complexity	
Items	Descriptions
PCL1	Electronic shopping of groceries is complex because I cannot see and feel the products
PCL2	Electronic shopping is in general very complex
PCL3	It is hard to find the needed products when shopping groceries via the internet
PCL4	With electronic shopping of groceries it is difficult to order products

Table C.2. Measurement Items for Revised DOI Factors (Perceived Complexity)

Perceived Compatibility	
Items	Descriptions
PCA1	Electronic shopping of groceries is attractive to me in my daily life
PCA2	Buying groceries via the internet is well suited to the way in which I normally shop groceries
PCA3	In general, electronic shopping of groceries is problem free

Table C.3. Measurement Items for Revised DOI Factors (Perceived Compatibility)

Perceived Relative Advantage	
Items	Descriptions
PRA1	Using electronic shopping of groceries saves much time
PRA2	Shopping groceries via the internet is favorable as it makes me less dependent of open hours
PRA3	There is a lot of money to save buying groceries via the internet

Table C.4. Measurement Items for Revised DOI Factors (Perceived Relative Advantage)

Perceived Online Grocery Risk	
Items	Descriptions
POR1	Return and exchange opportunities are not as good on the internet as in the supermarket/noninternet shop
POR2	A risk when buying groceries via the internet is receiving low quality products or incorrect items
POR3	Security around payment on the internet is not good enough
POR4	There are too many untrustworthy shops on the internet

Table C.5. Measurement Items for Revised DOI Factors (Perceived Online Grocery Risk)

Appendix D. Validity and Reliability of Revised DOI Factors Measurement Items

Constructs	Items	Factor Loading	SE	t-value	CR	AVE
PSN	PSN1	.8997	.0067	134.5538	.895	.810
	PSN2	.8998	.0067	134.9716		
PCL	PCL2	.8526	.0119	71.7796	.911	.773
	PCL3	.8951	.0090	99.4130		
	PCL4	.8886	.0094	94.3270		
PCA	PCA1	.9067	.0062	146.1854	.906	.764
	PCA2	.9096	.0090	100.8180		
	PCA3	.8007	.0172	46.5024		
PRA	PRA1	.8894	.0121	73.2620	.886	.723
	PRA2	.9019	.0074	121.4357		
	PRA3	.7517	.0197	38.2257		
POR	PIGR2	.7457	.0219	34.0458	.836	.630
	PIGR3	.8048	.0143	56.4450		
	PIGR4	.8286	.0129	64.4192		

Table D.1. Loadings of Measurement Items for Revised DOI Factors

	PSN	PCL	PCA	PRA	POR
PSN	.900				
PCL	-.345	.879			
PCA	.624	-.452	.874		
PRA	.382	-.300	.525	.850	
POR	-.212	.335	-.301	-.124	.794
Note: The diagonal elements are square roots of AVE					

Table D.2. Correlation among Revised DOI Factors Constructs

Appendix E. Relaxation of Assumption 5

For the generalizability, this study relax assumption 5 (discrete perception regarding product quality), because consumers' perception regarding product quality is not likely to be discrete in many cases.

By relaxing the assumption 5, the expected utility function is given by

$$\mathrm{EU} = \mathrm{R} - \mathrm{P}(\mathrm{Q} - Q_{min})\frac{Q_E - Q_{min}}{S(Q_{max} - Q_{\mathrm{min})}} - cS^2$$

Therefore, the optimal search range is

$$\max_S EU = \frac{\partial EU}{\partial S} = \frac{(Q - Q_{min})(Q_E - Q_{min})}{S^2(Q_{max} - Q_{min})} - 2cS = 0$$

$$S^3 = \frac{(Q - Q_{min})(Q_E - Q_{min})}{2c\,(Q_{max} - Q_{min})}$$

$$\boldsymbol{S^* = \frac{(Q - Q_{min})^{\frac{1}{3}}(Q_E - Q_{min})^{\frac{1}{3}}}{2^{\frac{1}{3}}c^{\frac{1}{3}}(Q_{max} - Q_{min})^{\frac{1}{3}}} \geq 0}$$

Thus, the proposition 1 holds. The partial derivative of S* with regard to c is as follow.

$$\boldsymbol{\frac{\partial S^*}{\partial c}} = \left(-\frac{1}{3}\right)\frac{(Q - Q_{min})^{\frac{1}{3}}(Q_E - Q_{min})^{\frac{1}{3}}}{2^{\frac{1}{3}}c^{\frac{4}{3}}(Q_{max} - Q_{min})^{\frac{1}{3}}} \leq \mathbf{0}$$

The above equation shows that the optimal search range decreases with the unit search costs, and thus the proposition 2 also holds. Further, the partial derivative of S* with regard to Q_{min}, and Q_{max} are also computed again.

$$\frac{\partial S^*}{\partial Q_{min}}$$

$$= \left(-\frac{1}{3}\right)\frac{\frac{1}{3}(Q-Q_{min})^{\frac{1}{3}}(Q_E-Q_{min})^{\frac{1}{3}}[(Q_{max}-Q_{min})^{\frac{1}{3}}-\frac{2Q_{min}-Q-Q_E}{(Q-Q_{min})(Q_E-Q_{min})}]}{2^{\frac{1}{3}}c^{\frac{1}{3}}(Q_{max}-Q_{min})^{\frac{2}{3}}}$$

$$= \left(-\frac{1}{3}\right)\frac{\frac{1}{3}(Q-Q_{min})^{\frac{1}{3}}(Q_E-Q_{min})^{\frac{1}{3}}[(Q_{max}-Q_{min})^{\frac{1}{3}}+\frac{(Q-Q_{min})+(Q_E-Q_{min})}{(Q-Q_{min})(Q_E-Q_{min})}]}{2^{\frac{1}{3}}c^{\frac{1}{3}}(Q_{max}-Q_{min})^{\frac{2}{3}}}$$

$$\leq \mathbf{0}$$

$$\frac{\partial S^*}{\partial Q_{max}} = \left(-\frac{1}{3}\right)\frac{(Q-Q_{min})^{\frac{1}{3}}(Q_E-Q_{min})^{\frac{1}{3}}}{2^{\frac{1}{3}}c^{\frac{1}{3}}(Q_{max}-Q_{min})^{\frac{4}{3}}} \leq \mathbf{0}$$

The above equations show that the proposition 3 and 4 hold without assumption 5. Figure E.1 shows the relationship between $Q_E - Q_{min}$ and $\frac{\partial S^*}{\partial Q_{min}}$. When the initial quality expectation and the minimum quality are in the close proximity, the value of $\frac{\partial S^*}{\partial Q_{min}}$ is much higher that of $\frac{\partial S^*}{\partial Q_{min}}$ under assumption 5. This property is also demonstrated in the Figure E.2.

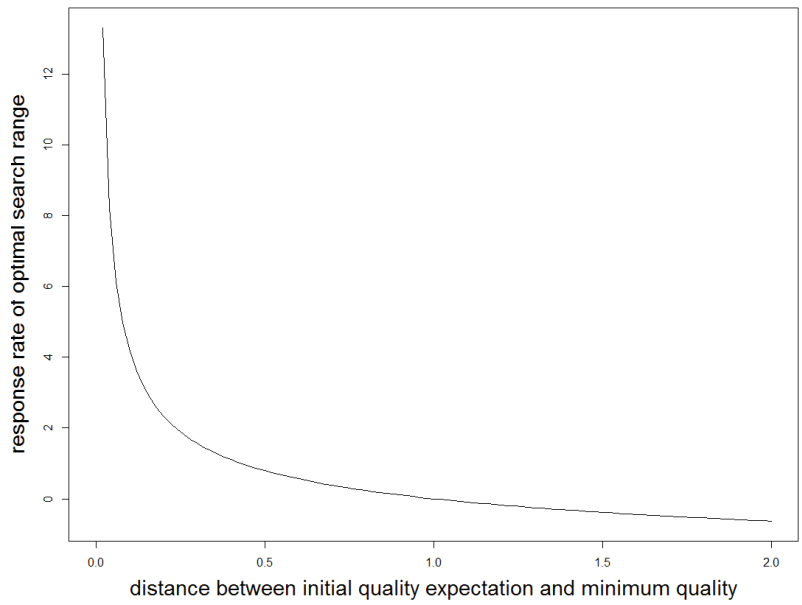

Figure E.1. Illustration of Proposition 4 without Assumption 5

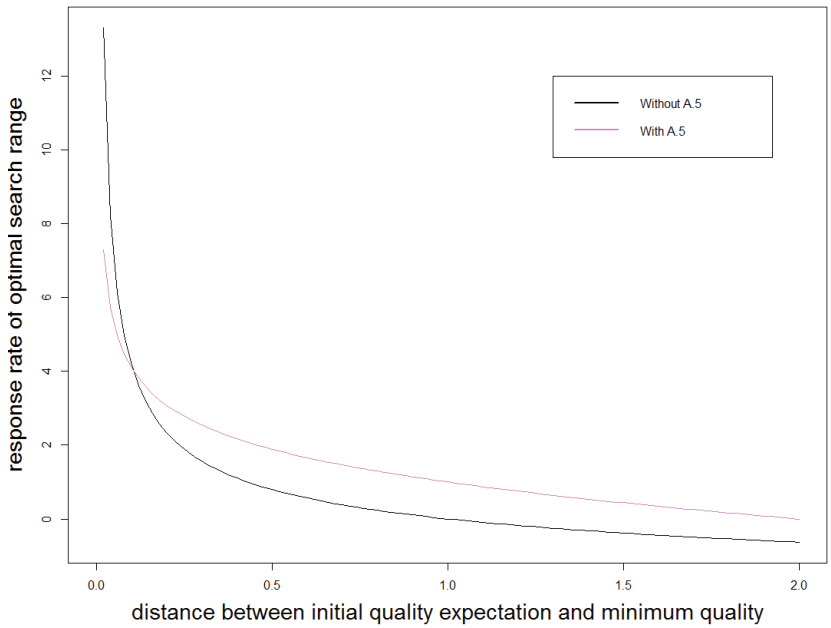

Figure E.2. Illustration of Proposition 4 with/without Assumption 5

As shown in the Figure E.2, if the distance between initial quality expectation and the minimum quality is close enough and the consumers' perception regarding product quality is not discrete, the optimal search range expanses much faster responding to the product heterogeneity steams from decrease in minimum quality. Therefore, minimum quality control is much important if the consumers' quality perception is delicate. The importance of minimum quality control, however, decreases rapidly, diverging the gap between the initial quality expectation and the minimum quality comparing to the case of discrete quality perception.

It is identified that the proposition 5 is retained without the assumption 5 as shown in the following equation.

$$\frac{\partial S^*}{\partial Q_E} = \frac{1}{3}\frac{(Q - Q_{min})^{\frac{1}{3}}(Q_E - Q_{min})^{-\frac{2}{3}}}{2^{\frac{1}{3}}c^{\frac{1}{3}}(Q_{max} - Q_{min})^{\frac{1}{3}}} \geq \mathbf{0}$$

In sum, the assumption 5, discrete quality perception of consumers, is not critical assumption in terms of deriving the propositions. Rather, the assumption 5 plays role as a "controller" when it comes to the response rate of optimal search range as shown in the Figure E.2. In this regard, the comparison of two models give additional intuition about importance of consumers' way of quality perception.

Appendix F. Relaxation of Assumption 4

To limit the analytical model to the online context, Assumption 4 (increasing search cost with the search range) is relaxed. Therefore, the total search cost is redefined as TSC=cS, and thus the marginal search cost is constant as c. That is, consumers do not allowed to enlarge their search range to the offline.

By relaxing the assumption 4, the expected utility function is given by

$$\mathrm{EU} = \mathrm{R} - \mathrm{P}(Q_E - Q_{min})\frac{Q_E - Q_{min}}{S(Q_{max} - Q_{\mathrm{min}})} - c\mathrm{S}$$

Therefore, the optimal search range is

$$\max_S EU = \frac{\partial EU}{\partial S} = \frac{(Q_E - Q_{min})^2}{S^2(Q_{max} - Q_{min})} - cS = 0$$

$$S^2 = \frac{(Q_E - Q_{min})^2}{c\,(Q_{max} - Q_{min})} - c = 0$$

$$\boldsymbol{S^* = \frac{(Q_E - Q_{min})^2}{c^{\frac{1}{2}}(Q_{max} - Q_{min})^{\frac{1}{3}}} \geq 0}$$

Thus, the proposition 1 holds. The partial derivative of S* with regard to c is as follow.

$$\boldsymbol{\frac{\partial S^*}{\partial c} = \left(-\frac{1}{2}\right)\frac{Q_E - Q_{min}}{c^{-\frac{3}{2}}(Q_{max} - Q_{min})^{\frac{1}{2}}} \leq 0}$$

The above equation shows that the optimal search range decreases with the unit search costs, and thus the proposition 2 also holds. Further, the partial derivative of S* with regard to Q_{min}, and Q_{max} are also computed again.

$$\frac{\partial S^*}{\partial Q_{min}} = \frac{\frac{1}{2}(Q_{max} - Q_{min})^{-\frac{1}{2}}(Q_E - Q_{min}) - (Q_{max} - Q_{min})^{\frac{1}{2}}}{c^{\frac{1}{2}}(Q_{max} - Q_{min})}$$

$$= \frac{(Q_{max} - Q_{min})^{\frac{1}{2}}(\frac{Q_E - Q_{min}}{2(Q_{max} - Q_{min})} - 1)}{c^{\frac{1}{2}}(Q_{max} - Q_{min})} < 0 \ (\because \max(\frac{Q_E - Q_{min}}{Q_{max} - Q_{min}}) = 1)$$

$$\frac{\partial S^*}{\partial Q_{max}} = \left(-\frac{1}{2}\right)\frac{Q_E - Q_{min}}{c^{\frac{1}{2}}(Q_{max} - Q_{min})^{\frac{3}{2}}} \leq 0$$

The above equations show that the proposition 3 holds without assumption 5.

Proposition 4, however, no longer hold without assumption 5. The response of $\frac{\partial S^*}{\partial Q_{min}}$ with regard to $Q_E - Q_{min}$ is opposite direction that of model under assumption 5. Therefore, the proposition 4 is revised as follow.

Proposition 4-F. The closer the consumers' initial quality expectation with minimum product quality, the slower consumers' optimal search range along with the decrease of minimum product quality.

Figure F.1 shows the relationship between $Q_E - Q_{min}$ and $\frac{\partial S^*}{\partial Q_{min}}$ under the condition that consumers' search range is restricted only in online.

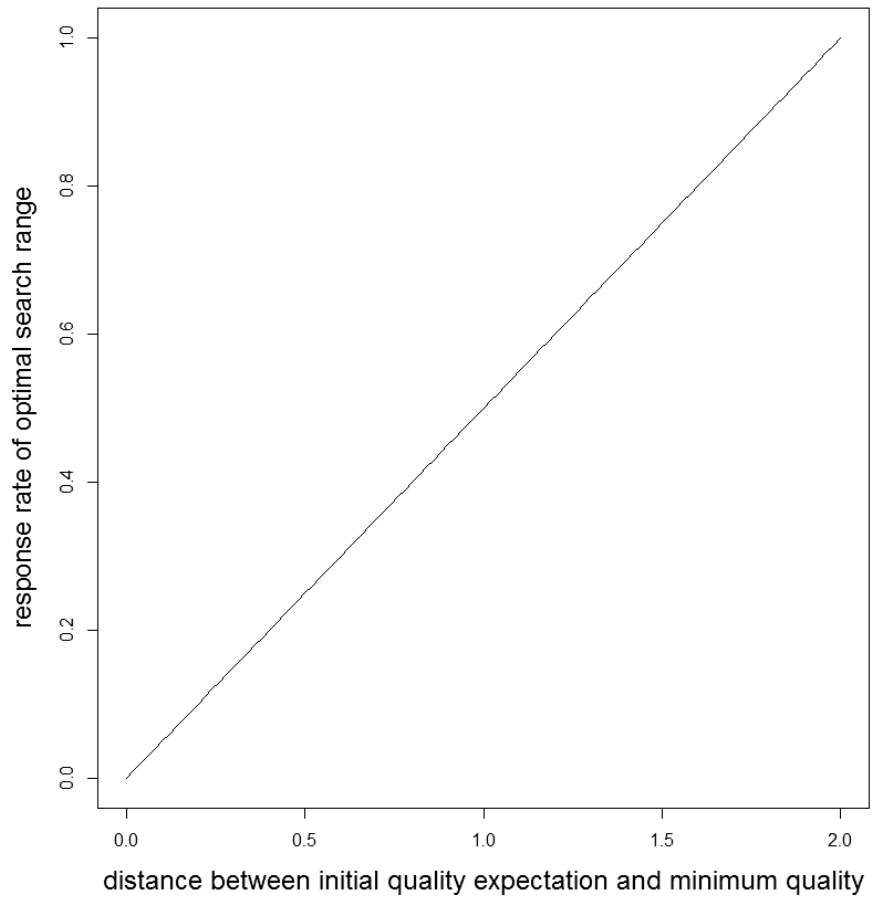

Figure F.1. Illustration of Proposition 4-F

The proposition 5 still holds under the condition that consumers' search range is restricted in online as the following equation.

$$\frac{\partial S^*}{\partial Q_E} = \frac{1}{c^{\frac{1}{2}}(Q_{max} - Q_{min})^{\frac{3}{2}}} > 0$$

To summarize, all propositions except for proposition 4 is hold, despite the restricted search range. The proposition 4 is, however, totally different with the case that consumers' search range is unrestricted. Therefore, it is possible

to interpret the difference in proposition 4 as an effect of competition with the offline channel.

요약 (국문초록)

소비자들의 농식품 구매채널 선택행동

Three Essays of Grocery Consumers' Channel Selection Behavior between Online and Offline Market

본 연구는 소비자들의 농식품 구매 채널 선택에 영향을 미치는 구조를 파악하는 것을 그 목적으로 한다. 본 연구에서 농식품을 상품 이질성 이론 (product heterogeneity theory)에 따라 농식품의 종류를 곡류와 야채류 두 가지로 나누고, 농식품의 종류에 따라 소비자들의 농식품 구매 채널 선택을 비교하였다. 이를 위해, 본 연구에서는 732 명의 소비자 패널들의 농식품 구매 영수증 데이터를 실증 분석하여, 소비자들의 식품관련 라이프스타일 (food related lifestyle)이 소비자들의 농식품 구매 채널 선택 및 온라인 농식품 구매액에 영향을 미침을 밝혔다. 그러나 13 개 식품관련 라이프스타일 변수 중 유의미한 변수는 농식품의 종류에 따라 다르게 나타났다. 또한 인지된 호환성은 농식품의 종류와 관련 없이 소비자들이 온라인 농식품 구매 채널을 선택하는데 유의한 결정 요인임이 밝혀 졌다. 마지막으로 온라인 농식품 구매 채널을 선택한 곡류 소비자들은 온라인 농식품 구매 채널을 배타적으로 사용하지만, 온라인 농식품 구매 채널을 선택한 야채류 소비자들은 온라인 농식품 구매 채널과 오프라인 농식품 구매 채널을 농식품 가격 측면에서 비교를 한다는 사실을 발견하였다. 본 연구의 시사점 및 향후 연구를 위한 제안 사항 또한 마지막 부분에 수록하였다.

Keywords: 농산물 전자상거래, 구매 채널 선택, 상품의 이질성, 탐색 비용, 식품관련 라이프스타일

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